

# LIGHT UNFLAVORED MESONS

## ( $S = C = B = 0$ )

For  $l = 1$  ( $\pi, b, \rho, a$ ):  $u\bar{d}, (u\bar{u}-d\bar{d})/\sqrt{2}, d\bar{u}$ ;  
for  $l = 0$  ( $\eta, \eta', h, h', \omega, \phi, f, f'$ ):  $c_1(u\bar{u} + d\bar{d}) + c_2(s\bar{s})$

NODE=MXXX005

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### $f_0(500)$

$$I^G(J^{PC}) = 0^+(0^{++})$$

also known as  $\sigma$ ; was  $f_0(600)$   
See the related review(s):  
[Scalar Mesons below 2 GeV](#)

### $f_0(500)$ T-MATRIX POLE $\sqrt{s}$

Note that  $\Gamma \approx 2 \operatorname{Im}(\sqrt{s_{\text{pole}}})$ .

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| VALUE (MeV)                                                                   | DOCUMENT ID                 | TECN | COMMENT                                                   |
|-------------------------------------------------------------------------------|-----------------------------|------|-----------------------------------------------------------|
| <b>(400–550)–<math>i</math>(200–350) OUR ESTIMATE</b>                         |                             |      |                                                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                             |      |                                                           |
| $(512 \pm 15) - i(188 \pm 12)$                                                | <sup>1</sup> ABLIKIM        | 17   | BES3 $J/\psi \rightarrow \gamma 3\pi$                     |
| $(440 \pm 10) - i(238 \pm 10)$                                                | <sup>2</sup> ALBALADEJO     | 12   | RVUE Compilation                                          |
| $(445 \pm 25) - i(278^{+22}_{-18})$                                           | <sup>3,4</sup> GARCIA-MAR.. | 11   | RVUE Compilation                                          |
| $(457^{+14}_{-13}) - i(279^{+11}_{-7})$                                       | <sup>3,5</sup> GARCIA-MAR.. | 11   | RVUE Compilation                                          |
| $(442^{+5}_{-8}) - i(274^{+6}_{-5})$                                          | <sup>6</sup> MOUSSALLAM     | 11   | RVUE Compilation                                          |
| $(452 \pm 13) - i(259 \pm 16)$                                                | <sup>7</sup> MENNESSIER     | 10   | RVUE Compilation                                          |
| $(448 \pm 43) - i(266 \pm 43)$                                                | <sup>8</sup> MENNESSIER     | 10   | RVUE Compilation                                          |
| $(455 \pm 6^{+31}_{-13}) - i(278 \pm 6^{+34}_{-43})$                          | <sup>9</sup> CAPRINI        | 08   | RVUE Compilation                                          |
| $(463 \pm 6^{+31}_{-17}) - i(259 \pm 6^{+33}_{-34})$                          | <sup>10</sup> CAPRINI       | 08   | RVUE Compilation                                          |
| $(552^{+84}_{-106}) - i(232^{+81}_{-72})$                                     | <sup>11</sup> ABLIKIM       | 07A  | BES2 $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$            |
| $(466 \pm 18) - i(223 \pm 28)$                                                | <sup>12</sup> BONVICINI     | 07   | CLEO $D^+ \rightarrow \pi^- \pi^+ \pi^+$                  |
| $(472 \pm 30) - i(271 \pm 30)$                                                | <sup>13</sup> BUGG          | 07A  | RVUE Compilation                                          |
| $(484 \pm 17) - i(255 \pm 10)$                                                | GARCIA-MAR..                | 07   | RVUE Compilation                                          |
| $(430) - i(325)$                                                              | <sup>14</sup> ANISOVICH     | 06   | RVUE Compilation                                          |
| $(441^{+16}_{-8}) - i(272^{+9}_{-12.5})$                                      | <sup>15</sup> CAPRINI       | 06   | RVUE $\pi\pi \rightarrow \pi\pi$                          |
| $(470 \pm 50) - i(285 \pm 25)$                                                | <sup>16</sup> ZHOU          | 05   | RVUE                                                      |
| $(541 \pm 39) - i(252 \pm 42)$                                                | <sup>17</sup> ABLIKIM       | 04A  | BES2 $J/\psi \rightarrow \omega \pi^+ \pi^-$              |
| $(528 \pm 32) - i(207 \pm 23)$                                                | <sup>18</sup> GALLEGOS      | 04   | RVUE Compilation                                          |
| $(533 \pm 25) - i(249 \pm 25)$                                                | <sup>19</sup> BUGG          | 03   | RVUE                                                      |
| $517 - i240$                                                                  | BLACK                       | 01   | RVUE $\pi^0 \pi^0 \rightarrow \pi^0 \pi^0$                |
| $(470 \pm 30) - i(295 \pm 20)$                                                | <sup>15</sup> COLANGELO     | 01   | RVUE $\pi\pi \rightarrow \pi\pi$                          |
| $(535^{+48}_{-36}) - i(155^{+76}_{-53})$                                      | <sup>20</sup> ISHIDA        | 01   | $\Upsilon(3S) \rightarrow \Upsilon \pi\pi$                |
| $610 \pm 14 - i620 \pm 26$                                                    | <sup>21</sup> SUROVTSEV     | 01   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                |
| $(540^{+36}_{-29}) - i(193^{+32}_{-40})$                                      | ISHIDA                      | 00B  | $p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0$                  |
| $445 - i235$                                                                  | HANNAH                      | 99   | RVUE $\pi$ scalar form factor                             |
| $(523 \pm 12) - i(259 \pm 7)$                                                 | KAMINSKI                    | 99   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, \sigma\sigma$  |
| $442 - i227$                                                                  | OLLER                       | 99   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                |
| $469 - i203$                                                                  | OLLER                       | 99B  | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                |
| $445 - i221$                                                                  | OLLER                       | 99C  | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, \eta\eta$      |
| $(1530^{+90}_{-250}) - i(560 \pm 40)$                                         | ANISOVICH                   | 98B  | RVUE Compilation                                          |
| $420 - i212$                                                                  | LOCHER                      | 98   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                |
| $440 - i245$                                                                  | <sup>22</sup> DOBADO        | 97   | RVUE Compilation                                          |
| $(602 \pm 26) - i(196 \pm 27)$                                                | <sup>23</sup> ISHIDA        | 97   | $\pi\pi \rightarrow \pi\pi$                               |
| $(537 \pm 20) - i(250 \pm 17)$                                                | <sup>24</sup> KAMINSKI      | 97B  | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, 4\pi$          |
| $470 - i250$                                                                  | <sup>25,26</sup> TORNQVIST  | 96   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$ |
| $387 - i305$                                                                  | <sup>26,27</sup> JANSSEN    | 95   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                |
| $420 - i370$                                                                  | <sup>28</sup> ACHASOV       | 94   | RVUE $\pi\pi \rightarrow \pi\pi$                          |
| $(506 \pm 10) - i(247 \pm 3)$                                                 | KAMINSKI                    | 94   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                |
| $370 - i356$                                                                  | <sup>29</sup> ZOU           | 94B  | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                |

OCCUR=2

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|                                                                                                                                                                                                       |                  |                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------------------------------------------|
| 408 – $i342$                                                                                                                                                                                          | 26,29 ZOU 93     | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$            |
| 470 – $i208$                                                                                                                                                                                          | 30 VANBEVEREN 86 | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, \eta\eta,$ |
| (750 ± 50) – $i(450 \pm 50)$                                                                                                                                                                          | 31 ESTABROOKS 79 | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$            |
| (660 ± 100) – $i(320 \pm 70)$                                                                                                                                                                         | PROTOPOPO... 73  | HBC $\pi\pi \rightarrow \pi\pi, K\bar{K}$             |
| 650 – $i370$                                                                                                                                                                                          | 32 BASDEVANT 72  | RVUE $\pi\pi \rightarrow \pi\pi$                      |
| 1 S-matrix pole; 8595 events.                                                                                                                                                                         |                  |                                                       |
| 2 Applying the chiral unitary approach at NLO to the $K_{e4}$ data of BATLEY 10 and $\pi N \rightarrow \pi\pi N$ data of HYAMS 73, GRAYER 74, and PROTOPOPOESCU 73.                                   |                  |                                                       |
| 3 Uses the $K_{e4}$ data of BATLEY 10C and the $\pi N \rightarrow \pi\pi N$ data of HYAMS 73, GRAYER 74, and PROTOPOPOESCU 73.                                                                        |                  |                                                       |
| 4 Analytic continuation using Roy equations.                                                                                                                                                          |                  |                                                       |
| 5 Analytic continuation using GKPY equations.                                                                                                                                                         |                  |                                                       |
| 6 Using Roy equations.                                                                                                                                                                                |                  |                                                       |
| 7 Average of three variants of the analytic K-matrix model. Uses the $K_{e4}$ data of BATLEY 08A and the $\pi N \rightarrow \pi\pi N$ data of HYAMS 73 and GRAYER 74.                                 |                  |                                                       |
| 8 Average of the analyses of three data sets in the K-matrix model. Uses the data of BATLEY 08A, HYAMS 73, and GRAYER 74, partially of COHEN 80 or ETKIN 82B.                                         |                  |                                                       |
| 9 From the $K_{e4}$ data of BATLEY 08A and $\pi N \rightarrow \pi\pi N$ data of HYAMS 73.                                                                                                             |                  |                                                       |
| 10 From the $K_{e4}$ data of BATLEY 08A and $\pi N \rightarrow \pi\pi N$ data of PROTOPOPOESCU 73, GRAYER 74, and ESTABROOKS 74.                                                                      |                  |                                                       |
| 11 From a mean of three different $f_0(500)$ parametrizations. Uses 40k events.                                                                                                                       |                  |                                                       |
| 12 From an isobar model using 2.6k events.                                                                                                                                                            |                  |                                                       |
| 13 Reanalysis of ABLIKIM 04A, PISLAK 01, and HYAMS 73 data.                                                                                                                                           |                  |                                                       |
| 14 Using the N/D method.                                                                                                                                                                              |                  |                                                       |
| 15 From the solution of the Roy equation (ROY 71) for the isoscalar S-wave and using a phase-shift analysis of HYAMS 73 and PROTOPOPOESCU 73 data.                                                    |                  |                                                       |
| 16 Reanalysis of the data from PROTOPOPOESCU 73, ESTABROOKS 74, GRAYER 74, ROSSELET 77, PISLAK 03, and AKHMETSHIN 04.                                                                                 |                  |                                                       |
| 17 From a mean of six different analyses and $f_0(500)$ parameterizations.                                                                                                                            |                  |                                                       |
| 18 Using data on $\psi(2S) \rightarrow J/\psi\pi\pi$ from BAI 00E and on $\Upsilon(nS) \rightarrow \Upsilon(mS)\pi\pi$ from BUTLER 94B and ALEXANDER 98.                                              |                  |                                                       |
| 19 From a combined analysis of HYAMS 73, AUGUSTIN 89, AITALA 01B, and PISLAK 01.                                                                                                                      |                  |                                                       |
| 20 A similar analysis (KOMADA 01) finds $(580^{+79}_{-30}) - i(190^{+107}_{-49})$ MeV.                                                                                                                |                  |                                                       |
| 21 Coupled channel reanalysis of BATON 70, BENSINGER 71, BAILLON 72, HYAMS 73, HYAMS 75, ROSSELET 77, COHEN 80, and ETKIN 82B using the uniformizing variable.                                        |                  |                                                       |
| 22 Using the inverse amplitude method and data of ESTABROOKS 73, GRAYER 74, and PROTOPOPOESCU 73.                                                                                                     |                  |                                                       |
| 23 Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.                                                                                |                  |                                                       |
| 24 Average and spread of 4 variants (“up” and “down”) of KAMINSKI 97B 3-channel model.                                                                                                                |                  |                                                       |
| 25 Uses data from BEIER 72B, OCHS 73, HYAMS 73, GRAYER 74, ROSSELET 77, CASON 83, ASTON 88, and ARMSTRONG 91B. Coupled channel analysis with flavor symmetry and all light two-pseudoscalars systems. |                  |                                                       |
| 26 Demonstrates explicitly that $f_0(500)$ and $f_0(1370)$ are two different poles.                                                                                                                   |                  |                                                       |
| 27 Analysis of data from FALVARD 88.                                                                                                                                                                  |                  |                                                       |
| 28 Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.                                                                                                                          |                  |                                                       |
| 29 Analysis of data from OCHS 73, GRAYER 74, and ROSSELET 77.                                                                                                                                         |                  |                                                       |
| 30 Coupled-channel analysis using data from PROTOPOPOESCU 73, HYAMS 73, HYAMS 75, GRAYER 74, ESTABROOKS 74, ESTABROOKS 75, FROGGATT 77, CORDEN 79, BISWAS 81.                                         |                  |                                                       |
| 31 Analysis of data from APEL 72C, GRAYER 74, CASON 76, PAWLICKI 77. Includes spread and errors of 4 solutions.                                                                                       |                  |                                                       |
| 32 Analysis of data from BATON 70, BENSINGER 71, COLTON 71, BAILLON 72, PROTOPOPOESCU 73, and WALKER 67.                                                                                              |                  |                                                       |

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## $f_0(500)$ BREIT-WIGNER MASS OR K-MATRIX POLE PARAMETERS

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

### (400–550) OUR ESTIMATE

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                         |                 |      |                                                         |
|-------------------------|-----------------|------|---------------------------------------------------------|
| 513 ± 32                | 33 MURAMATSU 02 | CLEO | $e^+e^- \approx 10$ GeV                                 |
| 478 $^{+24}_{-23}$ ± 17 | AITALA 01B      | E791 | $D^+ \rightarrow \pi^- \pi^+ \pi^+$                     |
| 563 $^{+58}_{-29}$      | 34 ISHIDA 01    |      | $\Upsilon(3S) \rightarrow \Upsilon \pi \pi$             |
| 555                     | 35 ASNER 00     | CLE2 | $\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$         |
| 540 ± 36                | ISHIDA 00B      |      | $p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0$                |
| 750 ± 4                 | ALEKSEEV 99     | SPEC | 1.78 $\pi^- p_{\text{polar}} \rightarrow \pi^- \pi^+ n$ |
| 744 ± 5                 | ALEKSEEV 98     | SPEC | 1.78 $\pi^- p_{\text{polar}} \rightarrow \pi^- \pi^+ n$ |
| 759 ± 5                 | 36 TROYAN 98    |      | 5.2 $np \rightarrow np \pi^+ \pi^-$                     |

NODE=M014M  
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|         |                 |    |      |                                                                                                            |
|---------|-----------------|----|------|------------------------------------------------------------------------------------------------------------|
| 780±30  | ALDE            | 97 | GAM2 | 450 $pp \rightarrow pp\pi^0\pi^0$                                                                          |
| 585±20  | 37 ISHIDA       | 97 |      | $\pi\pi \rightarrow \pi\pi$                                                                                |
| 761±12  | 38 SVEC         | 96 | RVUE | 6–17 $\pi N_{\text{polar}} \rightarrow \pi^+\pi^-N$                                                        |
| ~ 860   | 39,40 TORNQVIST | 96 | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$                                                       |
| 1165±50 | 41,42 ANISOVICH | 95 | RVUE | $\pi^-p \rightarrow \pi^0\pi^0n,$<br>$\bar{p}p \rightarrow \pi^0\pi^0\pi^0, \pi^0\pi^0\eta, \pi^0\eta\eta$ |
| ~ 1000  | 43 ACHASOV      | 94 | RVUE | $\pi\pi \rightarrow \pi\pi$                                                                                |
| 414±20  | 38 AUGUSTIN     | 89 | DM2  |                                                                                                            |

33 Statistical uncertainty only.

34 A similar analysis (KOMADA 01) finds  $526^{+48}_{-37}$  MeV.

35 From the best fit of the Dalitz plot.

36  $6\sigma$  effect, no PWA.

37 Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.

38 Breit-Wigner fit to S-wave intensity measured in  $\pi N \rightarrow \pi^-\pi^+N$  on polarized targets. The fit does not include  $f_0(980)$ .

39 Uses data from ASTON 88, OCHS 73, HYAMS 73, ARMSTRONG 91B, GRAYER 74, CASON 83, ROSSELET 77, and BEIER 72B. Coupled channel analysis with flavor symmetry and all light two-pseudoscalars systems.

40 Also observed by ASNER 00 in  $\tau^- \rightarrow \pi^-\pi^0\pi^0\nu_\tau$  decays.

41 Uses  $\pi^0\pi^0$  data from ANISOVICH 94, AMSLER 94D, and ALDE 95B,  $\pi^+\pi^-$  data from OCHS 73, GRAYER 74 and ROSSELET 77, and  $\eta\eta$  data from ANISOVICH 94.

42 The pole is on Sheet III. Demonstrates explicitly that  $f_0(500)$  and  $f_0(1370)$  are two different poles.

43 Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.

NODE=M014M;LINKAGE=UT

NODE=M014M;LINKAGE=KI

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NODE=M014M;LINKAGE=AA

NODE=M014M;LINKAGE=E

NODE=M014M;LINKAGE=B

NODE=M014M;LINKAGE=GG

NODE=M014M;LINKAGE=F

NODE=M014M;LINKAGE=G

NODE=M014M;LINKAGE=D

## $f_0(500)$ BREIT-WIGNER WIDTH

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

### (400–700) OUR ESTIMATE

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                           |                 |     |      |                                                                                                            |
|---------------------------|-----------------|-----|------|------------------------------------------------------------------------------------------------------------|
| 335± 67                   | 44 MURAMATSU    | 02  | CLEO | $e^+e^- \approx 10$ GeV                                                                                    |
| 324 $^{+42}_{-40} \pm 21$ | AITALA          | 01B | E791 | $D^+ \rightarrow \pi^-\pi^+\pi^+$                                                                          |
| 372 $^{+229}_{-95}$       | 45 ISHIDA       | 01  |      | $\Upsilon(3S) \rightarrow \Upsilon\pi\pi$                                                                  |
| 540                       | 46 ASNER        | 00  | CLE2 | $\tau^- \rightarrow \pi^-\pi^0\pi^0\nu_\tau$                                                               |
| 372± 80                   | ISHIDA          | 00B |      | $p\bar{p} \rightarrow \pi^0\pi^0\pi^0$                                                                     |
| 119± 13                   | ALEKSEEV        | 99  | SPEC | $1.78 \pi^- p_{\text{polar}} \rightarrow \pi^-\pi^+n$                                                      |
| 77± 22                    | ALEKSEEV        | 98  | SPEC | $1.78 \pi^- p_{\text{polar}} \rightarrow \pi^-\pi^+n$                                                      |
| 35± 12                    | 47 TROYAN       | 98  |      | $5.2 np \rightarrow np\pi^+\pi^-$                                                                          |
| 780± 60                   | ALDE            | 97  | GAM2 | $450 pp \rightarrow pp\pi^0\pi^0$                                                                          |
| 385± 70                   | 48 ISHIDA       | 97  |      | $\pi\pi \rightarrow \pi\pi$                                                                                |
| 290± 54                   | 49 SVEC         | 96  | RVUE | 6–17 $\pi N_{\text{polar}} \rightarrow \pi^+\pi^-N$                                                        |
| ~ 880                     | 50,51 TORNQVIST | 96  | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$                                                       |
| 460± 40                   | 52,53 ANISOVICH | 95  | RVUE | $\pi^-p \rightarrow \pi^0\pi^0n,$<br>$\bar{p}p \rightarrow \pi^0\pi^0\pi^0, \pi^0\pi^0\eta, \pi^0\eta\eta$ |
| ~ 3200                    | 54 ACHASOV      | 94  | RVUE | $\pi\pi \rightarrow \pi\pi$                                                                                |
| 494± 58                   | 49 AUGUSTIN     | 89  | DM2  |                                                                                                            |

44 Statistical uncertainty only.

45 A similar analysis (KOMADA 01) finds  $301^{+145}_{-100}$  MeV.

46 From the best fit of the Dalitz plot.

47  $6\sigma$  effect, no PWA.

48 Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.

49 Breit-Wigner fit to S-wave intensity measured in  $\pi N \rightarrow \pi^-\pi^+N$  on polarized targets. The fit does not include  $f_0(980)$ .

50 Uses data from ASTON 88, OCHS 73, HYAMS 73, ARMSTRONG 91B, GRAYER 74, CASON 83, ROSSELET 77, and BEIER 72B. Coupled channel analysis with flavor symmetry and all light two-pseudoscalars systems.

51 Also observed by ASNER 00 in  $\tau^- \rightarrow \pi^-\pi^0\pi^0\nu_\tau$  decays.

52 Uses  $\pi^0\pi^0$  data from ANISOVICH 94, AMSLER 94D, and ALDE 95B,  $\pi^+\pi^-$  data from OCHS 73, GRAYER 74 and ROSSELET 77, and  $\eta\eta$  data from ANISOVICH 94.

53 The pole is on Sheet III. Demonstrates explicitly that  $f_0(500)$  and  $f_0(1370)$  are two different poles.

54 Analysis of data from OCHS 73, ESTABROOKS 75, ROSSELET 77, and MUKHIN 80.

NODE=M014W;LINKAGE=UT

NODE=M014W;LINKAGE=KI

NODE=M014W;LINKAGE=KK

NODE=M014W;LINKAGE=TN

NODE=M014W;LINKAGE=AA

NODE=M014W;LINKAGE=E

NODE=M014W;LINKAGE=B

NODE=M014W;LINKAGE=GG

NODE=M014W;LINKAGE=F

NODE=M014W;LINKAGE=G

NODE=M014W;LINKAGE=D1

NODE=M014W

NODE=M014W

→ UNCHECKED ←

**$f_0(500)$  DECAY MODES**

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $\pi\pi$       | seen                           |
| $\Gamma_2$ $\gamma\gamma$ | seen                           |

NODE=M014215;NODE=M014

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=5;OUR EST;→ UNCHECKED ←

 **$f_0(500)$  PARTIAL WIDTHS**

| $\Gamma(\gamma\gamma)$ |             |      | $\Gamma_2$ |
|------------------------|-------------|------|------------|
| VALUE (keV)            | DOCUMENT ID | TECN | COMMENT    |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                               |                                                                                                                                                                                                |     |      |                                                   |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|---------------------------------------------------|
| 2.05 ± 0.21                   | 55 DAI                                                                                                                                                                                         | 14A | RVUE | Compilation                                       |
| 1.7 ± 0.4                     | 56 HOFERICH... 11                                                                                                                                                                              |     | RVUE | Compilation                                       |
| 3.08 ± 0.82                   | 57 MENNESSIER 11                                                                                                                                                                               |     | RVUE | Compilation                                       |
| 2.08 ± 0.2 $^{+0.07}_{-0.04}$ | 58 MOUSSALLAM11                                                                                                                                                                                |     | RVUE | Compilation                                       |
| 2.08                          | 59 MAO                                                                                                                                                                                         | 09  | RVUE | Compilation                                       |
| 1.2 ± 0.4                     | 60 BERNABEU 08                                                                                                                                                                                 |     | RVUE |                                                   |
| 3.9 ± 0.6                     | 57 MENNESSIER 08                                                                                                                                                                               |     | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |
| 1.8 ± 0.4                     | 61 OLLER 08                                                                                                                                                                                    |     | RVUE | Compilation                                       |
| 1.68 ± 0.15                   | 61,62 OLLER 08A                                                                                                                                                                                |     | RVUE | Compilation                                       |
| 3.1 ± 0.5                     | 63,64 PENNINGTON 08                                                                                                                                                                            |     | RVUE | Compilation                                       |
| 2.4 ± 0.4                     | 64,65 PENNINGTON 08                                                                                                                                                                            |     | RVUE | Compilation                                       |
| 4.1 ± 0.3                     | 66 PENNINGTON 06                                                                                                                                                                               |     | RVUE | $\gamma\gamma \rightarrow \pi^0\pi^0$             |
| 3.8 ± 1.5                     | 67,68 BOGLIONE 99                                                                                                                                                                              |     | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |
| 5.4 ± 2.3                     | 67 MORGAN 90                                                                                                                                                                                   |     | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |
| 10 ± 6                        | COURAU 86                                                                                                                                                                                      |     | DM1  | $e^+e^- \rightarrow \pi^+\pi^- e^+e^-$            |
| 55                            | Using dispersive analysis with phases from GARCIA-MARTIN 11A and BUETTAKER 04 as input.                                                                                                        |     |      |                                                   |
| 56                            | Using Roy-Steiner equations with $\pi\pi$ phase shifts from an update of COLANGELO 01 and from GARCIA-MARTIN 11A.                                                                              |     |      |                                                   |
| 57                            | Using an analytic K-matrix model.                                                                                                                                                              |     |      |                                                   |
| 58                            | Using dispersion integral with phase input from Roy equations and data from MARSISKE 90, BOYER 90, BEHREND 92, UEHARA 08A, and MORI 07.                                                        |     |      |                                                   |
| 59                            | Used dispersion theory. The value quoted used the $f_0(500)$ pole position of $457 - i276$ MeV.                                                                                                |     |      |                                                   |
| 60                            | Using $p$ , $n$ polarizabilities from PDG 06 and fitting to $\pi\pi$ phase motion from GARCIA-MARTIN 07 and $\sigma$ -poles from GARCIA-MARTIN 07 and CAPRINI 06.                              |     |      |                                                   |
| 61                            | Using twice-subtracted dispersion integrals.                                                                                                                                                   |     |      |                                                   |
| 62                            | Supersedes OLLER 08.                                                                                                                                                                           |     |      |                                                   |
| 63                            | Solution A (preferred solution based on $\chi^2$ -analysis).                                                                                                                                   |     |      |                                                   |
| 64                            | Dispersion theory based amplitude analysis of BOYER 90, MARSISKE 90, BEHREND 92, and MORI 07.                                                                                                  |     |      |                                                   |
| 65                            | Solution B (worse than solution A; still acceptable when systematic uncertainties are included).                                                                                               |     |      |                                                   |
| 66                            | Using unitarity and the $\sigma$ pole position from CAPRINI 06.                                                                                                                                |     |      |                                                   |
| 67                            | This width could equally well be assigned to the $f_0(1370)$ . The authors analyse data from BOYER 90 and MARSISKE 90 and report strong correlation with $\gamma\gamma$ width of $f_2(1270)$ . |     |      |                                                   |
| 68                            | Supersedes MORGAN 90.                                                                                                                                                                          |     |      |                                                   |

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NODE=M014W2;LINKAGE=BL

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| GARCIA-MAR... 11  | PRL 107 072001 | R. Garcia-Martin <i>et al.</i>               | (MADR, CRAC)          |
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| MENNESSIER 11     | PL B696 40     | G. Mennessier, S. Narison, X.-G. Wang        |                       |
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| ZHOU        | 05  | JHEP 0502 043                | Z.Y. Zhou <i>et al.</i>                        |                             | REFID=50823          |
| ABLIKIM     | 04A | PL B598 149                  | M. Ablikim <i>et al.</i>                       | (BES Collab.)               | REFID=49740          |
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| BUETTIKER   | 04  | EPJ C33 409                  | P. Buettiker, S. Descotes-Genon, B. Moussallam |                             | REFID=56428; ERROR=1 |
| GALLEGOS    | 04  | PR D69 074033                | A. Gallegos <i>et al.</i>                      |                             | REFID=49769          |
| BUGG        | 03  | PL B572 1                    | D.V. Bugg                                      |                             | REFID=49586          |
| PISLAK      | 03  | PR D67 072004                | S. Pislak <i>et al.</i>                        | (BNL E865 Collab.)          | REFID=49344          |
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| Also        |     | PRL 90 059901 (err.)         | H. Muramatsu <i>et al.</i>                     | (CLEO Collab.)              | REFID=49385          |
| AITALA      | 01B | PRL 86 770                   | E.M. Aitala <i>et al.</i>                      | (FNAL E791 Collab.)         | REFID=48005          |
| BLACK       | 01  | PR D64 014031                | D. Black <i>et al.</i>                         |                             | REFID=48314          |
| COLANGELO   | 01  | NP B603 125                  | G. Colangelo, J. Gasser, H. Leutwyler          |                             | REFID=49180          |
| ISHIDA      | 01  | PL B518 47                   | M. Ishida <i>et al.</i>                        |                             | REFID=48354          |
| KOMADA      | 01  | PL B508 31                   | T. Komada <i>et al.</i>                        |                             | REFID=48541          |
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| SUROVTSEV   | 01  | PR D63 054024                | Y.S. Surovtsev, D. Krupa, M. Nagy              |                             | REFID=48310          |
| ASNER       | 00  | PR D61 012002                | D.M. Asner <i>et al.</i>                       | (CLEO Collab.)              | REFID=47339          |
| BAI         | 00E | PR D62 032002                | J. Bai <i>et al.</i>                           | (BES Collab.)               | REFID=47955          |
| ISHIDA      | 00B | PTP 104 203                  | M. Ishida <i>et al.</i>                        |                             | REFID=48358          |
| ALEKSEEV    | 99  | NP B541 3                    | I.G. Alekseev <i>et al.</i>                    |                             | REFID=46614          |
| BOGLIONE    | 99  | EPJ C9 11                    | M. Boglione, M.R. Pennington                   |                             | REFID=46931          |
| HANNAH      | 99  | PR D60 017502                | T. Hannah                                      |                             | REFID=46935          |
| KAMINSKI    | 99  | EPJ C9 141                   | R. Kaminski, L. Lesniak, B. Loiseau            | (CRAC, PARIN)               | REFID=46927          |
| OLLER       | 99  | PR D60 099906 (erratum)      | J.A. Oller <i>et al.</i>                       |                             | REFID=46899          |
| OLLER       | 99B | NP A652 407 (erratum)        | J.A. Oller, E. Oset                            |                             | REFID=46924          |
| OLLER       | 99C | PR D60 074023                | J.A. Oller, E. Oset                            |                             | REFID=47386          |
| ALEKSEEV    | 98  | PAN 61 174                   | I.G. Alekseev <i>et al.</i>                    |                             | REFID=46328          |
| ALEXANDER   | 98  | PR D58 052004                | J.P. Alexander <i>et al.</i>                   | (CLEO Collab.)              | REFID=46329          |
| ANISOVICH   | 98B | SPU 41 419                   | V.V. Anisovich <i>et al.</i>                   |                             | REFID=46331          |
| LOCHER      | 98  | Translated from UFN 168 481  | M.P. Locher <i>et al.</i>                      | (PSI)                       | REFID=46372          |
| TROYAN      | 98  | EPJ C4 317                   | Yu. Troyan <i>et al.</i>                       |                             | REFID=46615          |
| ALDE        | 97  | JINRRC 5-91 33               | D.M. Alde <i>et al.</i>                        | (GAMS Collab.)              | REFID=45392          |
| DOBADO      | 97  | PL B397 350                  | A. Dobado, J.R. Pelaez                         |                             | REFID=53964          |
| ISHIDA      | 97  | PR D56 3057                  | S. Ishida <i>et al.</i>                        | (TOKY, MIYA, KEK)           | REFID=45998          |
| KAMINSKI    | 97B | PL B413 130                  | R. Kaminski, L. Lesniak, B. Loiseau            | (CRAC, IPN)                 | REFID=45778          |
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| SVEC        | 96  | PR D53 2343                  | M. Svec                                        | (MCGI)                      | REFID=44509          |
| TORNQVIST   | 96  | PRL 76 1575                  | N.A. Tornqvist, M. Roos                        | (HELS)                      | REFID=44507          |
| ALDE        | 95B | ZPHY C66 375                 | D.M. Alde <i>et al.</i>                        | (GAMS Collab.)              | REFID=44375          |
| ANISOVICH   | 95  | PL B355 363                  | V.V. Anisovich <i>et al.</i>                   | (PNPI, SERP)                | REFID=44442          |
| JANSSEN     | 95  | PR D52 2690                  | G. Janssen <i>et al.</i>                       | (STON, ADLD, JULI)          | REFID=44508          |
| ACHASOV     | 94  | PR D49 5779                  | N.N. Achasov, G.N. Shestakov                   | (NOVM)                      | REFID=44087          |
| AMSLER      | 94D | PL B333 277                  | C. Amsler <i>et al.</i>                        | (Crystal Barrel Collab.)    | REFID=44093          |
| ANISOVICH   | 94  | PL B323 233                  | V.V. Anisovich <i>et al.</i>                   | (Crystal Barrel Collab.)    | REFID=43659          |
| BUTLER      | 94B | PR D49 40                    | F. Butler <i>et al.</i>                        | (CLEO Collab.)              | REFID=43799          |
| KAMINSKI    | 94  | PR D50 3145                  | R. Kaminski, L. Lesniak, J.P. Maillet          | (CRAC+)                     | REFID=45771          |
| ZOU         | 94B | PR D50 591                   | B.S. Zou, D.V. Bugg                            | (LOQM)                      | REFID=44072          |
| ZOU         | 93  | PR D48 3948                  | B.S. Zou, D.V. Bugg                            | (LOQM)                      | REFID=43672          |
| BEHREND     | 92  | ZPHY C56 381                 | H.J. Behrend                                   | (CELLO Collab.)             | REFID=43172          |
| ARMSTRONG   | 91B | ZPHY C52 389                 | T.A. Armstrong <i>et al.</i>                   | (ATHU, BARI, BIRM+)         | REFID=41862          |
| BOYER       | 90  | PR D42 1350                  | J. Boyer <i>et al.</i>                         | (Mark II Collab.)           | REFID=41362          |
| MARSISKE    | 90  | PR D41 3324                  | H. Marsiske <i>et al.</i>                      | (Crystal Ball Collab.)      | REFID=41351          |
| MORGAN      | 90  | ZPHY C48 623                 | D. Morgan, M.R. Pennington                     | (RAL, DURH)                 | REFID=41583          |
| AUGUSTIN    | 89  | NP B320 1                    | J.E. Augustin, G. Cosme                        | (DM2 Collab.)               | REFID=41004          |
| ASTON       | 88  | NP B296 493                  | D. Aston <i>et al.</i>                         | (SLAC, NAGO, CINC, INUS)    | REFID=40262          |
| FALVARD     | 88  | PR D38 2706                  | A. Falvard <i>et al.</i>                       | (CLER, FRAS, LALO+)         | REFID=40576          |
| COURAU      | 86  | NP B271 1                    | A. Courau <i>et al.</i>                        | (CLER, LALO)                | REFID=44510          |
| VANBEVEREN  | 86  | ZPHY C30 615                 | E. van Beveren <i>et al.</i>                   | (NIJM, BIEL)                | REFID=45769          |
| CASON       | 83  | PR D28 1586                  | N.M. Cason <i>et al.</i>                       | (NDAM, ANL)                 | REFID=20752          |
| ETKIN       | 82B | PR D25 1786                  | A. Etkin <i>et al.</i>                         | (BNL, CUNY, TUFTS, VAND)    | REFID=20390          |
| BISWAS      | 81  | PRL 47 1378                  | N.N. Biswas <i>et al.</i>                      | (NDAM, ANL)                 | REFID=21106          |
| COHEN       | 80  | PR D22 2595                  | D. Cohen <i>et al.</i>                         | (ANL) IJP                   | REFID=20381          |
| MUKHIN      | 80  | JETPL 32 601                 | K.N. Mukhin <i>et al.</i>                      | (KIAE)                      | REFID=44528          |
| CORDEN      | 79  | Translated from ZETFP 32 616 | M.J. Corden <i>et al.</i>                      | (BIRM, RHEL, TELA+) JP      | REFID=20374          |
| ESTABROOKS  | 79  | NP B157 250                  | P. Estabrooks                                  | (CARL)                      | REFID=20375          |
| FROGGATT    | 77  | PR D19 2678                  | C.D. Froggatt, J.L. Petersen                   | (GLAS, NORD)                | REFID=21072          |
| PAWLICKI    | 77  | NP B129 89                   | A.J. Pawlicki <i>et al.</i>                    | (ANL) IJ                    | REFID=20367          |
| ROSSELET    | 77  | PR D15 3196                  | L. Rosselet <i>et al.</i>                      | (GEVA, SACL)                | REFID=11004          |
| CASON       | 76  | PR D15 574                   | N.M. Cason <i>et al.</i>                       | (NDAM, ANL) IJ              | REFID=21064          |
| ESTABROOKS  | 75  | PRL 36 1485                  | P.G. Estabrooks, A.D. Martin                   | (DURH)                      | REFID=20642          |
| HYAMS       | 75  | NP B95 322                   | B.D. Hyams <i>et al.</i>                       | (CERN, MPIM)                | REFID=20355          |
| SRINIVASAN  | 75  | NP B100 205                  | V. Srinivasan <i>et al.</i>                    | (NDAM, ANL)                 | REFID=21062          |
| ESTABROOKS  | 74  | PR D12 681                   | P.G. Estabrooks, A.D. Martin                   | (DURH)                      | REFID=20111          |
| GRAYER      | 74  | NP B79 301                   | G. Grayer <i>et al.</i>                        | (CERN, MPIM)                | REFID=20113          |
| ESTABROOKS  | 73  | NP B75 189                   | P.G. Estabrooks <i>et al.</i>                  | (CERN, MPIM)                | REFID=20345          |
| HYAMS       | 73  | Tallahassee                  | B.D. Hyams <i>et al.</i>                       | (CERN, MPIM)                | REFID=20107          |
| OCHS        | 73  | NP B64 134                   | W. Ochs                                        | (MPIM, MUNI)                | REFID=20349          |
| PROTOPOP... | 73  | Thesis                       | S.D. Protopopescu <i>et al.</i>                | (LBL)                       | REFID=20108          |
| PEL         | 72C | PR D7 1279                   | W.D. Apel <i>et al.</i>                        | (KARLK, KARLE, PISA)        | REFID=21013          |
| APEL        | 72C | PL 41B 542                   | W.D. Apel <i>et al.</i>                        | (SLAC)                      | REFID=21013          |
| BAILLON     | 72  | PL 38B 555                   | P.H. Baillon <i>et al.</i>                     | (CERN)                      | REFID=20093          |
| BASDEVANT   | 72  | PL 41B 178                   | J.L. Basdevant, C.D. Froggatt, J.L. Petersen   | (CERN)                      | REFID=20095          |
| BEIER       | 72B | PRL 29 511                   | E.W. Beier <i>et al.</i>                       | (PENN)                      | REFID=44530          |
| BENSINGER   | 71  | PL 36B 134                   | J.R. Bensinger <i>et al.</i>                   | (WISC)                      | REFID=21006          |
| COLTON      | 71  | PR D3 2028                   | E.P. Colton <i>et al.</i>                      | (LBL, FNAL, UCLA+)          | REFID=44533          |
| ROY         | 71  | PL 36B 353                   | S.M. Roy                                       |                             | REFID=51107          |
| BATON       | 70  | PL 33B 528                   | J.P. Baton, G. Laurens, J. Reigner             | (SACL)                      | REFID=20086          |
| WALKER      | 67  | RMP 39 695                   | W.D. Walker                                    | (WISC)                      | REFID=20960          |

NODE=M009

 **$\rho(770)$** 

$$J^{PC} = 1^{+}(1^{-})^{-}$$

NODE=M009

## THE $\rho(770)$

Updated September 2019 by S. Eidelman (Novosibirsk) and G. Venanzoni (Pisa).

The determination of the parameters of the  $\rho(770)$  is beset with many difficulties because of its large width. In physical region fits, the line shape does not correspond to a relativistic Breit-Wigner function with a  $P$ -wave width, but requires some additional shape parameter. This dependence on parameterization was demonstrated long ago [1]. Bose-Einstein correlations are another source of shifts in the  $\rho(770)$  line shape, particularly in multiparticle final-state systems [2].

The same model dependence afflicts any other source of resonance parameters, such as the energy dependence of the phase shift  $\delta_1^1$ , or the pole position. It is, therefore, not surprising that a study of  $\rho(770)$  dominance in the decays of the  $\eta$  and  $\eta'$  reveals the need for specific dynamical effects, in addition to the  $\rho(770)$  pole [3,4].

The cleanest determination of the  $\rho(770)$  mass and width comes from  $e^+e^-$  annihilation and  $\tau$ -lepton decays. Analysis of ALEPH [5] showed that the charged  $\rho(770)$  parameters measured from  $\tau$ -lepton decays are consistent with those of the neutral one determined from  $e^+e^-$  data [6]. This conclusion is qualitatively supported by the later studies of CLEO [7] and Belle [8]. However, comparison of the two-pion mass spectrum in  $\tau$  decays from OPAL [9], CLEO [7], and ALEPH [10,11], and the  $e^+e^- \rightarrow \pi^+\pi^-$  cross section from CMD-2 [12,13], showed significant discrepancies between the two shapes which can be as high as 10% above the  $\rho$  meson [14,15]. This discrepancy remains after measurements of the two-pion cross section in  $e^+e^-$  annihilation at KLOE [16,17,18,19], SND [20,21], BaBar [22] and, more recently BESIII [23]. The effect is not accounted for by isospin breaking [24,25,26,27], but the accuracy of its calculation may be overestimated [28,29].

This problem seems to be solved after a recent analysis in [30] which showed that after correcting the  $\tau$  data for the missing  $\rho-\gamma$  mixing contribution, besides the other known isospin symmetry violating corrections, the  $\pi\pi$   $I=1$  part of the hadronic vacuum polarization contribution to the muon  $g-2$  is fully compatible between  $\tau$  based and  $e^+e^-$  based evaluations.

The global fit of the whole set of the  $\rho$ ,  $\omega$ , and  $\phi$  decays, taking into account mixing effects in the hidden local symmetry model, also showed consistency of the data on  $\tau$  decays to two pions and  $e^+e^-$  annihilation [31,32]. However, because of the progress in  $e^+e^-$  data, the  $\tau$  input is now less precise and less reliable due to additional theoretical uncertainties [33] decreasing importance of  $\tau$  versus  $e^+e^-$  comparison for the determination of  $\rho(770)$  parameters and other applications, like, e.g., calculations of hadronic vacuum polarization.

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### $\rho(770)$ T-MATRIX POLE $\sqrt{s}$

| VALUE (MeV)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | DOCUMENT ID      | TECN | COMMENT                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------|-----------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                                                                                                                                                                                                                                                                                                                                                                                                 |                  |      |                             |
| $(761^{+4}_{-3}) - i(71.7^{+1.9}_{-2.3})$                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1 GARCIA-MAR..11 | RVUE | Compilation                 |
| $(763.7^{+1.7}_{-1.5}) - i(73.2^{+1.0}_{-1.1})$                                                                                                                                                                                                                                                                                                                                                                                                                               | 2 GARCIA-MAR..11 | RVUE | Compilation                 |
| $(754 \pm 18) - i(74 \pm 10)$                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3 PELAEZ 04A     | RVUE | $\pi\pi \rightarrow \pi\pi$ |
| <sup>1</sup> Reanalysis of the $K_{e4}$ data of BATLEY 10C and the $\pi N \rightarrow \pi\pi N$ data of HYAMS 73, GRAYER 74, and PROTOPODESCU 73 using Roy equations.<br><sup>2</sup> Reanalysis of the $K_{e4}$ data of BATLEY 10C and the $\pi N \rightarrow \pi\pi N$ data of HYAMS 73, GRAYER 74, and PROTOPODESCU 73 using GKPY equations.<br><sup>3</sup> Reanalysis of data from PROTOPODESCU 73, ESTABROOKS 74, GRAYER 74, and COHEN 80 in the unitarized ChPT model. |                  |      |                             |

NODE=M009PP

NODE=M009PP

OCCUR=2

OCCUR=2

NODE=M009PP;LINKAGE=A

NODE=M009PP;LINKAGE=C

NODE=M009PP;LINKAGE=B

### $\rho(770)$ MASS

We no longer list S-wave Breit-Wigner fits, or data with high combinatorial background.

NODE=M009205

NODE=M009205

### NEUTRAL ONLY, $e^+e^-$

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID       | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|-------|-------------------|------|---------------------------------------------|
| <b>775.26 ± 0.23 OUR AVERAGE</b>                                              |       |                   |      |                                             |
| [775.26 ± 0.25 MeV OUR 2020 AVERAGE]                                          |       |                   |      |                                             |
| 775.3 ± 0.5 ± 0.6                                                             |       | 1 ACHASOV 21      | SND  | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 775.02 ± 0.35                                                                 |       | 2 LEES 12G        | BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$       |
| 775.97 ± 0.46 ± 0.70                                                          | 900k  | 3 AKHMETSHIN 07   |      | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 774.6 ± 0.4 ± 0.5                                                             | 800k  | 4,5 ACHASOV 06    | SND  | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 775.65 ± 0.64 ± 0.50                                                          | 114k  | 6,7 AKHMETSHIN 04 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 775.9 ± 0.5 ± 0.5                                                             | 1.98M | 8 ALOISIO 03      | KLOE | $1.02 e^+e^- \rightarrow \pi^+\pi^-\pi^0$   |
| 775.8 ± 0.9 ± 2.0                                                             | 500k  | 8 ACHASOV 02      | SND  | $1.02 e^+e^- \rightarrow \pi^+\pi^-\pi^0$   |
| 775.9 ± 1.1                                                                   |       | 9 BARKOV 85       | OLYA | $e^+e^- \rightarrow \pi^+\pi^-$             |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |       |                   |      |                                             |
| 763.49 ± 0.53                                                                 |       | 10 BARTOS 17      | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 758.23 ± 0.46                                                                 |       | 11 BARTOS 17A     | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 775.8 ± 0.5 ± 0.3                                                             | 1.98M | 12 ALOISIO 03     | KLOE | $1.02 e^+e^- \rightarrow \pi^+\pi^-\pi^0$   |
| 775.9 ± 0.6 ± 0.5                                                             | 1.98M | 13 ALOISIO 03     | KLOE | $1.02 e^+e^- \rightarrow \pi^+\pi^-\pi^0$   |
| 775.0 ± 0.6 ± 1.1                                                             | 500k  | 14 ACHASOV 02     | SND  | $1.02 e^+e^- \rightarrow \pi^+\pi^-\pi^0$   |
| 775.1 ± 0.7 ± 5.3                                                             |       | 15 BENAYOUN 98    | RVUE | $e^+e^- \rightarrow \pi^+\pi^-, \mu^+\mu^-$ |
| 770.5 ± 1.9 ± 5.1                                                             |       | 16 GARDNER 98     | RVUE | $0.28-0.92 e^+e^- \rightarrow \pi^+\pi^-$   |
| 764.1 ± 0.7                                                                   |       | 17 O'CONNELL 97   | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 757.5 ± 1.5                                                                   |       | 18 BERNICHA 94    | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$             |
| 768 ± 1                                                                       |       | 19 GESKIN... 89   | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$             |

NODE=M009M0

NODE=M009M0

NEW

OCCUR=2

OCCUR=3

OCCUR=3

NODE=M009M0;LINKAGE=D

NODE=M009M0;LINKAGE=LE

NODE=M009M0;LINKAGE=AK

NODE=M009M0;LINKAGE=AC

NODE=M009M0;LINKAGE=SN

NODE=M009M0;LINKAGE=GS

NODE=M009M0;LINKAGE=PT

NODE=M009M0;LINKAGE=CH

NODE=M009M0;LINKAGE=K

<sup>1</sup> From a fit of the cross section in the energy range  $0.525 < \sqrt{s} < 0.883$  GeV parameterized by the sum of the Breit-Wigner amplitudes for the  $\rho(770)$ ,  $\omega$  and  $\rho(1450)$  resonances.

<sup>2</sup> Using the GOUNARIS 68 parametrization with the complex phase of the  $\rho$ - $\omega$  interference and leaving the masses and widths of the  $\rho(1450)$ ,  $\rho(1700)$ , and  $\rho(2150)$  resonances as free parameters of the fit.

<sup>3</sup> A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

<sup>4</sup> Supersedes ACHASOV 05A.

<sup>5</sup> A fit of the SND data from 400 to 1000 MeV using parameters of the  $\rho(1450)$  and  $\rho(1700)$  from a fit of the data of BARKOV 85, BISELLO 89 and ANDERSON 00A.

<sup>6</sup> Using the GOUNARIS 68 parametrization with the complex phase of the  $\rho$ - $\omega$  interference.

<sup>7</sup> Update of AKHMETSHIN 02.

<sup>8</sup> Assuming  $m_{\rho^+} = m_{\rho^-}$ ,  $\Gamma_{\rho^+} = \Gamma_{\rho^-}$ .

<sup>9</sup> From the GOUNARIS 68 parametrization of the pion form factor.



- 10 Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUB-NICKA 10 to analyze the data of LEES 12G and ABLIKIM 16C.
- 11 Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUB-NICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, and AMBROSINO 11A.
- 12 Assuming  $m_{\rho^+} = m_{\rho^-} = m_{\rho^0}$ ,  $\Gamma_{\rho^+} = \Gamma_{\rho^-} = \Gamma_{\rho^0}$ .
- 13 Without limitations on masses and widths.
- 14 Assuming  $m_{\rho^0} = m_{\rho^\pm}$ ,  $g_{\rho^0\pi\pi} = g_{\rho^\pm\pi\pi}$ .
- 15 Using the data of BARKOV 85 in the hidden local symmetry model.
- 16 From the fit to  $e^+e^- \rightarrow \pi^+\pi^-$  data from the compilations of HEYN 81 and BARKOV 85, including the GOUNARIS 68 parametrization of the pion form factor.
- 17 A fit of BARKOV 85 data assuming the direct  $\omega\pi\pi$  coupling.
- 18 Applying the S-matrix formalism to the BARKOV 85 data.
- 19 Includes BARKOV 85 data. Model-dependent width definition.

NODE=M009M0;LINKAGE=A

NODE=M009M0;LINKAGE=B

NODE=M009M0;LINKAGE=DF  
NODE=M009M0;LINKAGE=WO

NODE=M009M0;LINKAGE=HC  
NODE=M009M0;LINKAGE=K2  
NODE=M009M0;LINKAGE=G8

NODE=M009M0;LINKAGE=AB  
NODE=M009M0;LINKAGE=AA  
NODE=M009M0;LINKAGE=F

NODE=M009M5  
NODE=M009M5

**CHARGED ONLY,  $\tau$  DECAYS and  $e^+e^-$** 

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID    | TECN | CHG        | COMMENT                                   |
|-------------------------------------------------------------------------------|-------|----------------|------|------------|-------------------------------------------|
| <b>775.11<math>\pm</math>0.34 OUR AVERAGE</b>                                 |       |                |      |            |                                           |
| 774.6 $\pm$ 0.2 $\pm$ 0.5                                                     | 5.4M  | 1,2 FUJIKAWA   | 08   | BELL $\pm$ | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 775.5 $\pm$ 0.7                                                               |       | 2,3 SCHAEAL    | 05C  | ALEP       | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 775.5 $\pm$ 0.5 $\pm$ 0.4                                                     | 1.98M | 4 ALOISIO      | 03   | KLOE       | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 775.1 $\pm$ 1.1 $\pm$ 0.5                                                     | 87k   | 5,6 ANDERSON   | 00A  | CLE2       | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                |      |            |                                           |
| 761.60 $\pm$ 0.95                                                             |       | 7 BARTOS       | 17A  | RVUE       | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 774.8 $\pm$ 0.6 $\pm$ 0.4                                                     | 1.98M | 8 ALOISIO      | 03   | KLOE $-$   | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 776.3 $\pm$ 0.6 $\pm$ 0.7                                                     | 1.98M | 8 ALOISIO      | 03   | KLOE $+$   | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 773.9 $\pm$ 2.0 $^{+0.3}_{-1.0}$                                              |       | 9 SANZ-CILLERO | 03   | RVUE       | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |
| 774.5 $\pm$ 0.7 $\pm$ 1.5                                                     | 500k  | 4 ACHASOV      | 02   | SND $\pm$  | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 775.1 $\pm$ 0.5                                                               |       | 10 PICH        | 01   | RVUE       | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |

OCCUR=2

OCCUR=3

OCCUR=2

1  $|F_\pi(0)|^2$  fixed to 1.

2 From the GOUNARIS 68 parametrization of the pion form factor.

3 The error combines statistical and systematic uncertainties. Supersedes BARATE 97M.

4 Assuming  $m_{\rho^+} = m_{\rho^-}$ ,  $\Gamma_{\rho^+} = \Gamma_{\rho^-}$ .5  $\rho(1700)$  mass and width fixed at 1700 MeV and 235 MeV respectively.

6 From the GOUNARIS 68 parametrization of the pion form factor. The second error is a model error taking into account different parametrizations of the pion form factor.

7 Applies the Unitary &amp; Analytic Model of the pion electromagnetic form factor of DUB-NICKA 10 to analyze the data of FUJIKAWA 08.

8 Without limitations on masses and widths.

9 Using the data of BARATE 97M and the effective chiral Lagrangian.

10 From a fit of the model-independent parameterization of the pion form factor to the data of BARATE 97M.

NODE=M009M5;LINKAGE=FU  
NODE=M009M5;LINKAGE=GO  
NODE=M009M5;LINKAGE=SC  
NODE=M009M5;LINKAGE=CH  
NODE=M009M5;LINKAGE=A6  
NODE=M009M5;LINKAGE=K1

NODE=M009M5;LINKAGE=A

NODE=M009M5;LINKAGE=WO  
NODE=M009M5;LINKAGE=Z  
NODE=M009M5;LINKAGE=PC

**MIXED CHARGES, OTHER REACTIONS**

| VALUE (MeV)                                        | EVTS | DOCUMENT ID | TECN | CHG          | COMMENT                                    |
|----------------------------------------------------|------|-------------|------|--------------|--------------------------------------------|
| <b>763.0<math>\pm</math>0.3<math>\pm</math>1.2</b> | 600k | 1 ABELE     | 99E  | CBAR 0 $\pm$ | 0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |

1 Assuming the equality of  $\rho^+$  and  $\rho^-$  masses and widths.

NODE=M009M7  
NODE=M009M7

NODE=M009M7;LINKAGE=LB

**CHARGED ONLY, HADROPRODUCED**

| VALUE (MeV)                                 | EVTS | DOCUMENT ID | TECN | CHG      | COMMENT                                                 |
|---------------------------------------------|------|-------------|------|----------|---------------------------------------------------------|
| <b>766.5<math>\pm</math>1.1 OUR AVERAGE</b> |      |             |      |          |                                                         |
| 763.7 $\pm$ 3.2                             |      | ABELE       | 97   | CBAR     | $\bar{p}n \rightarrow \pi^- \pi^0 \pi^0$                |
| 768 $\pm$ 9                                 |      | AGUILAR...  | 91   | EHS      | 400 $pp$                                                |
| 767 $\pm$ 3                                 | 2935 | 1 CAPRARO   | 87   | SPEC $-$ | 200 $\pi^- \text{Cu} \rightarrow \pi^- \pi^0 \text{Cu}$ |
| 761 $\pm$ 5                                 | 967  | 1 CAPRARO   | 87   | SPEC $-$ | 200 $\pi^- \text{Pb} \rightarrow \pi^- \pi^0 \text{Pb}$ |
| 771 $\pm$ 4                                 |      | HUSTON      | 86   | SPEC $+$ | 202 $\pi^+ \text{A} \rightarrow \pi^+ \pi^0 \text{A}$   |
| 766 $\pm$ 7                                 | 6500 | 2 BYERLY    | 73   | OSPK $-$ | 5 $\pi^- p$                                             |
| 766.8 $\pm$ 1.5                             | 9650 | 3 PISUT     | 68   | RVUE $-$ | 1.7–3.2 $\pi^- p$ , $t < 10$                            |
| 767 $\pm$ 6                                 | 900  | 1 EISNER    | 67   | HBC $-$  | 4.2 $\pi^- p$ , $t < 10$                                |

1 Mass errors enlarged by us to  $\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

2 Phase shift analysis. Systematic errors added corresponding to spread of different fits.

3 From fit of 3-parameter relativistic  $P$ -wave Breit-Wigner to total mass distribution. Includes BATON 68, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65 and CARMONY 64.

NODE=M009M2  
NODE=M009M2

OCCUR=2

NODE=M009M2;LINKAGE=Z  
NODE=M009M2;LINKAGE=X  
NODE=M009M2;LINKAGE=A

**NEUTRAL ONLY, PHOTOPRODUCED**

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**769.2 ± 0.9 OUR AVERAGE**

[769.0 ± 1.0 MeV OUR 2020 AVERAGE]

|                                             |       |                           |      |      |                                          |
|---------------------------------------------|-------|---------------------------|------|------|------------------------------------------|
| 770.8 ± 1.3 <sup>+2.3</sup> <sub>-2.4</sub> | 900k  | ANDREEV                   | 20   | H1   | $ep \rightarrow e\pi^+\pi^-p$            |
| 771 ± 2 <sup>+2</sup> <sub>-1</sub>         | 63.5k | <sup>1</sup> ABRAMOWICZ12 | ZEUS |      | $ep \rightarrow e\pi^+\pi^-p$            |
| 770 ± 2 ± 1                                 | 79k   | <sup>2</sup> BREITWEG     | 98B  | ZEUS | 50–100 $\gamma p$                        |
| 767.6 ± 2.7                                 |       | BARTALUCCI                | 78   | CNTR | $\gamma p \rightarrow e^+e^-p$           |
| 775 ± 5                                     |       | GLADDING                  | 73   | CNTR | 2.9–4.7 $\gamma p$                       |
| 767 ± 4                                     | 1930  | BALLAM                    | 72   | HBC  | 2.8 $\gamma p$                           |
| 770 ± 4                                     | 2430  | BALLAM                    | 72   | HBC  | 4.7 $\gamma p$                           |
| 765 ± 10                                    |       | ALVENSLEB...              | 70   | CNTR | $\gamma A, t < 0.01$                     |
| 767.7 ± 1.9                                 | 140k  | BIGGS                     | 70   | CNTR | $< 4.1 \gamma C \rightarrow \pi^+\pi^-C$ |
| 765 ± 5                                     | 4000  | ASBURY                    | 67B  | CNTR | $\gamma + Pb$                            |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |     |                       |     |      |                   |
|---------|-----|-----------------------|-----|------|-------------------|
| 771 ± 2 | 79k | <sup>3</sup> BREITWEG | 98B | ZEUS | 50–100 $\gamma p$ |
|---------|-----|-----------------------|-----|------|-------------------|

<sup>1</sup> Using the KUHN 90 parametrization of the pion form factor, neglecting  $\rho$ - $\omega$  interference.<sup>2</sup> From the parametrization according to SOEDING 66.<sup>3</sup> From the parametrization according to ROSS 66.**NEUTRAL ONLY, OTHER REACTIONS**

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**769.0 ± 0.9 OUR AVERAGE**

Error includes scale factor of 1.4. See the ideogram below.

|             |       |                          |     |      |                                            |
|-------------|-------|--------------------------|-----|------|--------------------------------------------|
| 765 ± 6     |       | BERTIN                   | 97C | OBLX | 0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |
| 773 ± 1.6   |       | WEIDENAUER               | 93  | ASTE | $\bar{p}p \rightarrow \pi^+\pi^-\omega$    |
| 762.6 ± 2.6 |       | AGUILAR...               | 91  | EHS  | 400 $pp$                                   |
| 770 ± 2     |       | <sup>1</sup> HEYN        | 81  | RVUE | Pion form factor                           |
| 768 ± 4     |       | <sup>2,3</sup> BOHACIK   | 80  | RVUE |                                            |
| 769 ± 3     |       | <sup>4</sup> WICKLUND    | 78  | ASPK | 3,4,6 $\pi^\pm N$                          |
| 768 ± 1     | 76k   | DEUTSCH...               | 76  | HBC  | 16 $\pi^+p$                                |
| 767 ± 4     | 4100  | ENGLER                   | 74  | DBC  | 6 $\pi^+n \rightarrow \pi^+\pi^-p$         |
| 775 ± 4     | 32k   | <sup>2</sup> PROTOPOP... | 73  | HBC  | 7.1 $\pi^+p, t < 0.4$                      |
| 764 ± 3     | 6.8k  | <sup>5</sup> RATCLIFF    | 72  | ASPK | 15 $\pi^-p, t < 0.3$                       |
| 774 ± 3     | 1.7k  | REYNOLDS                 | 69  | HBC  | 2.26 $\pi^-p$                              |
| 769.2 ± 1.5 | 13.3k | <sup>6</sup> PISUT       | 68  | RVUE | 1.7–3.2 $\pi^-p, t < 10$                   |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                      |       |                           |     |      |                                            |
|----------------------|-------|---------------------------|-----|------|--------------------------------------------|
| 774.34 ± 0.18 ± 0.35 | 970k  | <sup>7</sup> ABLIKIM      | 18C | BES3 | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$  |
| 772.93 ± 0.18 ± 0.34 | 970k  | <sup>8</sup> ABLIKIM      | 18C | BES3 | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$  |
| 773.5 ± 2.5          |       | <sup>9</sup> COLANGELO    | 01  | RVUE | $\pi\pi \rightarrow \pi\pi$                |
| 762.3 ± 0.5 ± 1.2    | 600k  | <sup>10</sup> ABELE       | 99E | CBAR | 0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |
| 777 ± 2              | 4.9k  | <sup>11</sup> ADAMS       | 97  | E665 | 470 $\mu p \rightarrow \mu XB$             |
| 770 ± 2              |       | <sup>12</sup> BOGOLYUB... | 97  | MIRA | 32 $\bar{p}p \rightarrow \pi^+\pi^-X$      |
| 768 ± 8              |       | <sup>12</sup> BOGOLYUB... | 97  | MIRA | 32 $pp \rightarrow \pi^+\pi^-X$            |
| 761.1 ± 2.9          |       | DUBNICKA                  | 89  | RVUE | $\pi$ form factor                          |
| 777.4 ± 2.0          |       | <sup>13</sup> CHABAUD     | 83  | ASPK | 17 $\pi^-p$ polarized                      |
| 769.5 ± 0.7          |       | <sup>2,3</sup> LANG       | 79  | RVUE |                                            |
| 770 ± 9              |       | <sup>3</sup> ESTABROOKS   | 74  | RVUE | 17 $\pi^-p \rightarrow \pi^+\pi^-n$        |
| 773.5 ± 1.7          | 11.2k | <sup>14</sup> JACOBS      | 72  | HBC  | 2.8 $\pi^-p$                               |
| 775 ± 3              | 2.2k  | <sup>15</sup> HYAMS       | 68  | OSPK | 11.2 $\pi^-p$                              |

<sup>1</sup> HEYN 81 includes all spacelike and timelike  $F_\pi$  values until 1978.<sup>2</sup> From pole extrapolation.<sup>3</sup> From phase shift analysis of GRAYER 74 data.<sup>4</sup> Phase shift analysis. Systematic errors added corresponding to spread of different fits.<sup>5</sup> Published values contain misprints. Corrected by private communication RATCLIFF 74.<sup>6</sup> Includes MALAMUD 69, ARMENISE 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, GOLDBERGER 64, ABOLINS 63.<sup>7</sup> From a fit to  $\pi^+\pi^-$  mass using  $\rho(770)$  (parametrized with the Gounaris-Sakurai approach),  $\omega(782)$ , and box anomaly components.<sup>8</sup> From a fit to  $\pi^+\pi^-$  mass using  $\rho(770)$  (parametrized with the Gounaris-Sakurai approach),  $\omega(782)$ , and  $\rho(1450)$  components.<sup>9</sup> Breit-Wigner mass from a phase-shift analysis of HYAMS 73 and PROTOPOPESCU 73 data.<sup>10</sup> Using relativistic Breit-Wigner and taking into account  $\rho$ - $\omega$  interference.<sup>11</sup> Systematic errors not evaluated.<sup>12</sup> Systematic effects not studied.

NODE=M009M0P

NODE=M009M0P

NEW

OCCUR=2

OCCUR=2

NODE=M009M0P;LINKAGE=AB

NODE=M009M0P;LINKAGE=B5

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NODE=M009M0R

NODE=M009M0R

OCCUR=2

OCCUR=2

NODE=M009M0R;LINKAGE=B0

NODE=M009M0R;LINKAGE=C0

NODE=M009M0R;LINKAGE=H

NODE=M009M0R;LINKAGE=X

NODE=M009M0R;LINKAGE=03

NODE=M009M0R;LINKAGE=R

NODE=M009M0R;LINKAGE=B

NODE=M009M0R;LINKAGE=C

NODE=M009M0R;LINKAGE=CL

NODE=M009M0R;LINKAGE=BL

NODE=M009M0R;LINKAGE=A1

NODE=M009M0R;LINKAGE=QQ

<sup>13</sup> From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of P-wave intensity. CHABAUD 83 includes data of GRAYER 74.

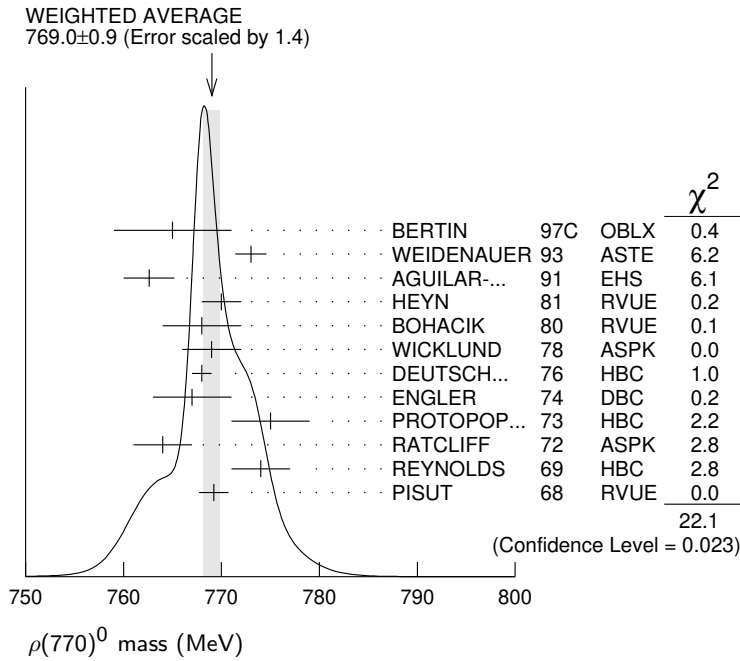
<sup>14</sup> Mass errors enlarged by us to  $\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

<sup>15</sup> Of HYAMS 68 six parametrizations, this is theoretically soundest. MR

NODE=M009M0R;LINKAGE=G

NODE=M009M0R;LINKAGE=Z

NODE=M009M0R;LINKAGE=02



### $m_{\rho(770)^0} - m_{\rho(770)^\pm}$

NODE=M009D

NODE=M009D

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN | CHG     | COMMENT                                                                          |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|------|---------|----------------------------------------------------------------------------------|
| <b>-0.7 ±0.8 OUR AVERAGE</b>                                                  |      | Error includes scale factor of 1.5. See the ideogram below. |      |         |                                                                                  |
| -2.4 ±0.8                                                                     |      | <sup>1</sup> SCHAEAL                                        | 05C  | ALEP    | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$                                        |
| 0.4 ±0.7 ±0.6 1.98M                                                           |      | <sup>2</sup> ALOISIO                                        | 03   | KLOE    | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                                     |
| 1.3 ±1.1 ±2.0 500k                                                            |      | <sup>2</sup> ACHASOV                                        | 02   | SND     | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                                     |
| 1.6 ±0.6 ±1.7 600k                                                            |      | ABELE                                                       | 99E  | CBAR ±0 | $0.0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0$                                    |
| -4 ±4 3000                                                                    |      | <sup>3</sup> REYNOLDS                                       | 69   | HBC -0  | $2.26 \pi^- p$                                                                   |
| -5 ±5 3600                                                                    |      | <sup>3</sup> FOSTER                                         | 68   | HBC ±0  | $0.0 \bar{p} p$                                                                  |
| 2.4 ±2.1 22950                                                                |      | <sup>4</sup> PISUT                                          | 68   | RVUE    | $\pi N \rightarrow \rho N$                                                       |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                                                             |      |         |                                                                                  |
| -3.37 ±1.06                                                                   |      | <sup>5</sup> BARTOS                                         | 17A  | RVUE    | $e^+ e^- \rightarrow \pi^+ \pi^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |

<sup>1</sup> From the combined fit of the  $\tau^-$  data from ANDERSON 00A and SCHAEAL 05C and  $e^+ e^-$  data from the compilation of BARKOV 85, AKHMETSHIN 04, and ALOISIO 05. Supersedes BARATE 97M.

<sup>2</sup> Assuming  $m_{\rho^+} = m_{\rho^-}$ ,  $\Gamma_{\rho^+} = \Gamma_{\rho^-}$ .

<sup>3</sup> From quoted masses of charged and neutral modes.

<sup>4</sup> Includes MALAMUD 69, ARMENISE 68, BATON 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65, CARMONY 64, GOLDBERGER 64, ABOLINS 63.

<sup>5</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, AMBROSINO 11A, and FUJIKAWA 08.

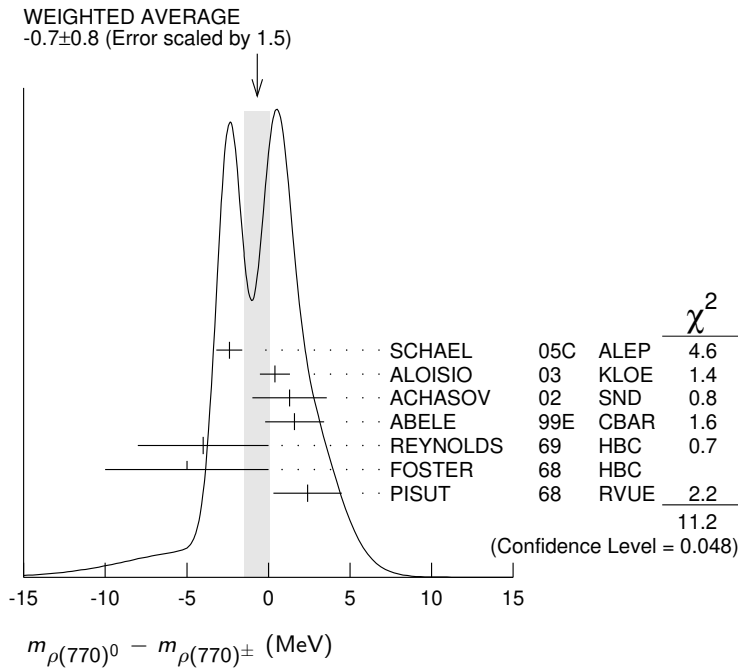
NODE=M009D;LINKAGE=SC

NODE=M009D;LINKAGE=CH

NODE=M009D;LINKAGE=A

NODE=M009D;LINKAGE=R

NODE=M009D;LINKAGE=B



### $m_{\rho(770)^+} - m_{\rho(770)^-}$

NODE=M009D1

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID          | TECN | COMMENT                                           |
|-------------------------------------------------------------------------------|-------|----------------------|------|---------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                      |      |                                                   |
| $1.5 \pm 0.8 \pm 0.7$                                                         | 1.98M | <sup>1</sup> ALOISIO | 03   | KLOE $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| <sup>1</sup> Without limitations on masses and widths.                        |       |                      |      |                                                   |

NODE=M009D1

NODE=M009D;LINKAGE=WO

### $\rho(770)$ RANGE PARAMETER

NODE=M009R

NODE=M009R

The range parameter  $R$  enters an energy-dependent correction to the width, of the form  $(1 + q_r^2 R^2) / (1 + q^2 R^2)$ , where  $q$  is the momentum of one of the pions in the  $\pi\pi$  rest system. At resonance,  $q = q_r$ .

| VALUE ( $\text{GeV}^{-1}$ )                                                  | DOCUMENT ID          | TECN | CHG  | COMMENT                  |
|------------------------------------------------------------------------------|----------------------|------|------|--------------------------|
| $5.3^{+0.9}_{-0.7}$                                                          | <sup>1</sup> CHABAUD | 83   | ASPK | 0 17 $\pi^- p$ polarized |
| <sup>1</sup> The old PISUT 68 value, properly corrected, was $3.2 \pm 0.6$ . |                      |      |      |                          |

NODE=M009R

NODE=M009R;LINKAGE=01

### $\rho(770)$ WIDTH

NODE=M009220

NODE=M009220

We no longer list  $S$ -wave Breit-Wigner fits, or data with high combinatorial background.

### NEUTRAL ONLY, $e^+ e^-$

NODE=M009W0

NODE=M009W0

NEW

| VALUE (MeV)                                           | EVTS  | DOCUMENT ID                                                 | TECN | COMMENT                                                |
|-------------------------------------------------------|-------|-------------------------------------------------------------|------|--------------------------------------------------------|
| <b>147.4 ±0.8 OUR AVERAGE</b>                         |       | Error includes scale factor of 2.0. See the ideogram below. |      |                                                        |
| [147.8 ± 0.9 MeV OUR 2020 AVERAGE Scale factor = 2.0] |       |                                                             |      |                                                        |
| 145.6 ±0.6 ±0.8                                       |       | <sup>1</sup> ACHASOV                                        | 21   | SND $e^+e^- \rightarrow \pi^+\pi^-$                    |
| 149.59±0.67                                           |       | <sup>2</sup> LEES                                           | 12G  | BABR $e^+e^- \rightarrow \pi^+\pi^-\gamma$             |
| 145.98±0.75±0.50                                      | 900k  | <sup>3</sup> AKHMETSHIN                                     | 07   | $e^+e^- \rightarrow \pi^+\pi^-$                        |
| 146.1 ±0.8 ±1.5                                       | 800k  | <sup>4,5</sup> ACHASOV                                      | 06   | SND $e^+e^- \rightarrow \pi^+\pi^-$                    |
| 143.85±1.33±0.80                                      | 114k  | <sup>6,7</sup> AKHMETSHIN                                   | 04   | CMD2 $e^+e^- \rightarrow \pi^+\pi^-$                   |
| 147.3 ±1.5 ±0.7                                       | 1.98M | <sup>8</sup> ALOISIO                                        | 03   | KLOE $1.02 \frac{e^+e^-}{\pi^+\pi^-\pi^0} \rightarrow$ |
| 151.1 ±2.6 ±3.0                                       | 500k  | <sup>8</sup> ACHASOV                                        | 02   | SND $1.02 \frac{e^+e^-}{\pi^+\pi^-\pi^0} \rightarrow$  |
| 150.5 ±3.0                                            |       | <sup>9</sup> BARKOV                                         | 85   | OLYA $e^+e^- \rightarrow \pi^+\pi^-$                   |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |       |    |            |     |      |                                                              |
|-----------------|-------|----|------------|-----|------|--------------------------------------------------------------|
| 144.06±0.85     |       | 10 | BARTOS     | 17  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                              |
| 144.56±0.80     |       | 11 | BARTOS     | 17A | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                              |
| 143.9 ±1.3 ±1.1 | 1.98M | 12 | ALOISIO    | 03  | KLOE | $1.02 \frac{e^+e^- \rightarrow \pi^+\pi^-}{\pi^+\pi^-\pi^0}$ |
| 147.4 ±1.5 ±0.7 | 1.98M | 13 | ALOISIO    | 03  | KLOE | $1.02 \frac{e^+e^- \rightarrow \pi^+\pi^-}{\pi^+\pi^-\pi^0}$ |
| 149.8 ±2.2 ±2.0 | 500k  | 14 | ACHASOV    | 02  | SND  | $1.02 \frac{e^+e^- \rightarrow \pi^+\pi^-}{\pi^+\pi^-\pi^0}$ |
| 147.9 ±1.5 ±7.5 |       | 15 | BENAYOUN   | 98  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-, \mu^+\mu^-$                  |
| 153.5 ±1.3 ±4.6 |       | 16 | GARDNER    | 98  | RVUE | $0.28-0.92 \frac{e^+e^- \rightarrow \pi^+\pi^-}{\pi^+\pi^-}$ |
| 145.0 ±1.7      |       | 17 | O'CONNELL  | 97  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                              |
| 142.5 ±3.5      |       | 18 | BERNICHIA  | 94  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                              |
| 138 ±1          |       | 19 | GESHKEN... | 89  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                              |

OCCUR=2

OCCUR=3

OCCUR=3

<sup>1</sup> From a fit of the cross section in the energy range  $0.525 < \sqrt{s} < 0.883$  GeV parameterized by the sum of the Breit-Wigner amplitudes for the  $\rho(770)$ ,  $\omega$  and  $\rho(1450)$  resonances.

<sup>2</sup> Using the GOUNARIS 68 parametrization with the complex phase of the  $\rho$ - $\omega$  interference and leaving the masses and widths of the  $\rho(1450)$ ,  $\rho(1700)$ , and  $\rho(2150)$  resonances as free parameters of the fit.

<sup>3</sup> A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

<sup>4</sup> Supersedes ACHASOV 05A.

<sup>5</sup> A fit of the SND data from 400 to 1000 MeV using parameters of the  $\rho(1450)$  and  $\rho(1700)$  from a fit of the data of BARKOV 85, BISELLO 89 and ANDERSON 00A.

<sup>6</sup> Using the GOUNARIS 68 parametrization with the complex phase of the  $\rho$ - $\omega$  interference.

<sup>7</sup> From a fit in the energy range 0.61 to 0.96 GeV. Update of AKHMETSHIN 02.

<sup>8</sup> Assuming  $m_{\rho^+} = m_{\rho^-}$ ,  $\Gamma_{\rho^+} = \Gamma_{\rho^-}$ .

<sup>9</sup> From the GOUNARIS 68 parametrization of the pion form factor.

<sup>10</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of LEES 12G and ABLIKIM 16C.

<sup>11</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, and AMBROSINO 11A.

<sup>12</sup> Assuming  $m_{\rho^+} = m_{\rho^-} = m_{\rho^0}$ ,  $\Gamma_{\rho^+} = \Gamma_{\rho^-} = \Gamma_{\rho^0}$ .

<sup>13</sup> Without limitations on masses and widths.

<sup>14</sup> Assuming  $m_{\rho^0} = m_{\rho^\pm}$ ,  $g_{\rho^0\pi\pi} = g_{\rho^\pm\pi\pi}$ .

<sup>15</sup> Using the data of BARKOV 85 in the hidden local symmetry model.

<sup>16</sup> From the fit to  $e^+e^- \rightarrow \pi^+\pi^-$  data from the compilations of HEYN 81 and BARKOV 85, including the GOUNARIS 68 parametrization of the pion form factor.

<sup>17</sup> A fit of BARKOV 85 data assuming the direct  $\omega\pi\pi$  coupling.

<sup>18</sup> Applying the S-matrix formalism to the BARKOV 85 data.

<sup>19</sup> Includes BARKOV 85 data. Model-dependent width definition.

NODE=M009W0;LINKAGE=D

NODE=M009W0;LINKAGE=LE

NODE=M009W;LINKAGE=AK

NODE=M009W0;LINKAGE=AC

NODE=M009W0;LINKAGE=SN

NODE=M009W5;LINKAGE=GS

NODE=M009W5;LINKAGE=P2

NODE=M009W;LINKAGE=CH

NODE=M009W;LINKAGE=K

NODE=M009W0;LINKAGE=A

NODE=M009W0;LINKAGE=B

NODE=M009W;LINKAGE=DF

NODE=M009W;LINKAGE=WO

NODE=M009W;LINKAGE=HC

NODE=M009W;LINKAGE=K2

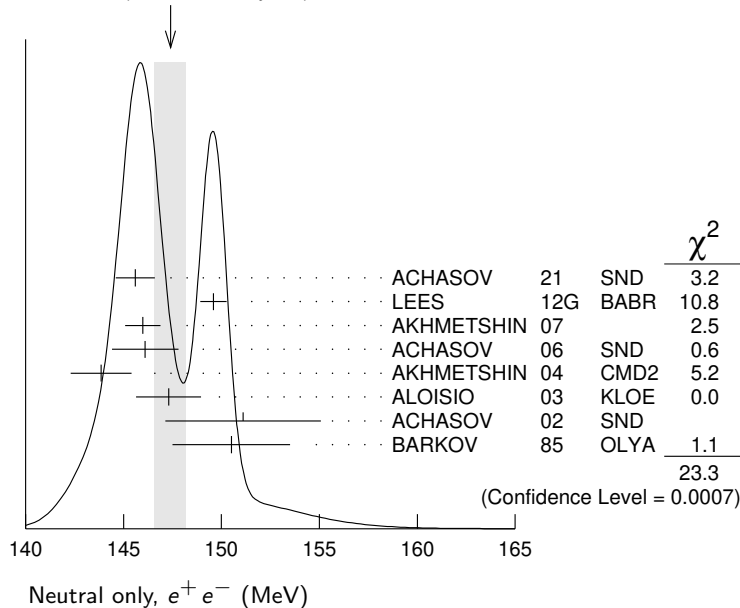
NODE=M009W;LINKAGE=G8

NODE=M009W;LINKAGE=AB

NODE=M009W;LINKAGE=AA

NODE=M009W;LINKAGE=F

WEIGHTED AVERAGE  
147.4±0.8 (Error scaled by 2.0)



**CHARGED ONLY,  $\tau$  DECAYS and  $e^+e^-$** 

| VALUE (MeV)                                                                   | EVTS           | DOCUMENT ID     | TECN | CHG   | COMMENT                                      |
|-------------------------------------------------------------------------------|----------------|-----------------|------|-------|----------------------------------------------|
| <b>149.1 <math>\pm 0.8</math> OUR FIT</b>                                     |                |                 |      |       |                                              |
| <b>149.1 <math>\pm 0.8</math> OUR AVERAGE</b>                                 |                |                 |      |       |                                              |
| 148.1 $\pm 0.4$ $\pm 1.7$ 5.4M                                                | <sup>1,2</sup> | FUJIKAWA 08     | BELL | $\pm$ | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$    |
| 149.0 $\pm 1.2$                                                               | <sup>2,3</sup> | SCHAELE 05c     | ALEP |       | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$    |
| 149.9 $\pm 2.3$ $\pm 2.0$ 500k                                                | <sup>4</sup>   | ACHASOV 02      | SND  | $\pm$ | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 150.4 $\pm 1.4$ $\pm 1.4$ 87k                                                 | <sup>5,6</sup> | ANDERSON 00A    | CLE2 |       | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$    |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                |                 |      |       |                                              |
| 139.90 $\pm 0.46$                                                             | <sup>7</sup>   | BARTOS 17A      | RVUE |       | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$    |
| 143.7 $\pm 1.3$ $\pm 1.2$ 1.98M                                               | <sup>4</sup>   | ALOISIO 03      | KLOE | $\pm$ | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 142.9 $\pm 1.3$ $\pm 1.4$ 1.98M                                               | <sup>8</sup>   | ALOISIO 03      | KLOE | $-$   | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 144.7 $\pm 1.4$ $\pm 1.2$ 1.98M                                               | <sup>8</sup>   | ALOISIO 03      | KLOE | $+$   | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |
| 150.2 $\pm 2.0$ $^{+0.7}_{-1.6}$                                              | <sup>9</sup>   | SANZ-CILLERO 03 | RVUE |       | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$    |
| 150.9 $\pm 2.2$ $\pm 2.0$ 500k                                                | <sup>10</sup>  | ACHASOV 02      | SND  |       | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |

NODE=M009W5  
NODE=M009W5

OCCUR=2

OCCUR=2

OCCUR=3

OCCUR=4

<sup>1</sup>  $|F_\pi(0)|^2$  fixed to 1.<sup>2</sup> From the GOUNARIS 68 parametrization of the pion form factor.<sup>3</sup> The error combines statistical and systematic uncertainties. Supersedes BARATE 97M.<sup>4</sup> Assuming  $m_{\rho^+} = m_{\rho^-}$ ,  $\Gamma_{\rho^+} = \Gamma_{\rho^-}$ .<sup>5</sup>  $\rho(1700)$  mass and width fixed at 1700 MeV and 235 MeV respectively.<sup>6</sup> From the GOUNARIS 68 parametrization of the pion form factor. The second error is a model error taking into account different parametrizations of the pion form factor.<sup>7</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUB-NICKA 10 to analyze the data of FUJIKAWA 08.<sup>8</sup> Without limitations on masses and widths.<sup>9</sup> Using the data of BARATE 97M and the effective chiral Lagrangian.<sup>10</sup> Assuming  $m_{\rho^0} = m_{\rho^\pm}$ ,  $g_{\rho^0 \pi \pi} = g_{\rho^\pm \pi \pi}$ .

NODE=M009W5;LINKAGE=FU  
NODE=M009W5;LINKAGE=GO  
NODE=M009W5;LINKAGE=SC

NODE=M009W5;LINKAGE=CH  
NODE=M009W5;LINKAGE=A6  
NODE=M009W5;LINKAGE=K1

NODE=M009W5;LINKAGE=A

NODE=M009W5;LINKAGE=WO  
NODE=M009W5;LINKAGE=Z

NODE=M009W5;LINKAGE=HC

NODE=M009W7  
NODE=M009W7

NODE=M009W;LINKAGE=LB

NODE=M009W2  
NODE=M009W2

OCCUR=2

NODE=M009W2;LINKAGE=A

NODE=M009W0P  
NODE=M009W0P

NEW

**MIXED CHARGES, OTHER REACTIONS**

| VALUE (MeV)                       | EVTS | DOCUMENT ID            | TECN | CHG     | COMMENT                                       |
|-----------------------------------|------|------------------------|------|---------|-----------------------------------------------|
| <b>149.5 <math>\pm 1.3</math></b> | 600k | <sup>1</sup> ABELE 99E | CBAR | 0 $\pm$ | 0.0 $\bar{p} p \rightarrow \pi^+ \pi^- \pi^0$ |

<sup>1</sup> Assuming the equality of  $\rho^+$  and  $\rho^-$  masses and widths.**CHARGED ONLY, HADROPRODUCED**

| VALUE (MeV)                                   | EVTS         | DOCUMENT ID | TECN | CHG | COMMENT                                                 |
|-----------------------------------------------|--------------|-------------|------|-----|---------------------------------------------------------|
| <b>150.2 <math>\pm 2.4</math> OUR FIT</b>     |              |             |      |     |                                                         |
| <b>150.2 <math>\pm 2.4</math> OUR AVERAGE</b> |              |             |      |     |                                                         |
| 152.8 $\pm 4.3$                               |              | ABELE 97    | CBAR |     | $\bar{p} n \rightarrow \pi^- \pi^0 \pi^0$               |
| 155 $\pm 11$ 2.9k                             | <sup>1</sup> | CAPRARO 87  | SPEC | $-$ | 200 $\pi^- \text{Cu} \rightarrow \pi^- \pi^0 \text{Cu}$ |
| 154 $\pm 20$ 967                              | <sup>1</sup> | CAPRARO 87  | SPEC | $-$ | 200 $\pi^- \text{Pb} \rightarrow \pi^- \pi^0 \text{Pb}$ |
| 150 $\pm 5$                                   |              | HUSTON 86   | SPEC | $+$ | 202 $\pi^+ \text{A} \rightarrow \pi^+ \pi^0 \text{A}$   |
| 146 $\pm 12$ 6.5k                             | <sup>2</sup> | BYERLY 73   | OSPK | $-$ | 5 $\pi^- p$                                             |
| 148.2 $\pm 4.1$ 9.6k                          | <sup>3</sup> | PISUT 68    | RVUE | $-$ | 1.7–3.2 $\pi^- p$ , $t < 10$                            |
| 146 $\pm 13$ 900                              |              | EISNER 67   | HBC  | $-$ | 4.2 $\pi^- p$ , $t < 10$                                |

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

137.0  $\pm 0.4$  <sup>4</sup> ABLIKIM 17 BES3  $J/\psi \rightarrow \gamma 3\pi$ <sup>1</sup> Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.<sup>2</sup> Phase shift analysis. Systematic errors added corresponding to spread of different fits.<sup>3</sup> From fit of 3-parameter relativistic  $P$ -wave Breit-Wigner to total mass distribution. Includes BATON 68, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, BLIEDEN 65 and CARMONY 64.<sup>4</sup> S-matrix pole at a fixed  $\rho$  meson mass of 775.49 MeV.

NODE=M009W2;LINKAGE=Z  
NODE=M009W2;LINKAGE=X  
NODE=M009W2;LINKAGE=A1

**NEUTRAL ONLY, PHOTOPRODUCED**

| VALUE (MeV)                                          | EVTS         | DOCUMENT ID   | TECN | COMMENT                          |
|------------------------------------------------------|--------------|---------------|------|----------------------------------|
| <b>151.5 <math>^{+1.9}_{-2.1}</math> OUR AVERAGE</b> |              |               |      |                                  |
| [151.7 $\pm 2.6$ MeV OUR 2020 AVERAGE]               |              |               |      |                                  |
| 151.3 $\pm 2.2$ $^{+1.6}_{-2.8}$ 900k                |              | ANDREEV 20    | H1   | $ep \rightarrow e\pi^+ \pi^- p$  |
| 155 $\pm 5$ $\pm 2$ 63.5k                            | <sup>1</sup> | ABRAMOWICZ 12 | ZEUS | $ep \rightarrow e\pi^+ \pi^- p$  |
| 146 $\pm 3$ $\pm 13$ 79k                             | <sup>2</sup> | BREITWEG 98B  | ZEUS | 50–100 $\gamma p$                |
| 150.9 $\pm 3.0$                                      |              | BARTALUCCI 78 | CNTR | $\gamma p \rightarrow e^+ e^- p$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |      |                       |     |      |                                            |
|-------------|------|-----------------------|-----|------|--------------------------------------------|
| 138 ± 3     | 79k  | <sup>3</sup> BREITWEG | 98B | ZEUS | 50–100 $\gamma p$                          |
| 147 ± 11    |      | GLADDING              | 73  | CNTR | 2.9–4.7 $\gamma p$                         |
| 155 ± 12    | 2430 | BALLAM                | 72  | HBC  | 4.7 $\gamma p$                             |
| 145 ± 13    | 1930 | BALLAM                | 72  | HBC  | 2.8 $\gamma p$                             |
| 140 ± 5     |      | ALVENSLEB...          | 70  | CNTR | $\gamma A$ , $t < 0.01$                    |
| 146.1 ± 2.9 | 140k | BIGGS                 | 70  | CNTR | $< 4.1 \gamma C \rightarrow \pi^+ \pi^- C$ |
| 160 ± 10    |      | LANZEROTTI            | 68  | CNTR | $\gamma p$                                 |
| 130 ± 5     | 4000 | ASBURY                | 67B | CNTR | $\gamma + Pb$                              |

OCCUR=2

OCCUR=2

<sup>1</sup> Using the KUHN 90 parametrization of the pion form factor, neglecting  $\rho$ - $\omega$  interference.

<sup>2</sup> From the parametrization according to SOEDING 66.

<sup>3</sup> From the parametrization according to ROSS 66.

NODE=M009W0P;LINKAGE=AB

NODE=M009W;LINKAGE=B5

NODE=M009W;LINKAGE=B6

## NEUTRAL ONLY, OTHER REACTIONS

| VALUE (MeV)                    | EVTs | DOCUMENT ID                         | TECN | COMMENT                                            |
|--------------------------------|------|-------------------------------------|------|----------------------------------------------------|
| <b>150.9 ± 1.7 OUR AVERAGE</b> |      | Error includes scale factor of 1.1. |      |                                                    |
| 122 ± 20                       |      | BERTIN                              | 97C  | OBLX $0.0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0$ |
| 145.7 ± 5.3                    |      | WEIDENAUER                          | 93   | ASTE $\bar{p} p \rightarrow \pi^+ \pi^- \omega$    |
| 144.9 ± 3.7                    |      | DUBNICKA                            | 89   | RVUE $\pi$ form factor                             |
| 148 ± 6                        |      | <sup>1,2</sup> BOHACIK              | 80   | RVUE                                               |
| 152 ± 9                        |      | <sup>3</sup> WICKLUND               | 78   | ASPK $3,4,6 \pi^\pm p N$                           |
| 154 ± 2                        | 76k  | DEUTSCH...                          | 76   | HBC $16 \pi^+ p$                                   |
| 157 ± 8                        | 6.8k | <sup>4</sup> RATCLIFF               | 72   | ASPK $15 \pi^- p$ , $t < 0.3$                      |
| 143 ± 8                        | 1.7k | REYNOLDS                            | 69   | HBC $2.26 \pi^- p$                                 |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                      |       |                          |     |                                                    |
|----------------------|-------|--------------------------|-----|----------------------------------------------------|
| 150.85 ± 0.55 ± 0.67 | 970k  | <sup>5</sup> ABLIKIM     | 18C | BES3 $\eta'(958) \rightarrow \gamma \pi^+ \pi^-$   |
| 150.18 ± 0.55 ± 0.65 | 970k  | <sup>6</sup> ABLIKIM     | 18C | BES3 $\eta'(958) \rightarrow \gamma \pi^+ \pi^-$   |
| 147.0 ± 2.5          | 600k  | <sup>7</sup> ABELE       | 99E | CBAR $0.0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0$ |
| 146 ± 3              | 4.9k  | <sup>8</sup> ADAMS       | 97  | E665 $470 \mu p \rightarrow \mu X B$               |
| 160.0 + 4.1<br>- 4.0 |       | <sup>9</sup> CHABAUD     | 83  | ASPK $17 \pi^- p$ polarized                        |
| 155 ± 1              |       | <sup>10</sup> HEYN       | 81  | RVUE $\pi$ form factor                             |
| 148.0 ± 1.3          |       | <sup>1,2</sup> LANG      | 79  | RVUE                                               |
| 146 ± 14             | 4.1k  | ENGLER                   | 74  | DBC $6 \pi^+ n \rightarrow \pi^+ \pi^- p$          |
| 143 ± 13             |       | <sup>2</sup> ESTABROOKS  | 74  | RVUE $17 \pi^- p \rightarrow \pi^+ \pi^- n$        |
| 160 ± 10             | 32k   | <sup>1</sup> PROTOPOP... | 73  | HBC $7.1 \pi^+ p$ , $t < 0.4$                      |
| 145 ± 12             | 2.2k  | <sup>3,11</sup> HYAMS    | 68  | OSPK $11.2 \pi^- p$                                |
| 163 ± 15             | 13.3k | <sup>12</sup> PISUT      | 68  | RVUE $1.7-3.2 \pi^- p$ , $t < 10$                  |

OCCUR=2

<sup>1</sup> From pole extrapolation.

<sup>2</sup> From phase shift analysis of GRAYER 74 data.

<sup>3</sup> Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

<sup>4</sup> Published values contain misprints. Corrected by private communication RATCLIFF 74.

<sup>5</sup> From a fit to  $\pi^+ \pi^-$  mass using  $\rho(770)$  (parametrized with the Gounaris-Sakurai approach),  $\omega(782)$ , and box anomaly components.

<sup>6</sup> From a fit to  $\pi^+ \pi^-$  mass using  $\rho(770)$  (parametrized with the Gounaris-Sakurai approach),  $\omega(782)$ , and  $\rho(1450)$  components.

<sup>7</sup> Using relativistic Breit-Wigner and taking into account  $\rho$ - $\omega$  interference.

<sup>8</sup> Systematic errors not evaluated.

<sup>9</sup> From fit of 3-parameter relativistic Breit-Wigner to helicity-zero part of  $P$ -wave intensity. CHABAUD 83 includes data of GRAYER 74.

<sup>10</sup> HEYN 81 includes all spacelike and timelike  $F_\pi$  values until 1978.

<sup>11</sup> Of HYAMS 68 six parametrizations this is theoretically soundest. MR

<sup>12</sup> Includes MALAMUD 69, ARMENISE 68, BACON 67, HUWE 67, MILLER 67B, ALFF-STEINBERGER 66, HAGOPIAN 66, HAGOPIAN 66B, JACOBS 66B, JAMES 66, WEST 66, GOLDBERGER 64, ABOLINS 63.

NODE=M009W;LINKAGE=C

NODE=M009W;LINKAGE=H

NODE=M009W;LINKAGE=Z

NODE=M009W;LINKAGE=03

NODE=M009W0R;LINKAGE=B

NODE=M009W0R;LINKAGE=C

NODE=M009W;LINKAGE=BL

NODE=M009W;LINKAGE=A1

NODE=M009W;LINKAGE=G

NODE=M009W;LINKAGE=B

NODE=M009W;LINKAGE=02

NODE=M009W;LINKAGE=R

## $\Gamma_{\rho(770)^0} - \Gamma_{\rho(770)^\pm}$

| VALUE (MeV)                  | EVTs  | DOCUMENT ID                         | TECN | COMMENT                                                                         |
|------------------------------|-------|-------------------------------------|------|---------------------------------------------------------------------------------|
| <b>0.3 ± 1.3 OUR AVERAGE</b> |       | Error includes scale factor of 1.4. |      |                                                                                 |
| -0.2 ± 1.0                   |       | <sup>1</sup> SCHAEAL                | 05C  | ALEP $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$                                  |
| 3.6 ± 1.8 ± 1.7              | 1.98M | <sup>2</sup> ALOISIO                | 03   | KLOE $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                               |
| 4.66 ± 0.85                  |       | <sup>3</sup> BARTOS                 | 17A  | RVUE $e^+ e^- \rightarrow \pi^+ \pi^-, \tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

NODE=M009W6

NODE=M009W6

<sup>1</sup> From the combined fit of the  $\tau^-$  data from ANDERSON 00A and SCHAELE 05C and  $e^+e^-$  data from the compilation of BARKOV 85, AKHMETSHIN 04, and ALOISIO 05. Supersedes BARATE 97M.

<sup>2</sup> Assuming  $m_{\rho^+} = m_{\rho^-}$ ,  $\Gamma_{\rho^+} = \Gamma_{\rho^-}$ .

<sup>3</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, AMBROSINO 11A, and FUJIKAWA 08.

$$\Gamma_{\rho(770)^+} = \Gamma_{\rho(770)^-}$$

| VALUE              | EVTS  | DOCUMENT ID          | TECN    | COMMENT                                   |
|--------------------|-------|----------------------|---------|-------------------------------------------|
| <b>1.8±2.0±0.5</b> | 1.98M | <sup>1</sup> ALOISIO | 03 KLOE | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |

<sup>1</sup> Without limitations on masses and widths.

NODE=M009W6;LINKAGE=SC

NODE=M009W6;LINKAGE=CH  
NODE=M009W6;LINKAGE=A

NODE=M009W16  
NODE=M009W16

NODE=M009W16;LINKAGE=WO

NODE=M009225;NODE=M009

DESIG=1;OUR EVAL;→ UNCHECKED ←  
DESIG=81

NODE=M009;CLUMP=A  
DESIG=11;OUR EVAL;→ UNCHECKED ←  
DESIG=3  
DESIG=5  
DESIG=21

NODE=M009;CLUMP=B  
DESIG=12;OUR EVAL;→ UNCHECKED ←  
DESIG=60  
DESIG=40  
DESIG=8  
DESIG=80  
DESIG=6  
DESIG=4  
DESIG=7;OUR EVAL;→ UNCHECKED ←  
DESIG=22  
DESIG=30  
DESIG=9  
DESIG=10

LINKAGE=MD2

### $\rho(770)$ DECAY MODES

| Mode                                     | Fraction ( $\Gamma_i/\Gamma$ )                   | Scale factor/<br>Confidence level |
|------------------------------------------|--------------------------------------------------|-----------------------------------|
| $\Gamma_1 \quad \pi\pi$                  | $\sim 100$                                       | %                                 |
| $\Gamma_2 \quad K\bar{K}$                |                                                  |                                   |
| <b><math>\rho(770)^\pm</math> decays</b> |                                                  |                                   |
| $\Gamma_3 \quad \pi^\pm\pi^0$            | $\sim 100$                                       | %                                 |
| $\Gamma_4 \quad \pi^\pm\gamma$           | $(4.5 \pm 0.5) \times 10^{-4}$                   | S=2.2                             |
| $\Gamma_5 \quad \pi^\pm\eta$             | $< 6 \times 10^{-3}$                             | CL=84%                            |
| $\Gamma_6 \quad \pi^\pm\pi^+\pi^-\pi^0$  | $< 2.0 \times 10^{-3}$                           | CL=84%                            |
| <b><math>\rho(770)^0</math> decays</b>   |                                                  |                                   |
| $\Gamma_7 \quad \pi^+\pi^-$              | $\sim 100$                                       | %                                 |
| $\Gamma_8 \quad \pi^+\pi^-\gamma$        | $(9.9 \pm 1.6) \times 10^{-3}$                   |                                   |
| $\Gamma_9 \quad \pi^0\gamma$             | $(4.7 \pm 0.8) \times 10^{-4}$                   | S=1.7                             |
| $\Gamma_{10} \quad \eta\gamma$           | $(3.00 \pm 0.21) \times 10^{-4}$                 |                                   |
| $\Gamma_{11} \quad \pi^0\pi^0\gamma$     | $(4.5 \pm 0.8) \times 10^{-5}$                   |                                   |
| $\Gamma_{12} \quad \mu^+\mu^-$           | [a] $(4.55 \pm 0.28) \times 10^{-5}$             |                                   |
| $\Gamma_{13} \quad e^+e^-$               | [a] $(4.72 \pm 0.05) \times 10^{-5}$             |                                   |
| $\Gamma_{14} \quad \pi^+\pi^-\pi^0$      | $(1.01^{+0.54}_{-0.36} \pm 0.34) \times 10^{-4}$ |                                   |
| $\Gamma_{15} \quad \pi^+\pi^-\pi^+\pi^-$ | $(1.8 \pm 0.9) \times 10^{-5}$                   |                                   |
| $\Gamma_{16} \quad \pi^+\pi^-\pi^0\pi^0$ | $(1.6 \pm 0.8) \times 10^{-5}$                   |                                   |
| $\Gamma_{17} \quad \pi^0e^+e^-$          | $< 1.2 \times 10^{-5}$                           | CL=90%                            |
| $\Gamma_{18} \quad \eta e^+e^-$          |                                                  |                                   |

[a] The  $\omega\rho$  interference is then due to  $\omega\rho$  mixing only, and is expected to be small. If  $e\mu$  universality holds,  $\Gamma(\rho^0 \rightarrow \mu^+\mu^-) = \Gamma(\rho^0 \rightarrow e^+e^-) \times 0.99785$ .

### CONSTRAINED FIT INFORMATION

An overall fit to the total width and a partial width uses 10 measurements and one constraint to determine 3 parameters. The overall fit has a  $\chi^2 = 10.7$  for 8 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |        |
|----------|--------|
| $x_4$    | -100   |
| $\Gamma$ | 15 -15 |
| $x_3$    | $x_4$  |

| Mode                           | Rate (MeV)    | Scale factor |
|--------------------------------|---------------|--------------|
| $\Gamma_3 \quad \pi^\pm\pi^0$  | 150.2 ± 2.4   |              |
| $\Gamma_4 \quad \pi^\pm\gamma$ | 0.068 ± 0.007 | 2.3          |

DESIG=11  
DESIG=3



## CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, and 7 branching ratios uses 21 measurements and one constraint to determine 9 parameters. The overall fit has a  $\chi^2 = 9.5$  for 13 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |       |          |          |          |          |          |
|----------|-------|-------|-------|----------|----------|----------|----------|----------|
| $x_8$    | -100  |       |       |          |          |          |          |          |
| $x_9$    | -5    | 0     |       |          |          |          |          |          |
| $x_{10}$ | -1    | 0     | 1     |          |          |          |          |          |
| $x_{11}$ | -1    | 0     | 0     | 0        |          |          |          |          |
| $x_{12}$ | 2     | -3    | 0     | 0        | 0        |          |          |          |
| $x_{13}$ | 0     | 0     | -6    | -9       | 0        | 0        |          |          |
| $x_{15}$ | -1    | 0     | 0     | 0        | 0        | 0        | 0        |          |
| $\Gamma$ | 0     | 0     | 3     | 5        | 0        | 0        | -54      | 0        |
|          | $x_7$ | $x_8$ | $x_9$ | $x_{10}$ | $x_{11}$ | $x_{12}$ | $x_{13}$ | $x_{15}$ |

| Mode                                    | Rate (MeV)                | Scale factor |
|-----------------------------------------|---------------------------|--------------|
| $\Gamma_7$ $\pi^+ \pi^-$                | 147.5 $\pm$ 0.9           |              |
| $\Gamma_8$ $\pi^+ \pi^- \gamma$         | 1.48 $\pm$ 0.24           |              |
| $\Gamma_9$ $\pi^0 \gamma$               | 0.070 $\pm$ 0.012         | 1.7          |
| $\Gamma_{10}$ $\eta \gamma$             | 0.0447 $\pm$ 0.0032       |              |
| $\Gamma_{11}$ $\pi^0 \pi^0 \gamma$      | 0.0066 $\pm$ 0.0012       |              |
| $\Gamma_{12}$ $\mu^+ \mu^-$             | [a] 0.0068 $\pm$ 0.0004   |              |
| $\Gamma_{13}$ $e^+ e^-$                 | [a] 0.00704 $\pm$ 0.00006 |              |
| $\Gamma_{15}$ $\pi^+ \pi^- \pi^+ \pi^-$ | 0.0027 $\pm$ 0.0014       |              |

DESIG=12

DESIG=60

DESIG=40

DESIG=8

DESIG=80

DESIG=6

DESIG=4

DESIG=22

## $\rho(770)$ PARTIAL WIDTHS

NODE=M009230

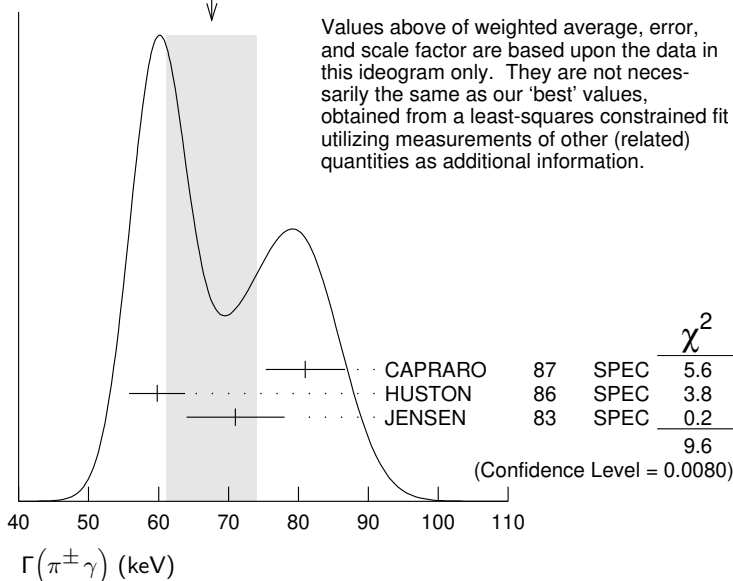
 $\Gamma(\pi^\pm \gamma)$  $\Gamma_4$ 

| VALUE (keV)                              | DOCUMENT ID                                                 | TECN | CHG  | COMMENT                                       |
|------------------------------------------|-------------------------------------------------------------|------|------|-----------------------------------------------|
| <b>68 <math>\pm</math> 7 OUR FIT</b>     | Error includes scale factor of 2.3.                         |      |      |                                               |
| <b>68 <math>\pm</math> 7 OUR AVERAGE</b> | Error includes scale factor of 2.2. See the ideogram below. |      |      |                                               |
| 81 $\pm$ 4 $\pm$ 4                       | CAPRARO                                                     | 87   | SPEC | - 200 $\pi^- A \rightarrow \pi^- \pi^0 A$     |
| 59.8 $\pm$ 4.0                           | HUSTON                                                      | 86   | SPEC | + 202 $\pi^+ A \rightarrow \pi^+ \pi^0 A$     |
| 71 $\pm$ 7                               | JENSEN                                                      | 83   | SPEC | - 156-260 $\pi^- A \rightarrow \pi^- \pi^0 A$ |

NODE=M009W3

NODE=M009W3

WEIGHTED AVERAGE  
68 $\pm$ 7 (Error scaled by 2.2)



$\Gamma(\pi^0\gamma)$  $\Gamma_9$ 

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                    |       |                      |    |     |                                            |
|--------------------|-------|----------------------|----|-----|--------------------------------------------|
| $77 \pm 17 \pm 11$ | 36500 | <sup>1</sup> ACHASOV | 03 | SND | $0.60-0.97 e^+e^- \rightarrow \pi^0\gamma$ |
| $121 \pm 31$       |       | DOLINSKY             | 89 | ND  | $e^+e^- \rightarrow \pi^0\gamma$           |

<sup>1</sup> Using  $\Gamma_{\text{total}} = 147.9 \pm 1.3$  MeV and  $B(\rho \rightarrow \pi^0\gamma)$  from ACHASOV 03.

NODE=M009W31  
NODE=M009W31

NODE=M009W31;LINKAGE=AV

 $\Gamma(\eta\gamma)$  $\Gamma_{10}$ 

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |                       |    |    |                                 |
|-------------|-----------------------|----|----|---------------------------------|
| $62 \pm 17$ | <sup>1</sup> DOLINSKY | 89 | ND | $e^+e^- \rightarrow \eta\gamma$ |
|-------------|-----------------------|----|----|---------------------------------|

<sup>1</sup> Solution corresponding to constructive  $\omega$ - $\rho$  interference.

NODE=M009W32  
NODE=M009W32

NODE=M009W32;LINKAGE=L

 $\Gamma(e^+e^-)$  $\Gamma_{13}$ 

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**7.04  $\pm$  0.06 OUR FIT**

**7.04  $\pm$  0.06 OUR AVERAGE**

|                             |      |                           |    |      |                                 |
|-----------------------------|------|---------------------------|----|------|---------------------------------|
| $7.048 \pm 0.057 \pm 0.050$ | 900k | <sup>1</sup> AKHMETSHIN   | 07 |      | $e^+e^- \rightarrow \pi^+\pi^-$ |
| $7.06 \pm 0.11 \pm 0.05$    | 114k | <sup>2,3</sup> AKHMETSHIN | 04 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-$ |
| $6.77 \pm 0.10 \pm 0.30$    |      | BARKOV                    | 85 | OLYA | $e^+e^- \rightarrow \pi^+\pi^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |      |                       |    |      |                                             |
|--------------------------|------|-----------------------|----|------|---------------------------------------------|
| $7.12 \pm 0.02 \pm 0.11$ | 800k | <sup>4</sup> ACHASOV  | 06 | SND  | $e^+e^- \rightarrow \pi^+\pi^-$             |
| $6.3 \pm 0.1$            |      | <sup>5</sup> BENAYOUN | 98 | RVUE | $e^+e^- \rightarrow \pi^+\pi^-, \mu^+\mu^-$ |

<sup>1</sup> A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.

<sup>2</sup> Using the GOUNARIS 68 parametrization with the complex phase of the  $\rho$ - $\omega$  interference.

<sup>3</sup> From a fit in the energy range 0.61 to 0.96 GeV. Update of AKHMETSHIN 02.

<sup>4</sup> Supersedes ACHASOV 05A.

<sup>5</sup> Using the data of BARKOV 85 in the hidden local symmetry model.

NODE=M009W4  
NODE=M009W4

OCCUR=2

NODE=M009W4;LINKAGE=AK  
NODE=M009W4;LINKAGE=GS  
NODE=M009W4;LINKAGE=P2  
NODE=M009W4;LINKAGE=AC  
NODE=M009W4;LINKAGE=K2

 $\Gamma(\pi^+\pi^-\pi^+\pi^-)$  $\Gamma_{15}$ 

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |     |            |    |      |                                                    |
|-----------------------|-----|------------|----|------|----------------------------------------------------|
| $2.8 \pm 1.4 \pm 0.5$ | 153 | AKHMETSHIN | 00 | CMD2 | $0.6-0.97 e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$ |
|-----------------------|-----|------------|----|------|----------------------------------------------------|

NODE=M009W33  
NODE=M009W33

 $\rho(770) \Gamma(e^+e^-) \Gamma(i) / \Gamma^2(\text{total})$ 

NODE=M009233

 $\Gamma(e^+e^-) / \Gamma_{\text{total}} \times \Gamma(\pi^+\pi^-) / \Gamma_{\text{total}}$  $\Gamma_{13} / \Gamma \times \Gamma_7 / \Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**4.89  $\pm$  0.04 OUR AVERAGE**

[(4.88  $\pm$  0.07)  $\times 10^{-5}$  OUR 2020 AVERAGE]

|                             |      |                        |    |     |                                 |
|-----------------------------|------|------------------------|----|-----|---------------------------------|
| $4.889 \pm 0.015 \pm 0.039$ |      | <sup>1</sup> ACHASOV   | 21 | SND | $e^+e^- \rightarrow \pi^+\pi^-$ |
| $4.876 \pm 0.023 \pm 0.064$ | 800k | <sup>2,3</sup> ACHASOV | 06 | SND | $e^+e^- \rightarrow \pi^+\pi^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |  |                       |    |      |                   |
|-----------------|--|-----------------------|----|------|-------------------|
| $4.72 \pm 0.02$ |  | <sup>4</sup> BENAYOUN | 10 | RVUE | $0.4-1.05 e^+e^-$ |
|-----------------|--|-----------------------|----|------|-------------------|

<sup>1</sup> From a fit of the cross section in the energy range  $0.525 < \sqrt{s} < 0.883$  GeV parameterized by the sum of the Breit-Wigner amplitudes for the  $\rho(770)$ ,  $\omega$  and  $\rho(1450)$  resonances.

<sup>2</sup> Supersedes ACHASOV 05A.

<sup>3</sup> A fit of the SND data from 400 to 1000 MeV using parameters of the  $\rho(1450)$  and  $\rho(1700)$  from a fit of the data of BARKOV 85, BISELLO 89 and ANDERSON 00A.

<sup>4</sup> A simultaneous fit of  $e^+e^- \rightarrow \pi^+\pi^-, \pi^+\pi^-\pi^0, \pi^0\gamma, \eta\gamma$  data.

NODE=M009G4;LINKAGE=A

NODE=M009G4;LINKAGE=AC  
NODE=M009G4;LINKAGE=SN

NODE=M009G4;LINKAGE=BE

 $\Gamma(e^+e^-) / \Gamma_{\text{total}} \times \Gamma(\eta\gamma) / \Gamma_{\text{total}}$  $\Gamma_{13} / \Gamma \times \Gamma_{10} / \Gamma$ 

| VALUE (units $10^{-8}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**1.42  $\pm$  0.10 OUR FIT**

**1.45  $\pm$  0.12 OUR AVERAGE**

|                          |       |                           |     |      |                                           |
|--------------------------|-------|---------------------------|-----|------|-------------------------------------------|
| $1.32 \pm 0.14 \pm 0.08$ | 33k   | <sup>1</sup> ACHASOV      | 07B | SND  | $0.6-1.38 e^+e^- \rightarrow \eta\gamma$  |
| $1.50 \pm 0.65 \pm 0.09$ | 17.4k | <sup>2</sup> AKHMETSHIN   | 05  | CMD2 | $0.60-1.38 e^+e^- \rightarrow \eta\gamma$ |
| $1.61 \pm 0.20 \pm 0.11$ | 23k   | <sup>3,4</sup> AKHMETSHIN | 01B | CMD2 | $e^+e^- \rightarrow \eta\gamma$           |
| $1.85 \pm 0.49$          |       | <sup>5</sup> DOLINSKY     | 89  | ND   | $e^+e^- \rightarrow \eta\gamma$           |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |  |                       |    |      |                   |
|-----------------|--|-----------------------|----|------|-------------------|
| $1.05 \pm 0.02$ |  | <sup>6</sup> BENAYOUN | 10 | RVUE | $0.4-1.05 e^+e^-$ |
|-----------------|--|-----------------------|----|------|-------------------|

NODE=M009G1  
NODE=M009G1

- <sup>1</sup> From a combined fit of  $\sigma(e^+e^- \rightarrow \eta\gamma)$  with  $\eta \rightarrow 3\pi^0$  and  $\eta \rightarrow \pi^+\pi^-\pi^0$ , and fixing  $B(\eta \rightarrow 3\pi^0) / B(\eta \rightarrow \pi^+\pi^-\pi^0) = 1.44 \pm 0.04$ . Recalculated by us from the cross section at the peak. Supersedes ACHASOV 00D and ACHASOV 06A.
- <sup>2</sup> From the  $\eta \rightarrow 2\gamma$  decay and using  $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$ .
- <sup>3</sup> From the  $\eta \rightarrow 3\pi^0$  decay and using  $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$ .
- <sup>4</sup> The combined fit from 600 to 1380 MeV taking into account  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$ , and  $\rho(1450)$  (mass and width fixed at 1450 MeV and 310 MeV respectively).
- <sup>5</sup> Recalculated by us from the cross section in the peak.
- <sup>6</sup> A simultaneous fit of  $e^+e^- \rightarrow \pi^+\pi^-$ ,  $\pi^+\pi^-\pi^0$ ,  $\pi^0\gamma$ ,  $\eta\gamma$  data.

NODE=M009G1;LINKAGE=AH

NODE=M009G;LINKAGE=AH

NODE=M009G;LINKAGE=AK

NODE=M009G;LINKAGE=BQ

NODE=M009G;LINKAGE=LP

NODE=M009G1;LINKAGE=BE

$\Gamma(e^+e^-)/\Gamma_{\text{total}} \times \Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$   $\Gamma_{13}/\Gamma \times \Gamma_9/\Gamma$

VALUE (units  $10^{-8}$ ) EVTS DOCUMENT ID TECN COMMENT

**2.2  $\pm 0.4$  OUR FIT** Error includes scale factor of 1.7.  $[(2.22 \pm 0.29) \times 10^{-8}$  OUR 2020 FIT Scale factor = 1.4]

**2.21  $\pm 0.34$  OUR AVERAGE** Error includes scale factor of 1.6. See the ideogram below.  $[(2.22 \pm 0.26) \times 10^{-8}$  OUR 2020 AVERAGE Scale factor = 1.3]

1.98  $\pm 0.22 \pm 0.10$  <sup>1</sup> ACHASOV 16A SND 0.60-1.38  $e^+e^- \rightarrow \pi^0\gamma$

2.90  $^{+0.60}_{-0.55} \pm 0.18$  18k AKHMETSHIN 05 CMD2 0.60-1.38  $e^+e^- \rightarrow \pi^0\gamma$

3.61  $\pm 0.74 \pm 0.49$  10k <sup>2</sup> DOLINSKY 89 ND  $e^+e^- \rightarrow \pi^0\gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.875  $\pm 0.026$  <sup>3</sup> BENAYOUN 10 RVUE 0.4-1.05  $e^+e^-$

2.37  $\pm 0.53 \pm 0.33$  36k <sup>4</sup> ACHASOV 03 SND 0.60-0.97  $e^+e^- \rightarrow \pi^0\gamma$

- <sup>1</sup> From the VMD model with the  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$  resonances, and an additional resonance describing the total contribution of the  $\rho(1450)$  and  $\omega(1420)$  states. Supersedes ACHASOV 03.

<sup>2</sup> Recalculated by us from the cross section in the peak.

<sup>3</sup> A simultaneous fit of  $e^+e^- \rightarrow \pi^+\pi^-$ ,  $\pi^+\pi^-\pi^0$ ,  $\pi^0\gamma$ ,  $\eta\gamma$  data.

<sup>4</sup> Using  $\sigma_{\phi \rightarrow \pi^0\gamma}$  from ACHASOV 00 and  $m_{\rho} = 775.97$  MeV in the model with the energy-independent phase of  $\rho$ - $\omega$  interference equal to  $(-10.2 \pm 7.0)^\circ$ .

NODE=M009G2

NODE=M009G2

NEW

NEW

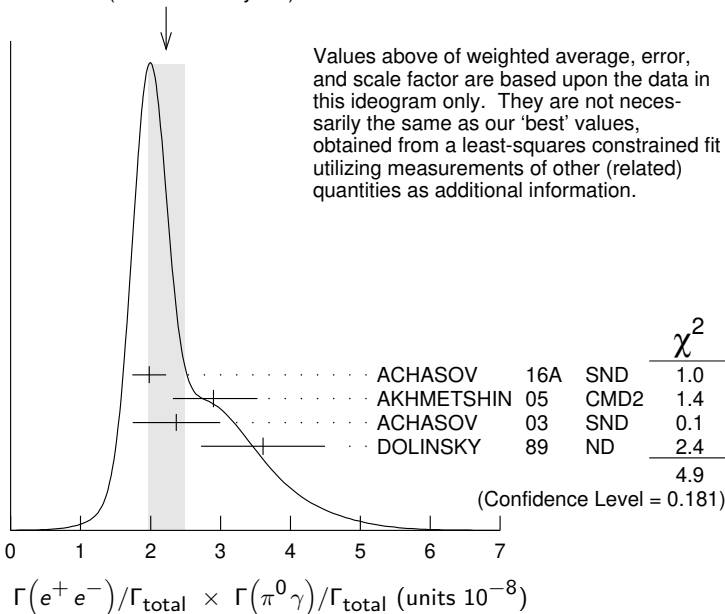
NODE=M009G2;LINKAGE=B

NODE=M009G2;LINKAGE=LP

NODE=M009G2;LINKAGE=BE

NODE=M009G;LINKAGE=SH

WEIGHTED AVERAGE  
2.22 $\pm 0.26$  (Error scaled by 1.3)



$\Gamma(e^+e^-)/\Gamma_{\text{total}} \times \Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{13}/\Gamma \times \Gamma_{14}/\Gamma$

VALUE (units  $10^{-9}$ ) EVTS DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.903  $\pm 0.076$  <sup>1</sup> BENAYOUN 10 RVUE 0.4-1.05  $e^+e^-$

4.58  $^{+2.46}_{-1.64} \pm 1.56$  1.2M <sup>2</sup> ACHASOV 03D RVUE 0.44-2.00  $e^+e^- \rightarrow \pi^+\pi^-\pi^0$

<sup>1</sup> A simultaneous fit of  $e^+e^- \rightarrow \pi^+\pi^-$ ,  $\pi^+\pi^-\pi^0$ ,  $\pi^0\gamma$ ,  $\eta\gamma$  data.

<sup>2</sup> Statistical significance is less than  $3\sigma$ .

NODE=M009G3

NODE=M009G3

NODE=M009G3;LINKAGE=BE

NODE=M009G3;LINKAGE=AC

## $\rho(770)$ BRANCHING RATIOS

NODE=M009235

$\Gamma(\pi^\pm\eta)/\Gamma(\pi\pi)$  $\Gamma_5/\Gamma_1$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | CHG | COMMENT                     |
|--------------------------|-----|-------------|------|-----|-----------------------------|
| <60                      | 84  | FERBEL      | 66   | HBC | $\pm$ $\pi^\pm p$ above 2.5 |

NODE=M009R4  
 NODE=M009R4

 $\Gamma(\pi^\pm\pi^+\pi^-\pi^0)/\Gamma(\pi\pi)$  $\Gamma_6/\Gamma_1$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | CHG | COMMENT                     |
|--------------------------|-----|-------------|------|-----|-----------------------------|
| <20                      | 84  | FERBEL      | 66   | HBC | $\pm$ $\pi^\pm p$ above 2.5 |

NODE=M009R1  
 NODE=M009R1

• • • We do not use the following data for averages, fits, limits, etc. • • •

35  $\pm$  40 JAMES 66 HBC + 2.1  $\pi^+ p$

 $\Gamma(\pi^+\pi^-\gamma)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE                                         | CL% | DOCUMENT ID                                                                   | TECN | COMMENT                                  |
|-----------------------------------------------|-----|-------------------------------------------------------------------------------|------|------------------------------------------|
| <b>0.0099 <math>\pm</math> 0.0016 OUR FIT</b> |     |                                                                               |      |                                          |
| <b>0.0099 <math>\pm</math> 0.0016</b>         |     | <sup>1</sup> DOLINSKY                                                         | 91   | ND $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
|                                               |     | • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                          |
| 0.0111 $\pm$ 0.0014                           |     | <sup>2</sup> VASSERMAN                                                        | 88   | ND $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| <0.005                                        | 90  | <sup>3</sup> VASSERMAN                                                        | 88   | ND $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |

NODE=M009R12  
 NODE=M009R12

<sup>1</sup> Bremsstrahlung from a decay pion and for photon energy above 50 MeV.

<sup>2</sup> Superseded by DOLINSKY 91.

<sup>3</sup> Structure radiation due to quark rearrangement in the decay.

OCCUR=2

NODE=M009R12;LINKAGE=J  
 NODE=M009R12;LINKAGE=I  
 NODE=M009R12;LINKAGE=N

 $\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | EVTS | DOCUMENT ID               | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|------|---------------------------|------|-------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                           |      |                                                 |
| 4.20 $\pm$ 0.52                                                               |      | <sup>1</sup> ACHASOV      | 16A  | SND 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$  |
| 6.21 $^{+1.28}_{-1.18} \pm 0.39$                                              | 18k  | <sup>2,3</sup> AKHMETSHIN | 05   | CMD2 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| 5.22 $\pm$ 1.17 $\pm$ 0.75                                                    | 36k  | <sup>3,4</sup> ACHASOV    | 03   | SND 0.60–0.97 $e^+e^- \rightarrow \pi^0\gamma$  |
| 6.8 $\pm$ 1.7                                                                 |      | <sup>5</sup> BENAYOUN     | 96   | RVUE 0.54–1.04 $e^+e^- \rightarrow \pi^0\gamma$ |
| 7.9 $\pm$ 2.0                                                                 |      | <sup>3</sup> DOLINSKY     | 89   | ND $e^+e^- \rightarrow \pi^0\gamma$             |

<sup>1</sup> Using  $B(\rho \rightarrow e^+e^-)$  from PDG 15. Supersedes ACHASOV 03.

<sup>2</sup> Using  $B(\rho \rightarrow e^+e^-) = (4.67 \pm 0.09) \times 10^{-5}$ .

<sup>3</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\pi^0\gamma)/\Gamma_{\text{total}}^2$ .

<sup>4</sup> Using  $B(\rho \rightarrow e^+e^-) = (4.54 \pm 0.10) \times 10^{-5}$ .

<sup>5</sup> Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution.

NODE=M009R9  
 NODE=M009R9

NODE=M009R9;LINKAGE=C  
 NODE=M009R9;LINKAGE=AK  
 NODE=M009R9;LINKAGE=BZ  
 NODE=M009R9;LINKAGE=AS  
 NODE=M009R9;LINKAGE=A

 $\Gamma(\eta\gamma)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | EVTS  | DOCUMENT ID                 | TECN | CHG    | COMMENT                                   |
|-------------------------------------------------------------------------------|-------|-----------------------------|------|--------|-------------------------------------------|
| <b>3.00 <math>\pm</math> 0.21 OUR FIT</b>                                     |       |                             |      |        |                                           |
| <b>2.90 <math>\pm</math> 0.32 OUR AVERAGE</b>                                 |       |                             |      |        |                                           |
| 2.79 $\pm$ 0.34 $\pm$ 0.03                                                    | 33k   | <sup>1</sup> ACHASOV        | 07B  | SND    | 0.6–1.38 $e^+e^- \rightarrow \eta\gamma$  |
| 3.6 $\pm$ 0.9                                                                 |       | <sup>2</sup> ANDREWS        | 77   | CNTR 0 | 6.7–10 $\gamma$ Cu                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                             |      |        |                                           |
| 3.21 $\pm$ 1.39 $\pm$ 0.20                                                    | 17.4k | <sup>3,4</sup> AKHMETSHIN   | 05   | CMD2   | 0.60–1.38 $e^+e^- \rightarrow \eta\gamma$ |
| 3.39 $\pm$ 0.42 $\pm$ 0.23                                                    |       | <sup>2,5,6</sup> AKHMETSHIN | 01B  | CMD2   | $e^+e^- \rightarrow \eta\gamma$           |
| 1.9 $^{+0.6}_{-0.8}$                                                          |       | <sup>7</sup> BENAYOUN       | 96   | RVUE   | 0.54–1.04 $e^+e^- \rightarrow \eta\gamma$ |
| 4.0 $\pm$ 1.1                                                                 |       | <sup>2,4</sup> DOLINSKY     | 89   | ND     | $e^+e^- \rightarrow \eta\gamma$           |

<sup>1</sup> ACHASOV 07B reports  $[\Gamma(\rho(770) \rightarrow \eta\gamma)/\Gamma_{\text{total}}] \times [B(\rho(770) \rightarrow e^+e^-)] = (1.32 \pm 0.14 \pm 0.08) \times 10^{-8}$  which we divide by our best value  $B(\rho(770) \rightarrow e^+e^-) = (4.72 \pm 0.05) \times 10^{-5}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. Supersedes ACHASOV 00D and ACHASOV 06A.

<sup>2</sup> Solution corresponding to constructive  $\omega$ - $\rho$  interference.

<sup>3</sup> Using  $B(\rho \rightarrow e^+e^-) = (4.67 \pm 0.09) \times 10^{-5}$  and  $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$ .

<sup>4</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\eta\gamma)/\Gamma_{\text{total}}^2$ .

<sup>5</sup> The combined fit from 600 to 1380 MeV taking into account  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$ , and  $\rho(1450)$  (mass and width fixed at 1450 MeV and 310 MeV respectively).

<sup>6</sup> Using  $B(\rho \rightarrow e^+e^-) = (4.75 \pm 0.10) \times 10^{-5}$  from AKHMETSHIN 02 and  $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$ .

<sup>7</sup> Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution. Constructive  $\rho$ - $\omega$  interference solution.

NODE=M009R7  
 NODE=M009R7

NODE=M009R7;LINKAGE=AO

NODE=M009R7;LINKAGE=A  
 NODE=M009R;LINKAGE=AK  
 NODE=M009R7;LINKAGE=AZ  
 NODE=M009R;LINKAGE=BQ

NODE=M009R;LINKAGE=BX

NODE=M009R7;LINKAGE=C

$\Gamma(\pi^0\pi^0\gamma)/\Gamma_{\text{total}}$ VALUE (units  $10^{-5}$ ) EVTS

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{11}/\Gamma$ NODE=M009R14  
NODE=M009R14**4.5±0.8 OUR FIT****4.5<sup>+0.9</sup><sub>-0.8</sub> OUR AVERAGE**5.2<sup>+1.5</sup><sub>-1.3</sub>±0.6 190 <sup>1</sup> AKHMETSHIN 04B CMD2 0.6–0.97  $e^+e^- \rightarrow \pi^0\pi^0\gamma$ 

OCCUR=2

4.1<sup>+1.0</sup><sub>-0.9</sub>±0.3 295 <sup>2</sup> ACHASOV 02F SND 0.36–0.97  $e^+e^- \rightarrow \pi^0\pi^0\gamma$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

4.8<sup>+3.4</sup><sub>-1.8</sub>±0.5 63 <sup>3</sup> ACHASOV 00G SND  $e^+e^- \rightarrow \pi^0\pi^0\gamma$ <sup>1</sup> This branching ratio includes the conventional VMD mechanism  $\rho \rightarrow \omega\pi^0$ ,  $\omega \rightarrow \pi^0\gamma$ , and the new decay mode  $\rho \rightarrow f_0(500)\gamma$ ,  $f_0(500) \rightarrow \pi^0\pi^0$  with a branching ratio  $(2.0^{+1.1}_{-0.9} \pm 0.3) \times 10^{-5}$  differing from zero by 2.0 standard deviations.

NODE=M009R14;LINKAGE=AH

<sup>2</sup> This branching ratio includes the conventional VMD mechanism  $\rho \rightarrow \omega\pi^0$ ,  $\omega \rightarrow \pi^0\gamma$  and the new decay mode  $\rho \rightarrow f_0(500)\gamma$ ,  $f_0(500) \rightarrow \pi^0\pi^0$  with a branching ratio  $(1.9^{+0.9}_{-0.8} \pm 0.4) \times 10^{-5}$  differing from zero by 2.4 standard deviations. Supersedes ACHASOV 00G.

NODE=M009R;LINKAGE=FF

<sup>3</sup> Superseded by ACHASOV 02F.

NODE=M009R;LINKAGE=GF

 $\Gamma(\mu^+\mu^-)/\Gamma(\pi^+\pi^-)$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{12}/\Gamma_7$ NODE=M009R5  
NODE=M009R5**4.60±0.28 OUR FIT****4.6 ±0.2 ±0.2**

ANTIPOV

89

SIGM

 $\pi^- \text{Cu} \rightarrow \mu^+\mu^-\pi^-\text{Cu}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

8.2<sup>+1.6</sup><sub>-3.6</sub> <sup>1</sup> ROTHWELL 69 CNTR Photoproduction5.6 ±1.5 <sup>2</sup> WEHMANN 69 OSPK 12  $\pi^- \text{C, Fe}$ 9.7<sup>+3.1</sup><sub>-3.3</sub> <sup>3,4</sup> HYAMS 67 OSPK 11  $\pi^- \text{Li, H}$ <sup>1</sup> Possibly large  $\rho$ - $\omega$  interference leads us to increase the minus error.NODE=M009R5;LINKAGE=R  
NODE=M009R5;LINKAGE=W<sup>2</sup> Result contains  $11 \pm 11\%$  correction using SU(3) for central value. The error on the correction takes account of possible  $\rho$ - $\omega$  interference and the upper limit agrees with the upper limit of  $\omega \rightarrow \mu^+\mu^-$  from this experiment.<sup>3</sup> But he even enlarges his error to take residual  $\omega$  contamination into account. Since his value is high, seems the other experiments also can't have too many  $\omega$ 's. But maybe Hyams has additional  $\mu$ 's from  $\rho \rightarrow \pi\pi$ , decaying  $\pi$ 's.

NODE=M009R5;LINKAGE=01

<sup>4</sup> HYAMS 67's mass resolution is 20 MeV. The  $\omega$  region was excluded.

NODE=M009R5;LINKAGE=H

 $\Gamma(e^+e^-)/\Gamma(\pi\pi)$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{13}/\Gamma_1$ NODE=M009R3  
NODE=M009R3

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.40±0.05 <sup>1,2</sup> BENAKSAS 72 OSPK  $e^+e^- \rightarrow \pi^+\pi^-$ <sup>1</sup> The  $\rho'$  contribution is not taken into account.NODE=M009R;LINKAGE=KS  
NODE=M009R3;LINKAGE=01<sup>2</sup> Barkov excludes Auslender and Benaksas for large statistical and systematic errors. $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )

CL%

EVTS

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{14}/\Gamma$ NODE=M009R10  
NODE=M009R10

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.01<sup>+0.54</sup><sub>-0.36</sub>±0.34 1.2M <sup>1</sup> ACHASOV 03D RVUE 0.44–2.00  $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ <1.2 90 VASSERMAN 88B ND  $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ <sup>1</sup> Statistical significance is less than  $3\sigma$ .

NODE=M009R;LINKAGE=NS

 $\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi\pi)$ 

VALUE

CL%

DOCUMENT ID

TECN

CHG

COMMENT

 $\Gamma_{14}/\Gamma_1$ NODE=M009R6  
NODE=M009R6

• • • We do not use the following data for averages, fits, limits, etc. • • •

~0.01 BRAMON 86 RVUE 0  $J/\psi \rightarrow \omega\pi^0$ <0.01 84 <sup>1</sup> ABRAMS 71 HBC 0  $3.7 \pi^+p$ <sup>1</sup> Model dependent, assumes  $I = 1, 2$ , or 3 for the  $3\pi$  system.

NODE=M009R6;LINKAGE=G

$$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{\text{total}} \quad \Gamma_{15}/\Gamma$$

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS | DOCUMENT ID   | TECN | COMMENT                                            |
|-------------------------------------------------------------------------------|-----|------|---------------|------|----------------------------------------------------|
| <b>1.8±0.9 OUR FIT</b>                                                        |     |      |               |      |                                                    |
| <b>1.8±0.9±0.3</b>                                                            | 153 |      | AKHMETSHIN 00 | CMD2 | 0.6–0.97 $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |               |      |                                                    |
| <20                                                                           | 90  |      | KURDADZE 88   | OLYA | $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$          |

NODE=M009R13  
NODE=M009R13

$$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma(\pi\pi) \quad \Gamma_{15}/\Gamma_1$$

| VALUE (units $10^{-4}$ )                                                      | CL% | DOCUMENT ID | TECN | CHG | COMMENT            |
|-------------------------------------------------------------------------------|-----|-------------|------|-----|--------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |     |                    |
| <15                                                                           | 90  | ERBE 69     | HBC  | 0   | 2.5–5.8 $\gamma p$ |
| <20                                                                           |     | CHUNG 68    | HBC  | 0   | 3.2,4.2 $\pi^- p$  |
| <20                                                                           | 90  | HUSON 68    | HLBC | 0   | 16.0 $\pi^- p$     |
| <80                                                                           |     | JAMES 66    | HBC  | 0   | 2.1 $\pi^+ p$      |

NODE=M009R11  
NODE=M009R11

$$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}} \quad \Gamma_{16}/\Gamma$$

| VALUE (units $10^{-5}$ )                                                      | CL% | DOCUMENT ID              | TECN | COMMENT                                   |
|-------------------------------------------------------------------------------|-----|--------------------------|------|-------------------------------------------|
| <b>1.60±0.74±0.18</b>                                                         |     | <sup>1</sup> ACHASOV 09A | SND  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                          |      |                                           |
| < 4                                                                           | 90  | AULCHENKO 87C            | ND   | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$ |
| <20                                                                           | 90  | KURDADZE 86              | OLYA | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$ |

NODE=M009R8  
NODE=M009R8

<sup>1</sup> Assuming no interference between the  $\rho$  and  $\omega$  contributions.

NODE=M009R8;LINKAGE=AC

$$\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{17}/\Gamma$$

| VALUE (units $10^{-5}$ )                                                      | CL% | DOCUMENT ID    | TECN | COMMENT                                      |
|-------------------------------------------------------------------------------|-----|----------------|------|----------------------------------------------|
| <b>&lt;1.2</b>                                                                | 90  | ACHASOV 08     | SND  | 0.36–0.97 $e^+e^- \rightarrow \pi^0 e^+ e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                |      |                                              |
| <1.6                                                                          |     | AKHMETSHIN 05A | CMD2 | 0.72–0.84 $e^+e^-$                           |

NODE=M009R15  
NODE=M009R15

$$\Gamma(\eta e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{18}/\Gamma$$

| VALUE (units $10^{-5}$ ) | DOCUMENT ID    | TECN | COMMENT            |
|--------------------------|----------------|------|--------------------|
| <0.7                     | AKHMETSHIN 05A | CMD2 | 0.72–0.84 $e^+e^-$ |

NODE=M009R16  
NODE=M009R16

## $\rho(770)$ REFERENCES

NODE=M009

|                                |                         |                                |                             |                     |
|--------------------------------|-------------------------|--------------------------------|-----------------------------|---------------------|
| ACHASOV 21                     | JHEP 2101 113           | M.N. Achasov <i>et al.</i>     | (SND Collab.)               | REFID=61040         |
| ANDREEV 20                     | EPJ C80 1189            | V. Andreev <i>et al.</i>       | (H1 Collab.)                | REFID=60773         |
| ABLIKIM 18C                    | PRL 120 242003          | M. Ablikim <i>et al.</i>       | (BESIII Collab.)            | REFID=58843         |
| ABLIKIM 17                     | PRL 118 012001          | M. Ablikim <i>et al.</i>       | (BESIII Collab.)            | REFID=57650         |
| BARTOS 17                      | PR D96 113004           | E. Bartos <i>et al.</i>        |                             | REFID=58325         |
| BARTOS 17A                     | IJMP A32 1750154        | E. Bartos <i>et al.</i>        |                             | REFID=58367         |
| ABLIKIM 16C                    | PL B753 629             | M. Ablikim <i>et al.</i>       | (BESIII Collab.)            | REFID=57138         |
| ACHASOV 16A                    | PR D93 092001           | M.N. Achasov <i>et al.</i>     | (SND Collab.)               | REFID=57513         |
| PDG 15                         | RPP 2015 at pdg.lbl.gov |                                | (PDG Collab.)               | REFID=56977;ERROR=2 |
| ABRAMOWICZ 12                  | EPJ C72 1869            | H. Abramowicz <i>et al.</i>    | (ZEUS Collab.)              | REFID=54274         |
| LEES 12G                       | PR D86 032013           | J.P. Lees <i>et al.</i>        | (BABAR Collab.)             | REFID=54299         |
| AMBROSINO 11A                  | PL B700 102             | F. Ambrosino <i>et al.</i>     | (KLOE Collab.)              | REFID=16683         |
| GARCIA-MAR... 11               | PRL 107 072001          | R. Garcia-Martin <i>et al.</i> | (MADR, CRAC)                | REFID=16761         |
| BATLEY 10C                     | EPJ C70 635             | J.R. Batley <i>et al.</i>      | (CERN NA48/2 Collab.)       | REFID=53567         |
| BENAYOUN 10                    | EPJ C65 211             | M. Benayoun <i>et al.</i>      |                             | REFID=53212         |
| DUBNICKA 10                    | APS 60 1                | S. Dubnicka, A.Z. Dubnickova   |                             | REFID=58797         |
| ACHASOV 09A                    | JETP 109 379            | M.N. Achasov <i>et al.</i>     | (SND Collab.)               | REFID=53101         |
| Translated from ZETF 136 442.  |                         |                                |                             |                     |
| AUBERT 09AS                    | PRL 103 231801          | B. Aubert <i>et al.</i>        | (BABAR Collab.)             | REFID=53136         |
| ACHASOV 08                     | JETP 107 61             | M.N. Achasov <i>et al.</i>     | (SND Collab.)               | REFID=52258         |
| Translated from ZETF 134 80.   |                         |                                |                             |                     |
| FUJIKAWA 08                    | PR D78 072006           | M. Fujikawa <i>et al.</i>      | (BELLE Collab.)             | REFID=52536         |
| ACHASOV 07B                    | PR D76 077101           | M.N. Achasov <i>et al.</i>     | (SND Collab.)               | REFID=51942         |
| AKHMETSHIN 07                  | PL B648 28              | R.R. Akhmetshin <i>et al.</i>  | (Novosibirsk CMD-2 Collab.) | REFID=51615         |
| ACHASOV 06                     | JETP 103 380            | M.N. Achasov <i>et al.</i>     | (Novosibirsk SND Collab.)   | REFID=51113         |
| Translated from ZETF 130 437.  |                         |                                |                             |                     |
| ACHASOV 06A                    | PR D74 014016           | M.N. Achasov <i>et al.</i>     | (SND Collab.)               | REFID=51133         |
| AULCHENKO 06                   | JETPL 84 413            | V.M. Aulchenko <i>et al.</i>   | (Novosibirsk CMD-2 Collab.) | REFID=51513         |
| Translated from ZETFP 84 491.  |                         |                                |                             |                     |
| ACHASOV 05A                    | JETP 101 1053           | M.N. Achasov <i>et al.</i>     | (Novosibirsk SND Collab.)   | REFID=51045         |
| Translated from ZETF 128 1201. |                         |                                |                             |                     |
| AKHMETSHIN 05A                 | PL B605 26              | R.R. Akhmetshin <i>et al.</i>  | (Novosibirsk CMD-2 Collab.) | REFID=50330         |
| AKHMETSHIN 05A                 | PL B613 29              | R.R. Akhmetshin <i>et al.</i>  | (Novosibirsk CMD-2 Collab.) | REFID=50508         |
| ALOISIO 05                     | PL B606 12              | A. Aloisio <i>et al.</i>       | (KLOE Collab.)              | REFID=51112         |
| AULCHENKO 05                   | JETPL 82 743            | V.M. Aulchenko <i>et al.</i>   | (Novosibirsk CMD-2 Collab.) | REFID=51060         |
| Translated from ZETFP 82 841.  |                         |                                |                             |                     |

|              |     |                               |                                          |                             |             |
|--------------|-----|-------------------------------|------------------------------------------|-----------------------------|-------------|
| SCHAEEL      | 05C | PRPL 421 191                  | S. Schael <i>et al.</i>                  | (ALEPH Collab.)             | REFID=50845 |
| AKHMETSHIN   | 04  | PL B578 285                   | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.) | REFID=49609 |
| AKHMETSHIN   | 04B | PL B580 119                   | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.) | REFID=49610 |
| PELAEZ       | 04A | MPL A19 2879                  | J.R. Pelaez                              | (MADU)                      | REFID=50347 |
| ACHASOV      | 03  | PL B559 171                   | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)   | REFID=49187 |
| ACHASOV      | 03D | PR D68 052006                 | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)   | REFID=49577 |
| ALOISIO      | 03  | PL B561 55                    | A. Aloisio <i>et al.</i>                 | (KLOE Collab.)              | REFID=49404 |
| SANZ-CILLERO | 03  | EPJ C27 587                   | J.J. Sanz-Cillero, A. Pich               |                             | REFID=49399 |
| ACHASOV      | 02  | PR D65 032002                 | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)   | REFID=48549 |
| ACHASOV      | 02F | PL B537 201                   | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)   | REFID=48816 |
| AKHMETSHIN   | 02  | PL B527 161                   | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.) | REFID=48565 |
| AKHMETSHIN   | 01B | PL B509 217                   | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.) | REFID=48167 |
| COLANGELO    | 01  | NP B603 125                   | G. Colangelo, J. Gasser, H. Leytwyler    |                             | REFID=49180 |
| PICH         | 01  | PR D63 093005                 | A. Pich, J. Portoles                     |                             | REFID=48313 |
| ACHASOV      | 00  | EPJ C12 25                    | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)   | REFID=47417 |
| ACHASOV      | 00D | JETPL 72 282                  | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)   | REFID=47882 |
| ACHASOV      | 00G | Translated from ZETFP 72 411. | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)   | REFID=47929 |
| ACHASOV      | 00G | JETPL 71 355                  | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)   | REFID=47421 |
| AKHMETSHIN   | 00  | Translated from ZETFP 71 519. | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.) | REFID=47468 |
| ANDERSON     | 00A | PL B475 190                   | S. Anderson <i>et al.</i>                | (CLEO Collab.)              | REFID=47414 |
| ABELE        | 99E | PR D61 112002                 | A. Abele <i>et al.</i>                   | (Crystal Barrel Collab.)    | REFID=45859 |
| BENAYOUN     | 98  | PL B469 270                   | M. Benayoun <i>et al.</i>                | (IPNP, NOVO, ADL+)          | REFID=46354 |
| BREITWEG     | 98B | EPJ C2 269                    | J. Breitweg <i>et al.</i>                | (ZEUS Collab.)              | REFID=46366 |
| GARDNER      | 98  | EPJ C2 247                    | S. Gardner, H.B. O'Connell               |                             | REFID=47981 |
| Also         |     | PR D57 2716                   | S. Gardner, H.B. O'Connell               |                             | REFID=45415 |
| ABELE        | 97  | PR D62 019903 (err.)          | A. Abele <i>et al.</i>                   | (Crystal Barrel Collab.)    | REFID=45533 |
| ADAMS        | 97  | PL B391 191                   | M.R. Adams <i>et al.</i>                 | (E665 Collab.)              | REFID=45622 |
| BARATE       | 97M | ZPHY C74 237                  | R. Barate <i>et al.</i>                  | (ALEPH Collab.)             | REFID=45701 |
| BERTIN       | 97C | ZPHY C76 15                   | A. Bertin <i>et al.</i>                  | (OBELIX Collab.)            | REFID=45393 |
| BOGOLYUB...  | 97  | PL B408 476                   | M.Y. Bogolyubsky <i>et al.</i>           | (MOSU, SERP)                | REFID=45860 |
| O'CONNELL    | 97  | PAN 60 46                     | H.B. O'Connell <i>et al.</i>             | (ADLD)                      | REFID=45753 |
| BENAYOUN     | 96  | Translated from YAF 60 53.    | M. Benayoun <i>et al.</i>                | (IPNP, NOVO)                | REFID=44097 |
| BERNICA      | 94  | NP A623 559                   | A. Bernica, G. Lopez Castro, J. Pestieau | (LOUV+)                     | REFID=43589 |
| WEIDENAUER   | 93  | ZPHY C72 221                  | P. Weidenauer <i>et al.</i>              | (ASTERIX Collab.)           | REFID=41637 |
| AGUILAR...   | 91  | PR D50 4454                   | M. Aguilar-Benitez <i>et al.</i>         | (LEBC-EHS Collab.)          | REFID=41369 |
| DOLINSKY     | 91  | ZPHY C59 387                  | S.I. Dolinsky <i>et al.</i>              | (NOVO)                      | REFID=45862 |
| KUHN         | 90  | ZPHY C50 405                  | J.H. Kuhn <i>et al.</i>                  | (MPIM)                      | REFID=40739 |
| ANTIPOV      | 89  | PRPL 202 99                   | Y.M. Antipov <i>et al.</i>               | (SERP, JINR, BGNA+)         | REFID=40740 |
| BISELLO      | 89  | ZPHY C48 445                  | D. Bisello <i>et al.</i>                 | (DM2 Collab.)               | REFID=41003 |
| DOLINSKY     | 89  | ZPHY C42 185                  | S.I. Dolinsky <i>et al.</i>              | (NOVO)                      | REFID=44082 |
| DUBNICKA     | 89  | PL B220 321                   | S. Dubnicka <i>et al.</i>                | (JINR, SLOV)                | REFID=41017 |
| GESHKEN...   | 89  | ZPHY G15 1349                 | B.V. Geshkenbein                         | (ITEP)                      | REFID=41121 |
| KURDADZE     | 88  | ZPHY C45 351                  | L.M. Kurdadze <i>et al.</i>              | (NOVO)                      | REFID=41019 |
| VASSERMAN    | 88  | JETPL 47 512                  | L.B. Vasserman <i>et al.</i>             | (NOVO)                      | REFID=41020 |
| VASSERMAN    | 88B | Translated from ZETFP 47 432. | I.B. Vasserman <i>et al.</i>             | (NOVO)                      | REFID=41370 |
| AULCHENKO    | 87C | SJNP 47 1035                  | V.M. Aulchenko <i>et al.</i>             | (NOVO)                      | REFID=40003 |
| CAPRARO      | 87  | Translated from YAF 47 1635.  | L. Capraro <i>et al.</i>                 | (CLER, FRAS, MILA+)         | REFID=22102 |
| BRAMON       | 86  | SJNP 48 480                   | A. Bramon, J. Casulleras                 | (BARC)                      | REFID=20137 |
| HUSTON       | 86  | IYF 87-90 Preprint            | J. Huston <i>et al.</i>                  | (ROCH, FNAL, MINN)          | REFID=40287 |
| KURDADZE     | 86  | NP B288 659                   | L.M. Kurdadze <i>et al.</i>              | (NOVO)                      | REFID=20134 |
| BARKOV       | 85  | PL B173 97                    | L.M. Barkov <i>et al.</i>                | (NOVO)                      | REFID=20561 |
| DRUZHININ    | 84  | PR D33 3199                   | V.P. Druzhinin <i>et al.</i>             | (NOVO)                      | REFID=20131 |
| CHABAUD      | 83  | JETPL 43 643                  | V. Chabaud <i>et al.</i>                 | (CERN, CRAC, MPIM)          | REFID=20132 |
| JENSEN       | 83  | Translated from ZETFP 43 497. | T. Jensen <i>et al.</i>                  | (ROCH, FNAL, MINN)          | REFID=20129 |
| HEYN         | 81  | NP B256 365                   | M.F. Heyn, C.B. Lang                     | (GRAZ)                      | REFID=20128 |
| BOHACIK      | 80  | PL 144B 136                   | J. Bohacik, H. Kuhnelt                   | (SLOV, WIEN)                | REFID=20381 |
| COHEN        | 80  | PR D21 1342                   | D. Cohen <i>et al.</i>                   | (ANL)                       | REFID=20126 |
| LANG         | 79  | PR D22 2595                   | C.B. Lang, A. Mas-Parareda               | (DESY, FRAS)                | REFID=20124 |
| BARTALUCCI   | 78  | NC 44A 587                    | S. Bartalucci <i>et al.</i>              | (ANL)                       | REFID=20120 |
| WICKLUND     | 78  | PR D17 1197                   | A.B. Wicklund <i>et al.</i>              | (ROCH)                      | REFID=20119 |
| ANDREWS      | 77  | PRL 38 198                    | D.E. Andrews <i>et al.</i>               | (AACH3, BERL, BONN+)        | REFID=20110 |
| DEUTSCH...   | 76  | NP B103 426                   | M. Deuschmann <i>et al.</i>              | (CMU, CASE)                 | REFID=20111 |
| ENGLER       | 74  | PR D10 2070                   | A. Engler <i>et al.</i>                  | (DURH)                      | REFID=20113 |
| ESTABROOKS   | 74  | NP B79 301                    | P.G. Estabrooks, A.D. Martin             | (CERN, MPIM)                | REFID=20104 |
| GRAYER       | 74  | NP B75 189                    | G. Grayer <i>et al.</i>                  | (MICH)                      | REFID=20106 |
| RATCLIFF     | 74  | Private Comm.                 | W.L. Byerly <i>et al.</i>                | (HARV)                      | REFID=20107 |
| BYERLY       | 73  | PR D7 637                     | G.E. Gladding <i>et al.</i>              | (CERN, MPIM)                | REFID=20108 |
| GLADDING     | 73  | PR D8 3721                    | B.D. Hyams <i>et al.</i>                 | (LBL)                       | REFID=20094 |
| HYAMS        | 73  | NP B64 134                    | S.D. Protopopescu <i>et al.</i>          | (SLAC, LBL, TUFTS)          | REFID=20096 |
| PROTOPOP...  | 73  | PR D7 1279                    | J. Ballam <i>et al.</i>                  | (ORSA)                      | REFID=20101 |
| BALLAM       | 72  | PR D5 545                     | D. Benaksas <i>et al.</i>                | (SACL)                      | REFID=20102 |
| BENAKSAS     | 72  | PL 39B 289                    | L.D. Jacobs                              | (SLAC)                      | REFID=20090 |
| JACOBS       | 72  | PR D6 1291                    | B.N. Ratcliff <i>et al.</i>              | (DESY)                      | REFID=20089 |
| RATCLIFF     | 72  | PL 38B 345                    | G.S. Abrams <i>et al.</i>                | (DARE)                      | REFID=20074 |
| ABRAMS       | 71  | PR D4 653                     | H. Alvensleben <i>et al.</i>             | (UCLA)                      | REFID=20077 |
| ALVENSLEB... | 70  | PRL 24 786                    | P.J. Biggs <i>et al.</i>                 | (FSU)                       | REFID=20082 |
| BIGGS        | 70  | PRL 24 1197                   | R. Erbe <i>et al.</i>                    | (NEAS)                      | REFID=20084 |
| ERBE         | 69  | PR 188 2060                   | E.I. Malamud, P.E. Schlein               | (HARV, CASE, SLAC+)         | REFID=20054 |
| MALAMUD      | 69  | Argonne Conf. 93              | B.G. Reynolds <i>et al.</i>              | (SACL)                      | REFID=20056 |
| REYNOLDS     | 69  | PR 184 1424                   | P.L. Rothwell <i>et al.</i>              | (CERN, CDEF)                | REFID=48054 |
| ROTHWELL     | 69  | PRL 23 1521                   | A.A. Wehmann <i>et al.</i>               | (ORSA, MILA, UCLA)          | REFID=20062 |
| WEHMANN      | 69  | PR 178 2095                   | N. Armenise <i>et al.</i>                | (CERN, MPIM)                | REFID=20063 |
| ARMENISE     | 68  | NC 54A 999                    | J.P. Baton, G. Laurens                   | (HARV)                      | REFID=20068 |
| BATON        | 68  | PR 176 1574                   | S.U. Chung <i>et al.</i>                 | (CERN)                      | REFID=20070 |
| CHUNG        | 68  | PR 165 1491                   | M. Foster <i>et al.</i>                  | (DESY, COLU)                | REFID=20038 |
| FOSTER       | 68  | NP B6 107                     | G.J. Gounaris, J.J. Sakurai              | (BNL)                       | REFID=20046 |
| GOUNARIS     | 68  | PRL 21 244                    | R. Huson <i>et al.</i>                   | (PURD)                      | REFID=20049 |
| HUSON        | 68  | PL 28B 208                    | B.D. Hyams <i>et al.</i>                 | (COLU)                      | REFID=20050 |
| HYAMS        | 68  | NP B7 1                       | L.J. Lanzerotti <i>et al.</i>            | (PURD)                      | REFID=20051 |
| LANZEROTTI   | 68  | PR 166 1365                   | J. Pisut, M. Roos                        | (COLU, RUTG)                | REFID=10762 |
| PISUT        | 68  | NP B6 325                     | T.C. Bacon <i>et al.</i>                 | (ROCH)                      | REFID=20028 |
| ASBURY       | 67B | PRL 19 865                    | R.L. Eisner <i>et al.</i>                | (PENN, SACL)                | REFID=20030 |
| BACON        | 67  | PR 157 1263                   | D.O. Huwe <i>et al.</i>                  | (PENN, LRL)                 | REFID=20033 |
| EISNER       | 67  | PR 164 1699                   | B.D. Hyams <i>et al.</i>                 | (YALE, BNL)                 | REFID=10770 |
| HUWE         | 67  | PL 24B 252                    | C. Alff-Steinberger <i>et al.</i>        |                             | REFID=46380 |
| HYAMS        | 67  | PL 24B 634                    | T. Ferbel                                |                             | REFID=46385 |
| MILLER       | 67B | PR 153 1423                   | V. Hagopian <i>et al.</i>                |                             | REFID=20035 |
| ALFF...      | 66  | PR 145 1072                   | V. Hagopian, Y.L. Pan                    |                             | REFID=20016 |
| FERBEL       | 66  | PL 21 111                     | L.D. Jacobs                              |                             | REFID=20578 |
| HAGOPIAN     | 66  | PR 145 1128                   | F.E. James, H.L. Kraybill                |                             | REFID=20013 |
| HAGOPIAN     | 66B | PR 152 1183                   | M. Ross, L. Stodolsky                    |                             | REFID=20006 |
| JACOBS       | 66B | UCRL 16877                    | E. West <i>et al.</i>                    |                             |             |
| JAMES        | 66  | PR 142 896                    | H.R. Bliden <i>et al.</i>                |                             |             |
| ROSS         | 66  | PR 149 1172                   | D.D. Carmony <i>et al.</i>               |                             |             |
| SOEDING      | 66  | PL B19 702                    | G. Goldhaber <i>et al.</i>               |                             |             |
| WEST         | 66  | PR 149 1089                   | M.A. Abolins <i>et al.</i>               |                             |             |
| BLIEDEN      | 65  | PL 19 444                     |                                          |                             |             |
| CARMONY      | 64  | PRL 12 254                    |                                          |                             |             |
| GOLDHABER    | 64  | PRL 12 336                    |                                          |                             |             |
| ABOLINS      | 63  | PRL 11 381                    |                                          |                             |             |

$\omega(782)$ 

$$J^{PC} = 0^-(1^--)$$

NODE=M001

 $\omega(782)$  MASS

NODE=M001M

| VALUE (MeV)                                                                   | EVTs  | DOCUMENT ID                         | TECN     | COMMENT                                        |
|-------------------------------------------------------------------------------|-------|-------------------------------------|----------|------------------------------------------------|
| <b>782.66±0.13 OUR AVERAGE</b>                                                |       | Error includes scale factor of 2.0. |          | See the ideogram below.                        |
| [782.65 ± 0.12 MeV OUR 2020 AVERAGE Scale factor = 1.9]                       |       |                                     |          |                                                |
| 777.9 ±2.2 <sup>+4.3</sup> <sub>-2.2</sub>                                    | 900k  | ANDREEV                             | 20 H1    | $ep \rightarrow e\pi^+\pi^-p$                  |
| 783.20±0.13±0.16                                                              | 18680 | AKHMETSHIN                          | 05 CMD2  | $0.60-1.38 e^+e^- \rightarrow \pi^0\gamma$     |
| 782.68±0.09±0.04                                                              | 11200 | <sup>1</sup> AKHMETSHIN             | 04 CMD2  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 782.79±0.08±0.09                                                              | 1.2M  | <sup>2</sup> ACHASOV                | 03D RVUE | $0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 781.96±0.17±0.80                                                              | 11k   | <sup>3</sup> AMSLER                 | 94C CBAR | $0.0 \bar{p}p \rightarrow \omega\eta\pi^0$     |
| 782.08±0.36±0.82                                                              | 3463  | <sup>4</sup> AMSLER                 | 94C CBAR | $0.0 \bar{p}p \rightarrow \omega\eta\pi^0$     |
| 781.96±0.13±0.17                                                              | 15k   | AMSLER                              | 93B CBAR | $0.0 \bar{p}p \rightarrow \omega\pi^0\pi^0$    |
| 782.4 ±0.2                                                                    | 270k  | WEIDENAUER                          | 93 ASTE  | $\bar{p}p \rightarrow 2\pi^+2\pi^-\pi^0$       |
| 782.4 ±0.5                                                                    | 7000  | <sup>5</sup> KEYNE                  | 76 CNTR  | $\pi^-p \rightarrow \omega n$                  |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |       |                                     |          |                                                |
| 782.58±0.03±0.01                                                              |       | <sup>6</sup> HOID                   | 20 RVUE  | $e^+e^- \rightarrow \pi^0\gamma$               |
| 781.68±0.09±0.03                                                              |       | <sup>7</sup> COLANGELO              | 19 RVUE  | $e^+e^- \rightarrow \pi^+\pi^-$                |
| 782.63±0.03±0.01                                                              |       | <sup>8</sup> HOFERICHT...           | 19 RVUE  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 781.91±0.24                                                                   |       | <sup>9</sup> LEES                   | 12G BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$          |
| 782.7 ±0.1 ±1.5                                                               | 19500 | <sup>10</sup> WURZINGER             | 95 SPEC  | $1.33 pd \rightarrow {}^3\text{He}\omega$      |
| 781.78±0.10                                                                   |       | <sup>10</sup> BARKOV                | 87 CMD   | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 782.2 ±0.4                                                                    | 1488  | <sup>11</sup> KURDADZE              | 83B OLYA | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 783.3 ±0.4                                                                    | 433   | CORDIER                             | 80 DM1   | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| 782.5 ±0.8                                                                    | 33260 | ROOS                                | 80 RVUE  | $0.0-3.6 \bar{p}p$                             |
| 782.6 ±0.8                                                                    | 3000  | BENKHEIRI                           | 79 OMEG  | $9-12 \pi^\pm p$                               |
| 781.8 ±0.6                                                                    | 1430  | COOPER                              | 78B HBC  | $0.7-0.8 \bar{p}p \rightarrow 5\pi$            |
| 782.7 ±0.9                                                                    | 535   | VANAPEL...                          | 78 HBC   | $7.2 \bar{p}p \rightarrow \bar{p}p\omega$      |
| 783.5 ±0.8                                                                    | 2100  | GESSAROLI                           | 77 HBC   | $11 \pi^-p \rightarrow \omega n$               |
| 782.5 ±0.8                                                                    | 418   | AGUILAR-...                         | 72B HBC  | $3.9,4.6 K^-p$                                 |
| 783.4 ±1.0                                                                    | 248   | BIZZARRI                            | 71 HBC   | $0.0 p\bar{p} \rightarrow K^+K^-\omega$        |
| 781.0 ±0.6                                                                    | 510   | BIZZARRI                            | 71 HBC   | $0.0 p\bar{p} \rightarrow K_1K_1\omega$        |
| 783.7 ±1.0                                                                    | 3583  | <sup>12</sup> COYNE                 | 71 HBC   | $3.7 \pi^+p \rightarrow p\pi^+\pi^+\pi^-\pi^0$ |
| 784.1 ±1.2                                                                    | 750   | ABRAMOVI...                         | 70 HBC   | $3.9 \pi^-p$                                   |
| 783.2 ±1.6                                                                    |       | <sup>13</sup> BIGGS                 | 70B CNTR | $<4.1 \gamma C \rightarrow \pi^+\pi^-C$        |
| 782.4 ±0.5                                                                    | 2400  | BIZZARRI                            | 69 HBC   | $0.0 \bar{p}p$                                 |

NODE=M001M

NEW

OCCUR=2

OCCUR=2

OCCUR=2

<sup>1</sup> Update of AKHMETSHIN 00C.<sup>2</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+ \pi^- \pi^0$  and ANTONELLI 92 on the  $\omega \pi^+ \pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.<sup>3</sup> From the  $\eta \rightarrow \gamma \gamma$  decay.<sup>4</sup> From the  $\eta \rightarrow 3\pi^0$  decay.<sup>5</sup> Observed by threshold-crossing technique. Mass resolution = 4.8 MeV FWHM.<sup>6</sup> The values were extracted from a dispersively improved Breit-Wigner parameterization and do not include vacuum polarization. Inclusion of vacuum polarization gives  $782.736 \pm 0.024$  MeV.<sup>7</sup> The  $\omega$  mass was extracted from a dispersively improved Breit-Wigner parameterization, the  $\omega$  width fixed at  $8.49 \pm 0.08$  MeV. The value does not include vacuum polarization which would shift the mass to  $781.81 \pm 0.09 \pm 0.03$  MeV. The mixing parameter is assumed real valued.<sup>8</sup> The values were extracted from a dispersively improved Breit-Wigner parameterization and do not include vacuum polarization.<sup>9</sup> From the  $\rho - \omega$  interference in the  $\pi^+ \pi^-$  mass spectrum using the Breit-Wigner for the  $\omega$  and leaving its mass and width as free parameters of the fit.<sup>10</sup> Systematic uncertainties underestimated.<sup>11</sup> Systematic uncertainties not estimated.<sup>12</sup> From best-resolution sample of COYNE 71.<sup>13</sup> From  $\omega - \rho$  interference in the  $\pi^+ \pi^-$  mass spectrum assuming  $\omega$  width 12.6 MeV.NODE=M001M;LINKAGE=PT  
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NODE=M001M;LINKAGE=G

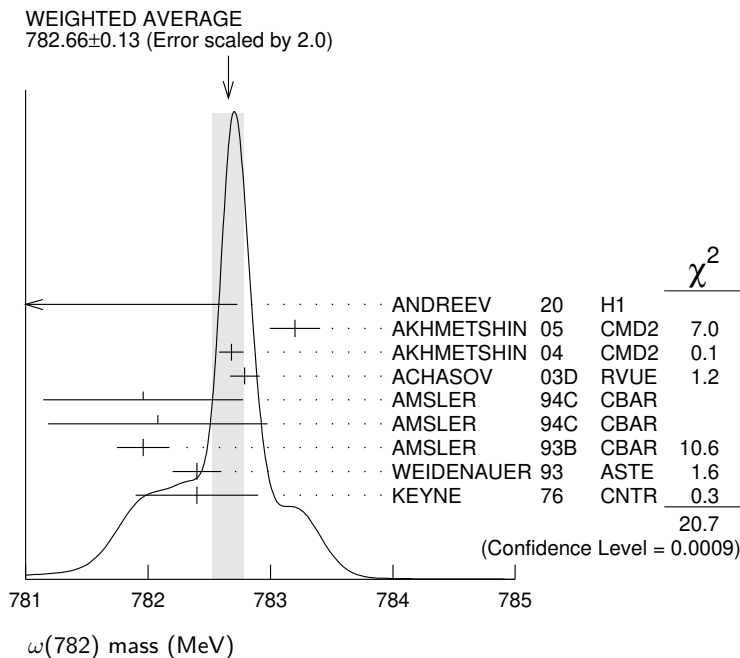
NODE=M001M;LINKAGE=A

NODE=M001M;LINKAGE=H

NODE=M001M;LINKAGE=LE

NODE=M001M;LINKAGE=KB  
NODE=M001M;LINKAGE=I  
NODE=M001M;LINKAGE=D  
NODE=M001M;LINKAGE=F





### $\omega(782)$ WIDTH

NODE=M001W

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID                  | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|-------|------------------------------|------|-------------------------------------------------|
| <b>8.68±0.13 OUR AVERAGE</b>                                                  |       |                              |      |                                                 |
| [8.49 ± 0.08 MeV OUR 2020 AVERAGE]                                            |       |                              |      |                                                 |
| 8.68±0.23±0.10                                                                | 11200 | <sup>1</sup> AKHMETSHIN 04   | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| 8.68±0.04±0.15                                                                | 1.2M  | <sup>2</sup> ACHASOV 03D     | RVUE | 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$  |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |       |                              |      |                                                 |
| 8.65±0.06±0.01                                                                |       | <sup>3</sup> HOID 20         | RVUE | $e^+e^- \rightarrow \pi^0\gamma$                |
| 8.71±0.04±0.04                                                                |       | <sup>4</sup> HOFERICTH... 19 | RVUE | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| 8.13±0.45                                                                     |       | <sup>5</sup> LEES 12G        | BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$           |
| 8.2 ±0.3                                                                      | 19500 | <sup>6</sup> WURZINGER 95    | SPEC | 1.33 $p d \rightarrow {}^3\text{He} \omega$     |
| 8.4 ±0.1                                                                      |       | <sup>7</sup> AULCHENKO 87    | ND   | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| 8.30±0.40                                                                     |       | <sup>6</sup> BARKOV 87       | CMD  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| 9.8 ±0.9                                                                      | 1488  | <sup>8</sup> KURDADZE 83B    | OLYA | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| 9.0 ±0.8                                                                      | 433   | <sup>6</sup> CORDIER 80      | DM1  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| 12 ±2                                                                         | 1430  | COOPER 78B                   | HBC  | 0.7–0.8 $\bar{p} p \rightarrow 5\pi$            |
| 9.4 ±2.5                                                                      | 2100  | GESSAROLI 77                 | HBC  | 11 $\pi^- p \rightarrow \omega n$               |
| 10.22±0.43                                                                    | 20000 | <sup>9</sup> KEYNE 76        | CNTR | $\pi^- p \rightarrow \omega n$                  |
| 13.3 ±2                                                                       | 418   | AGUILAR-... 72B              | HBC  | 3.9,4.6 $K^- p$                                 |
| 9.1 ±0.8                                                                      | 451   | <sup>6</sup> BENAKSAS 72B    | OSPK | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| 10.5 ±1.5                                                                     |       | BORENSTEIN 72                | HBC  | 2.18 $K^- p$                                    |
| 7.70±0.9 ±1.15                                                                | 940   | BROWN 72                     | MMS  | 2.5 $\pi^- p \rightarrow nMM$                   |
| 10.3 ±1.4                                                                     | 510   | BIZZARRI 71                  | HBC  | 0.0 $p\bar{p} \rightarrow K_1 K_1 \omega$       |
| 12.8 ±3.0                                                                     | 248   | BIZZARRI 71                  | HBC  | 0.0 $p\bar{p} \rightarrow K^+ K^- \omega$       |
| 9.5 ±1.0                                                                      | 3583  | COYNE 71                     | HBC  | 3.7 $\pi^+ p \rightarrow p\pi^+\pi^+\pi^-\pi^0$ |

NODE=M001W  
NEW

OCCUR=2

<sup>1</sup> Update of AKHMETSHIN 00C.

<sup>2</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.

<sup>3</sup> The values were extracted from a dispersively improved Breit-Wigner parameterization and do not include vacuum polarization. Inclusion of vacuum polarization gives 8.63 ± 0.05 MeV.

<sup>4</sup> The values were extracted from a dispersively improved Breit-Wigner parameterization and do not include vacuum polarization.

<sup>5</sup> From the  $\rho-\omega$  interference in the  $\pi^+\pi^-$  mass spectrum using the Breit-Wigner for the  $\omega$  and leaving its mass and width as free parameters of the fit.

<sup>6</sup> Systematic uncertainties underestimated.

<sup>7</sup> Relativistic Breit-Wigner includes radiative corrections. Systematic uncertainties not estimated.

<sup>8</sup> Systematic uncertainties not estimated.

<sup>9</sup> Observed by threshold-crossing technique. Mass resolution = 4.8 MeV FWHM.

NODE=M001W;LINKAGE=PT  
NODE=M001W;LINKAGE=VH

NODE=M001W;LINKAGE=E

NODE=M001W;LINKAGE=F

NODE=M001W;LINKAGE=LE

NODE=M001W;LINKAGE=I  
NODE=M001W;LINKAGE=GNODE=M001W;LINKAGE=J  
NODE=M001W;LINKAGE=B

**$\omega(782)$  DECAY MODES**

NODE=M001215;NODE=M001

| Mode                                           | Fraction ( $\Gamma_i/\Gamma$ )      | Scale factor/<br>Confidence level |          |
|------------------------------------------------|-------------------------------------|-----------------------------------|----------|
| $\Gamma_1$ $\pi^+\pi^-\pi^0$                   | (89.2 $\pm$ 0.7) %                  |                                   | DESIG=1  |
| $\Gamma_2$ $\pi^0\gamma$                       | ( 8.34 $\pm$ 0.26) %                | S=2.1                             | DESIG=3  |
| $\Gamma_3$ $\pi^+\pi^-$                        | ( 1.53 $^{+0.11}_{-0.13}$ ) %       | S=1.2                             | DESIG=2  |
| $\Gamma_4$ neutrals (excluding $\pi^0\gamma$ ) | ( 7 $^{+7}_{-5}$ ) $\times 10^{-3}$ | S=1.1                             | DESIG=13 |
| $\Gamma_5$ $\eta\gamma$                        | ( 4.5 $\pm$ 0.4) $\times 10^{-4}$   | S=1.1                             | DESIG=6  |
| $\Gamma_6$ $\pi^0 e^+ e^-$                     | ( 7.7 $\pm$ 0.6) $\times 10^{-4}$   |                                   | DESIG=14 |
| $\Gamma_7$ $\pi^0 \mu^+ \mu^-$                 | ( 1.34 $\pm$ 0.18) $\times 10^{-4}$ | S=1.5                             | DESIG=11 |
| $\Gamma_8$ $\eta e^+ e^-$                      |                                     |                                   | DESIG=18 |
| $\Gamma_9$ $e^+ e^-$                           | ( 7.39 $\pm$ 0.19) $\times 10^{-5}$ | S=1.7                             | DESIG=7  |
| $\Gamma_{10}$ $\pi^+\pi^-\pi^0\pi^0$           | < 2 $\times 10^{-4}$                | CL=90%                            | DESIG=12 |
| $\Gamma_{11}$ $\pi^+\pi^-\gamma$               | < 3.6 $\times 10^{-3}$              | CL=95%                            | DESIG=4  |
| $\Gamma_{12}$ $\pi^+\pi^-\pi^+\pi^-$           | < 1 $\times 10^{-3}$                | CL=90%                            | DESIG=15 |
| $\Gamma_{13}$ $\pi^0\pi^0\gamma$               | ( 6.7 $\pm$ 1.1) $\times 10^{-5}$   |                                   | DESIG=5  |
| $\Gamma_{14}$ $\eta\pi^0\gamma$                | < 3.3 $\times 10^{-5}$              | CL=90%                            | DESIG=17 |
| $\Gamma_{15}$ $\mu^+\mu^-$                     | ( 7.4 $\pm$ 1.8) $\times 10^{-5}$   |                                   | DESIG=8  |
| $\Gamma_{16}$ $3\gamma$                        | < 1.9 $\times 10^{-4}$              | CL=95%                            | DESIG=10 |

**Charge conjugation (C) violating modes**

|                           |   |                        |        |                              |
|---------------------------|---|------------------------|--------|------------------------------|
| $\Gamma_{17}$ $\eta\pi^0$ | C | < 2.1 $\times 10^{-4}$ | CL=90% | NODE=M001;CLUMP=A<br>DESIG=9 |
| $\Gamma_{18}$ $2\pi^0$    | C | < 2.2 $\times 10^{-4}$ | CL=90% | DESIG=193                    |
| $\Gamma_{19}$ $3\pi^0$    | C | < 2.3 $\times 10^{-4}$ | CL=90% | DESIG=16                     |
| $\Gamma_{20}$ invisible   |   | < 7 $\times 10^{-5}$   | CL=90% | DESIG=194                    |

**CONSTRAINED FIT INFORMATION**

An overall fit to 15 branching ratios uses 49 measurements and one constraint to determine 10 parameters. The overall fit has a  $\chi^2 = 48.2$  for 40 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |       |       |       |       |       |       |          |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|----------|
| $x_2$    | 23    |       |       |       |       |       |       |       |          |
| $x_3$    | -18   | -4    |       |       |       |       |       |       |          |
| $x_4$    | -93   | -55   | 1     |       |       |       |       |       |          |
| $x_5$    | 7     | 15    | -1    | -12   |       |       |       |       |          |
| $x_6$    | -1    | 0     | 0     | 0     | 0     |       |       |       |          |
| $x_7$    | 0     | 0     | 0     | 0     | 0     | 0     |       |       |          |
| $x_9$    | -28   | -56   | 5     | 44    | -27   | 0     | 0     |       |          |
| $x_{13}$ | 1     | 4     | 0     | -2    | 1     | 0     | 0     | -2    |          |
| $x_{15}$ | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | 0        |
|          | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ | $x_6$ | $x_7$ | $x_9$ | $x_{13}$ |

 **$\omega(782)$  PARTIAL WIDTHS**

NODE=M001218

 **$\Gamma(\pi^0\gamma)$**  **$\Gamma_2$** 

| VALUE (keV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |       |                      |    |     |                                                 |
|-----------------------|-------|----------------------|----|-----|-------------------------------------------------|
| 880 $\pm$ 50          | 7815  | <sup>1</sup> ACHASOV | 13 | SND | 1.05–2.00 $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 788 $\pm$ 12 $\pm$ 27 | 36500 | <sup>2</sup> ACHASOV | 03 | SND | 0.60–0.97 $e^+e^- \rightarrow \pi^0\gamma$      |
| 764 $\pm$ 51          | 10625 | DOLINSKY             | 89 | ND  | $e^+e^- \rightarrow \pi^0\gamma$                |

<sup>1</sup> Systematic uncertainty not estimated.

<sup>2</sup> Using  $\Gamma_\omega = 8.44 \pm 0.09$  MeV and  $B(\omega \rightarrow \pi^0\gamma)$  from ACHASOV 03.

NODE=M001W1  
NODE=M001W1

NODE=M001W1;LINKAGE=AC  
NODE=M001W1;LINKAGE=AD

$\Gamma(\eta\gamma)$  $\Gamma_5$ 

| VALUE (keV)                                                                                                   | DOCUMENT ID                 | TECN | COMMENT                         |
|---------------------------------------------------------------------------------------------------------------|-----------------------------|------|---------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                 |                             |      |                                 |
| $6.1 \pm 2.5$                                                                                                 | <sup>1</sup> DOLINSKY 89 ND |      | $e^+e^- \rightarrow \eta\gamma$ |
| <sup>1</sup> Using $\Gamma_\omega = 8.4 \pm 0.1$ MeV and $B(\omega \rightarrow \eta\gamma)$ from DOLINSKY 89. |                             |      |                                 |

NODE=M001W2  
 NODE=M001W2

NODE=M001W2;LINKAGE=DA

 $\Gamma(e^+e^-)$  $\Gamma_9$ 

| VALUE (keV)                                                                                                                   | EVTS  | DOCUMENT ID                  | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------------------------------------------------------|-------|------------------------------|------|------------------------------------------------|
| <b>0.60 ± 0.02 OUR EVALUATION</b>                                                                                             |       |                              |      |                                                |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                 |       |                              |      |                                                |
| $0.591 \pm 0.015$                                                                                                             | 11200 | <sup>1,2</sup> AKHMETSHIN 04 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$           |
| $0.653 \pm 0.003 \pm 0.021$                                                                                                   | 1.2M  | <sup>3</sup> ACHASOV 03D     | RVUE | $0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| $0.600 \pm 0.031$                                                                                                             | 10625 | DOLINSKY 89 ND               |      | $e^+e^- \rightarrow \pi^0\gamma$               |
| <sup>1</sup> Using $B(\omega \rightarrow \pi^+\pi^-\pi^0) = 0.891 \pm 0.007$ and $\Gamma_{\text{total}} = 8.44 \pm 0.09$ MeV. |       |                              |      |                                                |
| <sup>2</sup> Update of AKHMETSHIN 00C.                                                                                        |       |                              |      |                                                |
| <sup>3</sup> Using ACHASOV 03, ACHASOV 03D and $B(\omega \rightarrow \pi^+\pi^-) = (1.70 \pm 0.28)\%$ .                       |       |                              |      |                                                |

NODE=M001W7  
 NODE=M001W7

→ UNCHECKED ←

NODE=M001W7;LINKAGE=3P  
 NODE=M001W7;LINKAGE=PT  
 NODE=M001W;LINKAGE=VF

 $\omega(782) \Gamma(e^+e^-) \Gamma(i) / \Gamma^2(\text{total})$ 

NODE=M001225

 $\Gamma(e^+e^-) / \Gamma_{\text{total}} \times \Gamma(\pi^+\pi^-\pi^0) / \Gamma_{\text{total}}$  $\Gamma_9 / \Gamma \times \Gamma_1 / \Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                     | EVTS  | DOCUMENT ID                 | TECN | COMMENT                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------|------|-------------------------------------------------|
| <b>6.60 ± 0.16 OUR FIT</b> Error includes scale factor of 1.9. $[(6.56 \pm 0.12) \times 10^{-5}]$ OUR 2020 FIT Scale factor = 1.6]                                                                                           |       |                             |      |                                                 |
| <b>6.41 ± 0.13 OUR AVERAGE</b> Error includes scale factor of 1.2. $[(6.38 \pm 0.10) \times 10^{-5}]$ OUR 2020 AVERAGE Scale factor = 1.1]                                                                                   |       |                             |      |                                                 |
| $6.24 \pm 0.11 \pm 0.08$                                                                                                                                                                                                     | 11.2k | <sup>1</sup> AKHMETSHIN 04  | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| $6.70 \pm 0.06 \pm 0.27$                                                                                                                                                                                                     |       | AUBERT,B 04N                | BABR | $10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$ |
| $6.74 \pm 0.04 \pm 0.24$                                                                                                                                                                                                     | 1.2M  | <sup>2,3</sup> ACHASOV 03D  | RVUE | $0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$  |
| $6.37 \pm 0.35$                                                                                                                                                                                                              |       | <sup>2</sup> DOLINSKY 89 ND |      | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                |       |                             |      |                                                 |
| $6.20 \pm 0.13$                                                                                                                                                                                                              |       | <sup>4</sup> BENAYOUN 10    | RVUE | $0.4-1.05 e^+e^-$                               |
| $6.45 \pm 0.24$                                                                                                                                                                                                              |       | <sup>5</sup> BARKOV 87      | CMD  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| $5.79 \pm 0.42$                                                                                                                                                                                                              | 1488  | <sup>6</sup> KURDADZE 83B   | OLYA | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| $5.89 \pm 0.54$                                                                                                                                                                                                              | 433   | <sup>5</sup> CORDIER 80     | DM1  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| $7.54 \pm 0.84$                                                                                                                                                                                                              | 451   | <sup>5</sup> BENAKSAS 72B   | OSPK | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$            |
| <sup>1</sup> Update of AKHMETSHIN 00C.                                                                                                                                                                                       |       |                             |      |                                                 |
| <sup>2</sup> Recalculated by us from the cross section in the peak.                                                                                                                                                          |       |                             |      |                                                 |
| <sup>3</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the $\pi^+\pi^-\pi^0$ and ANTONELLI 92 on the $\omega\pi^+\pi^-$ final states. Supersedes ACHASOV 99E and ACHASOV 02E. |       |                             |      |                                                 |
| <sup>4</sup> A simultaneous fit of $e^+e^- \rightarrow \pi^+\pi^-$ , $\pi^+\pi^-\pi^0$ , $\pi^0\gamma$ , $\eta\gamma$ data.                                                                                                  |       |                             |      |                                                 |
| <sup>5</sup> Recalculated by us from the cross section in the peak. Systematic uncertainties underestimated.                                                                                                                 |       |                             |      |                                                 |
| <sup>6</sup> Recalculated by us from the cross section in the peak. Systematic uncertainties not estimated.                                                                                                                  |       |                             |      |                                                 |

NODE=M001G2  
 NODE=M001G2

NEW

NEW

NODE=M001G;LINKAGE=PT  
 NODE=M001G;LINKAGE=LP  
 NODE=M001G;LINKAGE=VH

NODE=M001G2;LINKAGE=BE  
 NODE=M001G2;LINKAGE=A

NODE=M001G2;LINKAGE=B

 $\Gamma(e^+e^-) / \Gamma_{\text{total}} \times \Gamma(\pi^0\gamma) / \Gamma_{\text{total}}$  $\Gamma_9 / \Gamma \times \Gamma_2 / \Gamma$ 

| VALUE (units $10^{-6}$ )                                                                                                                                                                                                              | EVTS | DOCUMENT ID                 | TECN | COMMENT                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------|------|--------------------------------------------|
| <b>6.16 ± 0.17 OUR FIT</b> Error includes scale factor of 2.1. $[(6.18 \pm 0.11) \times 10^{-6}]$ OUR 2020 FIT Scale factor = 1.6]                                                                                                    |      |                             |      |                                            |
| <b>6.34 ± 0.10 OUR AVERAGE</b> $[(6.37 \pm 0.09) \times 10^{-6}]$ OUR 2020 AVERAGE]                                                                                                                                                   |      |                             |      |                                            |
| $6.336 \pm 0.056 \pm 0.089$                                                                                                                                                                                                           |      | <sup>1</sup> ACHASOV 16A    | SND  | $0.60-1.38 e^+e^- \rightarrow \pi^0\gamma$ |
| $6.47 \pm 0.14 \pm 0.39$                                                                                                                                                                                                              | 18k  | AKHMETSHIN 05               | CMD2 | $0.60-1.38 e^+e^- \rightarrow \pi^0\gamma$ |
| $6.34 \pm 0.21 \pm 0.21$                                                                                                                                                                                                              | 10k  | <sup>2</sup> DOLINSKY 89 ND |      | $e^+e^- \rightarrow \pi^0\gamma$           |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                         |      |                             |      |                                            |
| $6.80 \pm 0.13$                                                                                                                                                                                                                       |      | <sup>3</sup> BENAYOUN 10    | RVUE | $0.4-1.05 e^+e^-$                          |
| $6.50 \pm 0.11 \pm 0.20$                                                                                                                                                                                                              | 36k  | <sup>4</sup> ACHASOV 03     | SND  | $0.60-0.97 e^+e^- \rightarrow \pi^0\gamma$ |
| <sup>1</sup> From the VMD model with the interfering $\rho(770)$ , $\omega(782)$ , $\phi(1020)$ , and an additional resonance describing the total contribution of the $\rho(1450)$ and $\omega(1420)$ states. Supersedes ACHASOV 03. |      |                             |      |                                            |
| <sup>2</sup> Recalculated by us from the cross section in the peak.                                                                                                                                                                   |      |                             |      |                                            |
| <sup>3</sup> A simultaneous fit of $e^+e^- \rightarrow \pi^+\pi^-$ , $\pi^+\pi^-\pi^0$ , $\pi^0\gamma$ , $\eta\gamma$ data.                                                                                                           |      |                             |      |                                            |
| <sup>4</sup> Using $\sigma(\phi \rightarrow \pi^0\gamma)$ from ACHASOV 00 and $m_\omega = 782.57$ MeV in the model with the energy-independent phase of $\rho$ - $\omega$ interference equal to $(-10.2 \pm 7.0)^\circ$ .             |      |                             |      |                                            |

NODE=M001G4  
 NODE=M001G4

NEW

NEW

NODE=M001G4;LINKAGE=A

NODE=M001G4;LINKAGE=LP  
 NODE=M001G4;LINKAGE=BE  
 NODE=M001G;LINKAGE=SH

$$\Gamma(e^+e^-)/\Gamma_{\text{total}} \times \Gamma(\pi^+\pi^-)/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma \times \Gamma_3/\Gamma$$

VALUE (units  $10^{-6}$ ) EVTS DOCUMENT ID TECN COMMENT

**1.28 ± 0.05 OUR AVERAGE**

[(1.23 ± 0.07) × 10<sup>-6</sup> OUR 2020 AVERAGE]

1.318 ± 0.051 ± 0.021 1 ACHASOV 21 SND  $e^+e^- \rightarrow \pi^+\pi^-$

1.225 ± 0.058 ± 0.041 800k 2 ACHASOV 06 SND  $e^+e^- \rightarrow \pi^+\pi^-$

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.166 ± 0.036 3 BENAYOUN 13 RVUE 0.4–1.05  $e^+e^-$

1.05 ± 0.08 4 DAVIER 13 RVUE  $e^+e^- \rightarrow \pi^+\pi^-(\gamma)$

<sup>1</sup> From a fit of the cross section in the energy range  $0.525 < \sqrt{s} < 0.883$  GeV parameterized by the sum of the Breit-Wigner amplitudes for the  $\rho(770)$ ,  $\omega$  and  $\rho(1450)$  resonances. The measured phase of the  $\rho(770)$ — $\omega$  interference is  $(110.7 \pm 1.5 \pm 1.0)^\circ$ .

<sup>2</sup> Supersedes ACHASOV 05A.

<sup>3</sup> A simultaneous fit to  $e^+e^- \rightarrow \pi^+\pi^-, \pi^+\pi^-\pi^0, \pi^0\gamma, \eta\gamma, K\bar{K}$ , and  $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$  data. Supersedes BENAYOUN 10.

<sup>4</sup> From  $e^+e^- \rightarrow \pi^+\pi^-(\gamma)$  data of LEES 12G.

NODE=M001G5

NODE=M001G5

NEW

NODE=M001G5;LINKAGE=C

NODE=M001G5;LINKAGE=AC

NODE=M001G5;LINKAGE=B

NODE=M001G5;LINKAGE=A

$$\Gamma(e^+e^-)/\Gamma_{\text{total}} \times \Gamma(\eta\gamma)/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma \times \Gamma_5/\Gamma$$

VALUE (units  $10^{-8}$ ) EVTS DOCUMENT ID TECN COMMENT

**3.32 ± 0.28 OUR FIT** Error includes scale factor of 1.1.

**3.18 ± 0.28 OUR AVERAGE**

3.10 ± 0.31 ± 0.11 33k 1 ACHASOV 07B SND 0.6–1.38  $e^+e^- \rightarrow \eta\gamma$

3.17<sup>+1.85</sup><sub>-1.31</sub> ± 0.21 17.4k 2 AKHMETSHIN 05 CMD2 0.60–1.38  $e^+e^- \rightarrow \eta\gamma$

3.41 ± 0.52 ± 0.21 23k 3,4 AKHMETSHIN 01B CMD2  $e^+e^- \rightarrow \eta\gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

4.50 ± 0.10 5 BENAYOUN 10 RVUE 0.4–1.05  $e^+e^-$

<sup>1</sup> From a combined fit of  $\sigma(e^+e^- \rightarrow \eta\gamma)$  with  $\eta \rightarrow 3\pi^0$  and  $\eta \rightarrow \pi^+\pi^-\pi^0$ , and fixing  $B(\eta \rightarrow 3\pi^0) / B(\eta \rightarrow \pi^+\pi^-\pi^0) = 1.44 \pm 0.04$ . Recalculated by us from the cross section at the peak. Supersedes ACHASOV 00D and ACHASOV 06A.

<sup>2</sup> From the  $\eta \rightarrow 2\gamma$  decay and using  $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$ .

<sup>3</sup> From the  $\eta \rightarrow 3\pi^0$  decay and using  $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$ .

<sup>4</sup> The combined fit from 600 to 1380 MeV taking into account  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$ , and  $\rho(1450)$  (mass and width fixed at 1450 MeV and 310 MeV respectively).

<sup>5</sup> A simultaneous fit of  $e^+e^- \rightarrow \pi^+\pi^-, \pi^+\pi^-\pi^0, \pi^0\gamma, \eta\gamma$  data.

NODE=M001G3

NODE=M001G3

NODE=M001G3;LINKAGE=AH

NODE=M001G;LINKAGE=AH

NODE=M001G;LINKAGE=AK

NODE=M001G;LINKAGE=BQ

NODE=M001G3;LINKAGE=BE

$$\Gamma(e^+e^-)/\Gamma_{\text{total}} \times \Gamma(\mu^+\mu^-)/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma \times \Gamma_{15}/\Gamma$$

VALUE (units  $10^{-9}$ ) EVTS DOCUMENT ID TECN COMMENT

**4.3 ± 1.8 ± 2.2** 4.5M 1 ANASTASI 17 KLOE  $e^+e^- \rightarrow \mu^+\mu^-\gamma$

<sup>1</sup> From a fit of the real part of the vacuum polarization by a sum of the leptonic and hadronic contributions, where the hadronic contribution is parametrized as a sum of Breit-Wigner resonances  $\omega(782)$ ,  $\phi(1020)$  and using a GOUNARIS 68 parametrization for the  $\rho(770)$ , and a non-resonant term.

NODE=M001G01

NODE=M001G01

NODE=M001G01;LINKAGE=A

## $\omega(782)$ BRANCHING RATIOS

NODE=M001220

$$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}} \quad \Gamma_1/\Gamma$$

NIECKNIG 12 describes final-state interactions between the three pions in a dispersive framework using data on the  $\pi\pi$   $P$ -wave scattering phase shift.

VALUE EVTS DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.9024 ± 0.0019 1 AMBROSINO 08G KLOE 1.0–1.03  $e^+e^- \rightarrow \pi^+\pi^-\pi^0, 2\pi^0\gamma$

0.8965 ± 0.0016 ± 0.0048 1.2M 2,3 ACHASOV 03D RVUE 0.44–2.00  $e^+e^- \rightarrow \pi^+\pi^-\pi^0$

0.880 ± 0.020 ± 0.032 11200 3,4 AKHMETSHIN 00C CMD2  $e^+e^- \rightarrow \pi^+\pi^-\pi^0$

0.8942 ± 0.0062 3 DOLINSKY 89 ND  $e^+e^- \rightarrow \pi^+\pi^-\pi^0$

<sup>1</sup> Not independent of  $\Gamma(\pi^0\gamma) / \Gamma(\pi^+\pi^-\pi^0)$  from AMBROSINO 08G.

<sup>2</sup> Using ACHASOV 03, ACHASOV 03D and  $B(\omega \rightarrow \pi^+\pi^-) = (1.70 \pm 0.28)\%$ .

<sup>3</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}^2$ .

<sup>4</sup> Using  $\Gamma(e^+e^-) = 0.60 \pm 0.02$  keV.

NODE=M001R21

NODE=M001R21

NODE=M001R21

NODE=M001R21;LINKAGE=AM

NODE=M001R;LINKAGE=VF

NODE=M001R;LINKAGE=ZL

NODE=M001R;LINKAGE=KH

$\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ VALUE (units  $10^{-2}$ ) EVTS

DOCUMENT ID

TECN

COMMENT

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

|                |      |     |            |     |      |                                                     |
|----------------|------|-----|------------|-----|------|-----------------------------------------------------|
| 8.88±0.18      |      | 1   | ACHASOV    | 16A | SND  | 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$          |
| 8.09±0.14      |      | 2   | AMBROSINO  | 08G | KLOE | $e^+e^- \rightarrow \pi^+\pi^-2\pi^0, 2\pi^0\gamma$ |
| 9.06±0.20±0.57 | 18k  | 3,4 | AKHMETSHIN | 05  | CMD2 | 0.60–1.38 $e^+e^- \rightarrow \pi^0\gamma$          |
| 9.34±0.15±0.31 | 36k  | 4   | ACHASOV    | 03  | SND  | 0.60–0.97 $e^+e^- \rightarrow \pi^0\gamma$          |
| 8.65±0.16±0.42 | 1.2M | 5,6 | ACHASOV    | 03D | RVUE | 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$      |
| 8.39±0.24      | 9k   | 7   | BENAYOUN   | 96  | RVUE | $e^+e^- \rightarrow \pi^0\gamma$                    |
| 8.88±0.62      | 10k  | 4   | DOLINSKY   | 89  | ND   | $e^+e^- \rightarrow \pi^0\gamma$                    |

<sup>1</sup> Using  $B(\omega \rightarrow e^+e^-)$  from PDG 15. Supersedes ACHASOV 03.<sup>2</sup> Not independent of  $\Gamma(\pi^0\gamma) / \Gamma(\pi^+\pi^-\pi^0)$  from AMBROSINO 08G.<sup>3</sup> Using  $B(\omega \rightarrow e^+e^-) = (7.14 \pm 0.13) \times 10^{-5}$ .<sup>4</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\pi^0\gamma)/\Gamma_{\text{total}}^2$ .<sup>5</sup> Using ACHASOV 03, ACHASOV 03D and  $B(\omega \rightarrow \pi^+\pi^-) = (1.70 \pm 0.28)\%$ .<sup>6</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}^2$ .<sup>7</sup> Reanalysis of DRUZHININ 84, DOLINSKY 89, DOLINSKY 91 taking into account the triangle anomaly contributions.NODE=M001R28  
NODE=M001R28NODE=M001R28;LINKAGE=A  
NODE=M001R28;LINKAGE=AM  
NODE=M001R;LINKAGE=AH  
NODE=M001R;LINKAGE=VL  
NODE=M001R28;LINKAGE=VF  
NODE=M001R28;LINKAGE=ZL  
NODE=M001R28;LINKAGE=A1 $\Gamma(\pi^0\gamma)/\Gamma(\pi^+\pi^-\pi^0)$  $\Gamma_2/\Gamma_1$ VALUE (units  $10^{-2}$ )

DOCUMENT ID

TECN

COMMENT

**9.34±0.29 OUR FIT** Error includes scale factor of 2.3.  $[(9.41 \pm 0.23) \times 10^{-2}]$  OUR 2020 FIT Scale factor = 2.0]**9.05±0.27 OUR AVERAGE** Error includes scale factor of 1.8.

|                |  |   |           |     |      |                                                     |
|----------------|--|---|-----------|-----|------|-----------------------------------------------------|
| 8.97±0.16      |  |   | AMBROSINO | 08G | KLOE | $e^+e^- \rightarrow \pi^+\pi^-2\pi^0, 2\pi^0\gamma$ |
| 9.94±0.36±0.38 |  | 1 | AULCHENKO | 00A | SND  | $e^+e^- \rightarrow \pi^+\pi^-2\pi^0, 2\pi^0\gamma$ |
| 8.4 ±1.3       |  |   | KEYNE     | 76  | CNTR | $\pi^-p \rightarrow \omega n$                       |
| 10.9 ±2.5      |  |   | BENAKSAS  | 72C | OSPK | $e^+e^- \rightarrow \pi^0\gamma$                    |
| 8.1 ±2.0       |  |   | BALDIN    | 71  | HLBC | $2.9 \pi^+p$                                        |
| 13 ±4          |  |   | JACQUET   | 69B | HLBC | $2.05 \pi^+p \rightarrow \pi^+p\omega$              |

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

|               |  |     |          |     |      |                                                |
|---------------|--|-----|----------|-----|------|------------------------------------------------|
| 9.7 ±0.2 ±0.5 |  | 2,3 | ACHASOV  | 03D | RVUE | 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 9.9 ±0.7      |  | 2   | DOLINSKY | 89  | ND   | $e^+e^- \rightarrow \pi^0\gamma$               |

<sup>1</sup> From  $\sigma_0^{\omega\pi^0} \rightarrow \pi^0\pi^0\gamma(m_\phi)/\sigma_0^{\omega\pi^0} \rightarrow \pi^+\pi^-\pi^0\pi^0(m_\phi)$  with a phase-space correction factor of 1/1.023.<sup>2</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\pi^0\gamma)/\Gamma_{\text{total}}^2$ .<sup>3</sup> Using ACHASOV 03. Based on 1.2M events.NODE=M001R3  
NODE=M001R3

NEW

NODE=M001R3;LINKAGE=AL

NODE=M001R3;LINKAGE=VL  
NODE=M001R3;LINKAGE=VW $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ See also  $\Gamma(\pi^+\pi^-)/\Gamma(\pi^+\pi^-\pi^0)$ .VALUE (units  $10^{-2}$ ) EVTS

DOCUMENT ID

TECN

COMMENT

**1.53<sup>+0.11</sup><sub>-0.13</sub> OUR FIT** Error includes scale factor of 1.2.  $[(1.53 \pm 0.06) \times 10^{-2}]$  OUR 2020 FIT]**1.49±0.13 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.  $[(1.51 \pm 0.07) \times 10^{-2}]$  OUR 2020 AVERAGE Scale factor = 1.1]

|                                              |       |     |              |     |      |                                               |
|----------------------------------------------|-------|-----|--------------|-----|------|-----------------------------------------------|
| 1.46±0.12±0.02                               | 900k  | 1   | AKHMETSHIN   | 07  |      | $e^+e^- \rightarrow \pi^+\pi^-$               |
| 1.30±0.24±0.05                               | 11.2k | 2   | AKHMETSHIN   | 04  | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-$               |
| 2.38 <sup>+1.77</sup> <sub>-0.90</sub> ±0.18 | 5.4k  | 3   | ACHASOV      | 02E | SND  | 1.1–1.38 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 2.3 ±0.5                                     |       |     | BARKOV       | 85  | OLYA | $e^+e^- \rightarrow \pi^+\pi^-$               |
| 1.6 <sup>+0.9</sup> <sub>-0.7</sub>          |       |     | QUENZER      | 78  | DM1  | $e^+e^- \rightarrow \pi^+\pi^-$               |
| 3.6 ±1.9                                     |       |     | BENAKSAS     | 72  | OSPK | $e^+e^- \rightarrow \pi^+\pi^-$               |
| 1.29±0.22±0.03                               | 970k  | 4,5 | ABLIKIM      | 18C | BES3 | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$     |
| 1.28±0.22±0.03                               | 970k  | 6,7 | ABLIKIM      | 18C | BES3 | $\eta'(958) \rightarrow \gamma\pi^+\pi^-$     |
| 1.52±0.08                                    |       | 8   | HANHART      | 18  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$               |
| 1.75±0.11                                    | 4.5M  | 9   | ACHASOV      | 05A | SND  | $e^+e^- \rightarrow \pi^+\pi^-$               |
| 2.01±0.29                                    |       | 10  | BENAYOUN     | 03  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$               |
| 1.9 ±0.3                                     |       | 11  | GARDNER      | 99  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$               |
| 2.3 ±0.4                                     |       | 12  | BENAYOUN     | 98  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-, \mu^+\mu^-$   |
| 1.0 ±0.11                                    |       | 13  | WICKLUND     | 78  | ASPK | $3,4,6 \pi^\pm N$                             |
| 1.22±0.30                                    |       |     | ALVENSLEB... | 71C | CNTR | Photoproduction                               |
| 1.3 <sup>+1.2</sup> <sub>-0.9</sub>          |       |     | MOFFEIT      | 71  | HBC  | $2,8,4,7 \gamma p$                            |
| 0.80 <sup>+0.28</sup> <sub>-0.20</sub>       |       | 14  | BIGGS        | 70B | CNTR | $4,2 \gamma C \rightarrow \pi^+\pi^-C$        |

NODE=M001R15  
NODE=M001R15  
NODE=M001R15

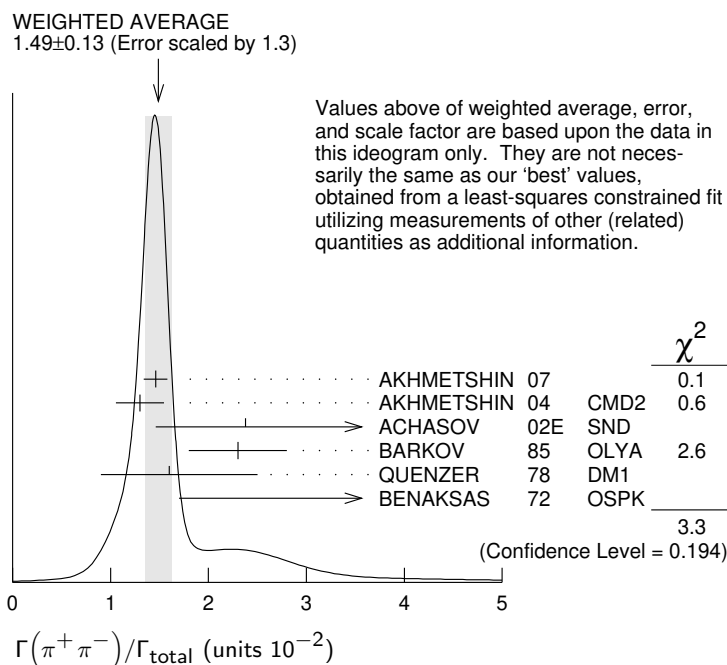
NEW

NEW

OCCUR=3  
OCCUR=2

- <sup>1</sup> A combined fit of AKHMETSHIN 07, AULCHENKO 06, and AULCHENKO 05.
- <sup>2</sup> Update of AKHMETSHIN 02.
- <sup>3</sup> From the  $m_{\pi^+\pi^-}$  spectrum taking into account the interference of the  $\rho\pi$  and  $\omega\pi$  amplitudes.
- <sup>4</sup> From a fit to  $\pi^+\pi^-$  mass using  $\rho(770)$  (parametrized with the Gounaris-Sakurai approach),  $\omega(782)$ , and box anomaly components.
- <sup>5</sup> ABLIKIM 18C reports  $[\Gamma(\omega(782) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\eta'(958) \rightarrow \omega\gamma)] = (3.25 \pm 0.21 \pm 0.52) \times 10^{-4}$  which we divide by our best value  $B(\eta'(958) \rightarrow \omega\gamma) = (2.52 \pm 0.07) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.
- <sup>6</sup> From a fit to  $\pi^+\pi^-$  mass using  $\rho(770)$  (parametrized with the Gounaris-Sakurai approach),  $\omega(782)$ , and  $\rho(1450)$  components.
- <sup>7</sup> ABLIKIM 18C reports  $[\Gamma(\omega(782) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\eta'(958) \rightarrow \omega\gamma)] = (3.22 \pm 0.21 \pm 0.52) \times 10^{-4}$  which we divide by our best value  $B(\eta'(958) \rightarrow \omega\gamma) = (2.52 \pm 0.07) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.
- <sup>8</sup> Dispersive analysis. Value extracted from average of data from AUBERT 09AS, AKHMETSHIN 07, ACHASOV 06, AMBROSINO 11A, BABUSCI 13D, ABLIKIM 16B normalised by PDG 16 evaluation for  $\Gamma(\omega \rightarrow e^+e^-)$ .
- <sup>9</sup> Using  $\Gamma(\omega \rightarrow e^+e^-)$  from the 2004 Edition of this Review (PDG 04).
- <sup>10</sup> Using the data of AKHMETSHIN 02 in the hidden local symmetry model.
- <sup>11</sup> Using the data of BARKOV 85.
- <sup>12</sup> Using the data of BARKOV 85 in the hidden local symmetry model.
- <sup>13</sup> From a model-dependent analysis assuming complete coherence.
- <sup>14</sup> Re-evaluated under  $\Gamma(\pi^+\pi^-)/\Gamma(\pi^+\pi^-\pi^0)$  by BEHREND 71 using more accurate  $\omega \rightarrow \rho$  photoproduction cross-section ratio.

NODE=M001R15;LINKAGE=AK  
 NODE=M001R15;LINKAGE=PT  
 NODE=M001R;LINKAGE=VE  
 NODE=M001R15;LINKAGE=E  
 NODE=M001R15;LINKAGE=H  
 NODE=M001R15;LINKAGE=J  
 NODE=M001R15;LINKAGE=K  
 NODE=M001R15;LINKAGE=D  
 NODE=M001R;LINKAGE=SN  
 NODE=M001R;LINKAGE=BY  
 NODE=M001R15;LINKAGE=H4  
 NODE=M001R15;LINKAGE=Q  
 NODE=M001R15;LINKAGE=F  
 NODE=M001R15;LINKAGE=B



$\Gamma(\pi^+\pi^-)/\Gamma(\pi^+\pi^-\pi^0)$

$\Gamma_3/\Gamma_1$

See also  $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$ .

| VALUE                          | DOCUMENT ID | TECN | COMMENT                                                            |
|--------------------------------|-------------|------|--------------------------------------------------------------------|
| <b>0.0172 ± 0.0014 OUR FIT</b> |             |      | Error includes scale factor of 1.2. [0.0171 ± 0.0007 OUR 2020 FIT] |

**0.026 ± 0.005 OUR AVERAGE**

|                        |                         |    |      |                                 |
|------------------------|-------------------------|----|------|---------------------------------|
| 0.021 +0.028<br>-0.009 | <sup>1,2</sup> RATCLIFF | 72 | ASPK | 15 $\pi^- p \rightarrow n 2\pi$ |
| 0.028 ± 0.006          | <sup>1</sup> BEHREND    | 71 | ASPK | Photoproduction                 |
| 0.022 +0.009<br>-0.01  | <sup>3</sup> ROOS       | 70 | RVUE |                                 |

<sup>1</sup> The fitted width of these data is 160 MeV in agreement with present average, thus the  $\omega$  contribution is overestimated. Assuming  $\rho$  width 145 MeV.

<sup>2</sup> Significant interference effect observed. NB of  $\omega \rightarrow 3\pi$  comes from an extrapolation.

<sup>3</sup> ROOS 70 combines ABRAMOVICH 70 and BIZZARRI 70.

NODE=M001R2  
 NODE=M001R2  
 NODE=M001R2  
 NEW

NODE=M001R2;LINKAGE=A

NODE=M001R2;LINKAGE=S  
 NODE=M001R2;LINKAGE=R

$\Gamma(\pi^+\pi^-)/\Gamma(\pi^0\gamma)$  $\Gamma_3/\Gamma_2$ 

| VALUE            | EVTS  | DOCUMENT ID          | TECN | COMMENT |
|------------------|-------|----------------------|------|---------|
| <b>0.20±0.04</b> | 1.98M | <sup>1</sup> ALOISIO | 03   | KLOE    |

 $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ <sup>1</sup> Using the data of ALOISIO 02D.NODE=M001R33  
NODE=M001R33

NODE=M001R;LINKAGE=KL

 $\Gamma(\text{neutrals})/\Gamma_{\text{total}}$  $(\Gamma_2+\Gamma_4)/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.091±0.006 OUR FIT****0.081±0.011 OUR AVERAGE**

|                                                                               |    |          |     |      |                |
|-------------------------------------------------------------------------------|----|----------|-----|------|----------------|
| 0.075±0.025                                                                   |    | BIZZARRI | 71  | HBC  | 0.0 $p\bar{p}$ |
| 0.079±0.019                                                                   |    | DEINET   | 69B | OSPK | 1.5 $\pi^- p$  |
| 0.084±0.015                                                                   |    | BOLLINI  | 68C | CNTR | 2.1 $\pi^- p$  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |    |          |     |      |                |
| 0.073±0.018                                                                   | 42 | BASILE   | 72B | CNTR | 1.67 $\pi^- p$ |

NODE=M001R14  
NODE=M001R14 $\Gamma(\text{neutrals})/\Gamma(\pi^+\pi^-\pi^0)$  $(\Gamma_2+\Gamma_4)/\Gamma_1$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.102±0.008 OUR FIT****0.103<sup>+0.011</sup><sub>-0.010</sub> OUR AVERAGE**

|                                                                               |     |             |     |      |                                          |
|-------------------------------------------------------------------------------|-----|-------------|-----|------|------------------------------------------|
| 0.15 ±0.04                                                                    | 46  | AGUILAR-... | 72B | HBC  | 3.9,4.6 $K^- p$                          |
| 0.10 ±0.03                                                                    | 19  | BARASH      | 67B | HBC  | 0.0 $\bar{p}p$                           |
| 0.134±0.026                                                                   | 850 | DIGIUGNO    | 66B | CNTR | 1.4 $\pi^- p$                            |
| 0.097±0.016                                                                   | 348 | FLATTE      | 66  | HBC  | 1.4 – 1.7 $K^- p \rightarrow \Lambda MM$ |
| 0.06 <sup>+0.05</sup> <sub>-0.02</sub>                                        |     | JAMES       | 66  | HBC  | 2.1 $\pi^+ p$                            |
| 0.08 ±0.03                                                                    | 35  | KRAEMER     | 64  | DBC  | 1.2 $\pi^+ d$                            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |     |      |                                          |
| 0.11 ±0.02                                                                    | 20  | BUSCHBECK   | 63  | HBC  | 1.5 $K^- p$                              |

NODE=M001R1  
NODE=M001R1 $\Gamma(\pi^0\gamma)/\Gamma(\text{neutrals})$  $\Gamma_2/(\Gamma_2+\Gamma_4)$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |    |                    |     |      |                                |
|-----------|----|--------------------|-----|------|--------------------------------|
| 0.78±0.07 |    | <sup>1</sup> DAKIN | 72  | OSPK | 1.4 $\pi^- p \rightarrow n MM$ |
| >0.81     | 90 | DEINET             | 69B | OSPK |                                |

<sup>1</sup> Error statistical only. Authors obtain good fit also assuming  $\pi^0\gamma$  as the only neutral decay.NODE=M001R18  
NODE=M001R18

NODE=M001R18;LINKAGE=D

 $\Gamma(\text{neutrals})/\Gamma(\text{charged particles})$  $(\Gamma_2+\Gamma_4)/(\Gamma_1+\Gamma_3)$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.100±0.008 OUR FIT****0.124±0.021**FELDMAN 67C OSPK 1.2  $\pi^- p$ NODE=M001R9  
NODE=M001R9 $\Gamma(\eta\gamma)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units 10 <sup>-4</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

**4.5 ±0.4 OUR FIT** Error includes scale factor of 1.1.**6.3 ±1.3 OUR AVERAGE** Error includes scale factor of 1.2.

|                                                                               |       |                           |     |      |                                            |
|-------------------------------------------------------------------------------|-------|---------------------------|-----|------|--------------------------------------------|
| 6.6 ±1.7                                                                      |       | <sup>1</sup> ABELE        | 97E | CBAR | 0.0 $\bar{p}p \rightarrow 5\gamma$         |
| 8.3 ±2.1                                                                      |       | ALDE                      | 93  | GAM2 | 38 $\pi^- p \rightarrow \omega n$          |
| 3.0 <sup>+2.5</sup> <sub>-1.8</sub>                                           |       | <sup>2</sup> ANDREWS      | 77  | CNTR | 6.7–10 $\gamma Cu$                         |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                           |     |      |                                            |
| 4.2 ±0.4 ±0.1                                                                 | 33k   | <sup>3</sup> ACHASOV      | 07B | SND  | 0.6–1.38 $e^+ e^- \rightarrow \eta\gamma$  |
| 4.44 <sup>+2.59</sup> <sub>-1.83</sub> ±0.28                                  | 17.4k | <sup>4,5</sup> AKHMETSHIN | 05  | CMD2 | 0.60–1.38 $e^+ e^- \rightarrow \eta\gamma$ |
| 5.10±0.72±0.34                                                                | 23k   | <sup>6</sup> AKHMETSHIN   | 01B | CMD2 | $e^+ e^- \rightarrow \eta\gamma$           |
| 0.7 to 5.5                                                                    |       | <sup>7</sup> CASE         | 00  | CBAR | 0.0 $p\bar{p} \rightarrow \eta\eta\gamma$  |
| 6.56 <sup>+2.41</sup> <sub>-2.55</sub>                                        | 3525  | <sup>2,8</sup> BENAYOUN   | 96  | RVUE | $e^+ e^- \rightarrow \eta\gamma$           |
| 7.3 ±2.9                                                                      |       | <sup>2,4</sup> DOLINSKY   | 89  | ND   | $e^+ e^- \rightarrow \eta\gamma$           |

NODE=M001R19  
NODE=M001R19

<sup>1</sup> No flat  $\eta\eta\gamma$  background assumed.

<sup>2</sup> Solution corresponding to constructive  $\omega$ - $\rho$  interference.

<sup>3</sup> ACHASOV 07B reports  $[\Gamma(\omega(782) \rightarrow \eta\gamma)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow e^+e^-)] = (3.10 \pm 0.31 \pm 0.11) \times 10^{-8}$  which we divide by our best value  $B(\omega(782) \rightarrow e^+e^-) = (7.39 \pm 0.19) \times 10^{-5}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. Supersedes ACHASOV 00D and ACHASOV 06A.

<sup>4</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\eta\gamma)/\Gamma_{\text{total}}^2$ .

<sup>5</sup> Using  $B(\omega \rightarrow e^+e^-) = (7.14 \pm 0.13) \times 10^{-5}$  and  $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$ .

<sup>6</sup> Using  $B(\omega \rightarrow e^+e^-) = (7.07 \pm 0.19) \times 10^{-5}$  and using  $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$ . Solution corresponding to constructive  $\omega$ - $\rho$  interference. The combined fit from 600 to 1380 MeV taking into account  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$ , and  $\rho(1450)$  (mass and width fixed at 1450 MeV and 310 MeV respectively). Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\eta\gamma)/\Gamma_{\text{total}}^2$ .

<sup>7</sup> Depending on the degree of coherence with the flat  $\eta\eta\gamma$  background and using  $B(\omega \rightarrow \pi^0\gamma) = (8.5 \pm 0.5) \times 10^{-2}$ .

<sup>8</sup> Reanalysis of DRUZHININ 84, DOLINSKY 89, DOLINSKY 91 taking into account the triangle anomaly contributions.

NODE=M001R;LINKAGE=EA  
NODE=M001R19;LINKAGE=A  
NODE=M001R19;LINKAGE=AO

NODE=M001R13;LINKAGE=WL  
NODE=M001R19;LINKAGE=AK  
NODE=M001R19;LINKAGE=TS

NODE=M001R;LINKAGE=CS

NODE=M001R19;LINKAGE=A1

## $\Gamma(\eta\gamma)/\Gamma(\pi^0\gamma)$

VALUE DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |                       |     |      |                                    |
|-----------------|-----------------------|-----|------|------------------------------------|
| 0.0098 ± 0.0024 | <sup>1</sup> ALDE     | 93  | GAM2 | $38\pi^- p \rightarrow \omega n$   |
| 0.0082 ± 0.0033 | <sup>2</sup> DOLINSKY | 89  | ND   | $e^+e^- \rightarrow \eta\gamma$    |
| 0.010 ± 0.045   | APEL                  | 72B | OSPK | $4-8 \pi^- p \rightarrow n3\gamma$ |

<sup>1</sup> Model independent determination.

<sup>2</sup> Solution corresponding to constructive  $\omega$ - $\rho$  interference.

NODE=M001R11;LINKAGE=A  
NODE=M001R11;LINKAGE=K

## $\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$

VALUE (units  $10^{-4}$ ) EVTS DOCUMENT ID TECN COMMENT

**7.7 ± 0.6 OUR FIT**

**7.7 ± 0.6 OUR AVERAGE**

|                    |             |     |      |                                              |
|--------------------|-------------|-----|------|----------------------------------------------|
| 7.61 ± 0.53 ± 0.64 | ACHASOV     | 08  | SND  | $0.36-0.97 e^+e^- \rightarrow \pi^0 e^+ e^-$ |
| 8.19 ± 0.71 ± 0.62 | AKHMETSHIN  | 05A | CMD2 | $0.72-0.84 e^+e^-$                           |
| 5.9 ± 1.9          | 43 DOLINSKY | 88  | ND   | $e^+e^- \rightarrow \pi^0 e^+ e^-$           |

NODE=M001R23  
NODE=M001R23

## $\Gamma(\pi^0 \mu^+ \mu^-)/\Gamma_{\text{total}}$

VALUE (units  $10^{-4}$ ) EVTS DOCUMENT ID TECN COMMENT

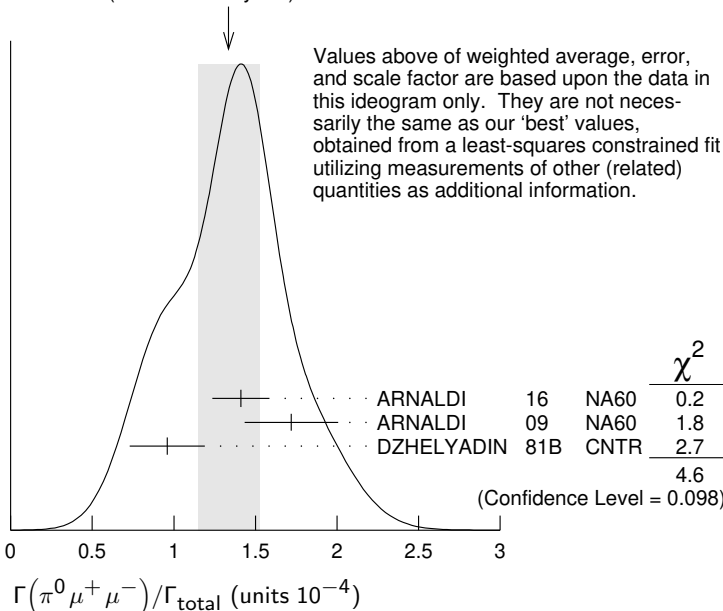
**1.34 ± 0.18 OUR FIT** Error includes scale factor of 1.5.

**1.34 ± 0.19 OUR AVERAGE** Error includes scale factor of 1.5. See the ideogram below.

|                    |            |     |      |                                      |
|--------------------|------------|-----|------|--------------------------------------|
| 1.41 ± 0.09 ± 0.15 | ARNALDI    | 16  | NA60 | 400 GeV ( $p$ -A) collisions         |
| 1.72 ± 0.25 ± 0.14 | 3k ARNALDI | 09  | NA60 | 158A In-In collisions                |
| 0.96 ± 0.23        | DZHELYADIN | 81B | CNTR | $25-33 \pi^- p \rightarrow \omega n$ |

NODE=M001R12  
NODE=M001R12

WEIGHTED AVERAGE  
1.34 ± 0.19 (Error scaled by 1.5)





$\Gamma(\eta^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt;1.1

AKHMETSHIN 05A CMD2 0.72-0.84  $e^+ e^-$ NODE=M001R34  
NODE=M001R34 $\Gamma(e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**0.739±0.019 OUR FIT** Error includes scale factor of 1.7.  $[(0.736 \pm 0.015) \times 10^{-4} \text{ OUR 2020 FIT Scale factor} = 1.5]$ NODE=M001R13  
NODE=M001R13

NEW

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.700±0.016 11200 <sup>1,2</sup> AKHMETSHIN 04 CMD2  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ 0.752±0.004±0.024 1.2M <sup>2,3</sup> ACHASOV 03D RVUE 0.44–2.00  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ 0.714±0.036 <sup>2</sup> DOLINSKY 89 ND  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ 0.72 ±0.03 <sup>2</sup> BARKOV 87 CMD  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ 0.64 ±0.04 1488 <sup>2</sup> KURDADZE 83B OLYA  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ 0.675±0.069 433 <sup>2</sup> CORDIER 80 DM1  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ 0.83 ±0.10 451 <sup>2</sup> BENAKSAS 72B OSPK  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ 0.77 ±0.06 <sup>4</sup> AUGUSTIN 69D OSPK  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ 0.65 ±0.13 33 <sup>5</sup> ASTVACAT... 68 OSPK Assume SU(3)+mixing<sup>1</sup> Using  $B(\omega \rightarrow \pi^+ \pi^- \pi^0) = 0.891 \pm 0.007$ . Update of AKHMETSHIN 00C.<sup>2</sup> Not independent of the corresponding  $\Gamma(e^+ e^-) \times \Gamma(\pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}^2$ .<sup>3</sup> Using ACHASOV 03, ACHASOV 03D and  $B(\omega \rightarrow \pi^+ \pi^-) = (1.70 \pm 0.28)\%$ .<sup>4</sup> Rescaled by us to correspond to  $\omega$  width 8.4 MeV. Systematic errors underestimated.<sup>5</sup> Not resolved from  $\rho$  decay. Error statistical only.

NODE=M001R13;LINKAGE=4P

NODE=M001R13;LINKAGE=ZL

NODE=M001R13;LINKAGE=VF

NODE=M001R13;LINKAGE=E

NODE=M001R13;LINKAGE=A

 $\Gamma(\pi^+ \pi^- \pi^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ VALUE (units  $10^{-4}$ )

CL%

DOCUMENT ID

TECN

COMMENT

< 2 90 ACHASOV 09A SND  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \pi^0$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

<200 90 KURDADZE 86 OLYA  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \pi^0$ NODE=M001R5  
NODE=M001R5 $\Gamma(\pi^+ \pi^- \gamma)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

<0.0036 95 WEIDENAUER 90 ASTE  $p\bar{p} \rightarrow \pi^+ \pi^- \pi^+ \pi^- \gamma$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.004 95 BITYUKOV 88B SPEC 32  $\pi^- p \rightarrow \pi^+ \pi^- \gamma X$ NODE=M001R22  
NODE=M001R22 $\Gamma(\pi^+ \pi^- \gamma)/\Gamma(\pi^+ \pi^- \pi^0)$  $\Gamma_{11}/\Gamma_1$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.066 90 KALBFLEISCH 75 HBC 2.18  $K^- p \rightarrow \Lambda \pi^+ \pi^- \gamma$ <0.05 90 FLATTE 66 HBC 1.2 – 1.7  $K^- p \rightarrow \Lambda \pi^+ \pi^- \gamma$ NODE=M001R4  
NODE=M001R4 $\Gamma(\pi^+ \pi^- \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

<1 × 10<sup>-3</sup> 90 KURDADZE 88 OLYA  $e^+ e^- \rightarrow \pi^+ \pi^- \pi^+ \pi^-$ NODE=M001R24  
NODE=M001R24 $\Gamma(\pi^0 \pi^0 \gamma)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**6.7±1.1 OUR FIT****6.5±1.2 OUR AVERAGE**6.4<sup>+2.4</sup><sub>-2.0</sub>±0.8 190 <sup>1</sup> AKHMETSHIN 04B CMD2 0.6–0.97  $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$ 6.6<sup>+1.4</sup><sub>-1.3</sub>±0.6 295 ACHASOV 02F SND 0.36–0.97  $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

11.8<sup>+2.1</sup><sub>-1.9</sub>±1.4 190 <sup>2</sup> AKHMETSHIN 04B CMD2 0.6–0.97  $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$ 7.8±2.7±2.0 63 <sup>1,3</sup> ACHASOV 00G SND  $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$ 12.7±2.3±2.5 63 <sup>2,3</sup> ACHASOV 00G SND  $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$ NODE=M001R29  
NODE=M001R29

OCCUR=2

OCCUR=2

<sup>1</sup> In the model assuming the  $\rho \rightarrow \pi^0 \pi^0 \gamma$  decay via the  $\omega\pi$  and  $f_0(500)\gamma$  mechanisms.<sup>2</sup> In the model assuming the  $\rho \rightarrow \pi^0 \pi^0 \gamma$  decay via the  $\omega\pi$  mechanism only.<sup>3</sup> Superseded by ACHASOV 02F.

NODE=M001R29;LINKAGE=A

NODE=M001R29;LINKAGE=B

NODE=M001R;LINKAGE=GF

$$\Gamma(\pi^0\pi^0\gamma)/\Gamma(\pi^+\pi^-\pi^0)$$

$$\Gamma_{13}/\Gamma_1$$

| VALUE                                                                         | CL% | DOCUMENT ID | TECN     | COMMENT                                   |
|-------------------------------------------------------------------------------|-----|-------------|----------|-------------------------------------------|
| <b>&lt;0.00045</b>                                                            | 90  | DOLINSKY    | 89 ND    | $e^+e^- \rightarrow \pi^0\pi^0\gamma$     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                                           |
| <0.08                                                                         | 95  | JACQUET     | 69B HLBC | $2.05 \pi^+ p \rightarrow \pi^+ p \omega$ |

NODE=M001R10  
NODE=M001R10

$$\Gamma(\pi^0\pi^0\gamma)/\Gamma(\pi^0\gamma)$$

$$\Gamma_{13}/\Gamma_2$$

| VALUE (units $10^{-4}$ )                                                      | CL%         | EVTS | DOCUMENT ID | TECN     | COMMENT                                    |
|-------------------------------------------------------------------------------|-------------|------|-------------|----------|--------------------------------------------|
| <b><math>8.0 \pm 1.3</math> OUR FIT</b>                                       |             |      |             |          |                                            |
| [( $7.9 \pm 1.3$ ) $\times 10^{-4}$ OUR 2020 FIT]                             |             |      |             |          |                                            |
| <b><math>8.5 \pm 2.9</math></b>                                               | $40 \pm 14$ |      | ALDE        | 94B GAM2 | $38\pi^- p \rightarrow \pi^0\pi^0\gamma n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |             |          |                                            |
| < 50                                                                          | 90          |      | DOLINSKY    | 89 ND    | $e^+e^- \rightarrow \pi^0\pi^0\gamma$      |
| <1800                                                                         | 95          |      | KEYNE       | 76 CNTR  | $\pi^- p \rightarrow \omega n$             |
| <1500                                                                         | 90          |      | BENAKSAS    | 72C OSPK | $e^+e^-$                                   |
| <1400                                                                         |             |      | BALDIN      | 71 HLBC  | $2.9 \pi^+ p$                              |
| <1000                                                                         | 90          |      | BARMIN      | 64 HLBC  | $1.3-2.8 \pi^- p$                          |

NODE=M001R7  
NODE=M001R7  
NEW

$$\Gamma(\pi^0\pi^0\gamma)/\Gamma(\text{neutrals})$$

$$\Gamma_{13}/(\Gamma_2+\Gamma_4)$$

| VALUE                                                                         | CL% | DOCUMENT ID        | TECN     | COMMENT                       |
|-------------------------------------------------------------------------------|-----|--------------------|----------|-------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                    |          |                               |
| $0.22 \pm 0.07$                                                               |     | <sup>1</sup> DAKIN | 72 OSPK  | $1.4 \pi^- p \rightarrow nMM$ |
| <0.19                                                                         | 90  | DEINET             | 69B OSPK |                               |
| <sup>1</sup> See $\Gamma(\pi^0\gamma)/\Gamma(\text{neutrals})$ .              |     |                    |          |                               |

NODE=M001R17  
NODE=M001R17

NODE=M001R17;LINKAGE=D

$$\Gamma(\eta\pi^0\gamma)/\Gamma_{\text{total}}$$

$$\Gamma_{14}/\Gamma$$

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID    | TECN | COMMENT                                       |
|--------------------------|-----|----------------|------|-----------------------------------------------|
| <b>&lt;3.3</b>           | 90  | AKHMETSHIN 04B | CMD2 | $0.6-0.97 e^+e^- \rightarrow \eta\pi^0\gamma$ |

NODE=M001R32  
NODE=M001R32

$$\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$$

$$\Gamma_{15}/\Gamma$$

| VALUE (units $10^{-5}$ )                                                                                                                                                  | EVTS | DOCUMENT ID           | TECN     | COMMENT                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------|----------|---------------------------------------|
| <b><math>7.4 \pm 1.8</math> OUR FIT</b>                                                                                                                                   |      |                       |          |                                       |
| <b><math>7.4 \pm 1.8</math> OUR AVERAGE</b>                                                                                                                               |      |                       |          |                                       |
| $6.6 \pm 1.4 \pm 1.7$                                                                                                                                                     | 4.5M | <sup>1</sup> ANASTASI | 17 KLOE  | $e^+e^- \rightarrow \mu^+\mu^-\gamma$ |
| $9.0 \pm 2.9 \pm 1.1$                                                                                                                                                     | 18   | HEISTER               | 02C ALEP | $Z \rightarrow \mu^+\mu^- + X$        |
| <sup>1</sup> Assuming lepton universality in the decay $\omega \rightarrow \ell^+\ell^-$ and correcting for different phase space between electron and muon final states. |      |                       |          |                                       |

NODE=M001R30  
NODE=M001R30

NODE=M001R30;LINKAGE=A

$$\Gamma(\mu^+\mu^-)/\Gamma(\pi^+\pi^-\pi^0)$$

$$\Gamma_{15}/\Gamma_1$$

| VALUE (units $10^{-3}$ )                                                      | CL% | DOCUMENT ID | TECN    | COMMENT                                         |
|-------------------------------------------------------------------------------|-----|-------------|---------|-------------------------------------------------|
| <b>&lt;0.2</b>                                                                | 90  | WILSON      | 69 OSPK | $12 \pi^- C \rightarrow Fe$                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |         |                                                 |
| <1.7                                                                          | 74  | FLATTE      | 66 HBC  | $1.2 - 1.7 K^- p \rightarrow \Lambda\mu^+\mu^-$ |
| <1.2                                                                          |     | BARBARO-... | 65 HBC  | $2.7 K^- p$                                     |

NODE=M001R6  
NODE=M001R6

$$\Gamma(\pi^0\mu^+\mu^-)/\Gamma(\mu^+\mu^-)$$

$$\Gamma_7/\Gamma_{15}$$

| VALUE                                                                         | EVTS | DOCUMENT ID             | TECN    | COMMENT         |
|-------------------------------------------------------------------------------|------|-------------------------|---------|-----------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                         |         |                 |
| $1.2 \pm 0.6$                                                                 | 30   | <sup>1</sup> DZHELYADIN | 79 CNTR | $25-33 \pi^- p$ |
| <sup>1</sup> Superseded by DZHELYADIN 81B result above.                       |      |                         |         |                 |

NODE=M001R20  
NODE=M001R20

NODE=M001R20;LINKAGE=S

$$\Gamma(3\gamma)/\Gamma_{\text{total}}$$

$$\Gamma_{16}/\Gamma$$

| VALUE (units $10^{-4}$ )                                                      | CL% | DOCUMENT ID             | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------|-----|-------------------------|----------|-------------------------------------|
| <b>&lt;1.9</b>                                                                | 95  | <sup>1</sup> ABELE      | 97E CBAR | $0.0 \bar{p} p \rightarrow 5\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                         |          |                                     |
| <2                                                                            | 90  | <sup>1</sup> PROKOSHKIN | 95 GAM2  | $38 \pi^- p \rightarrow 3\gamma n$  |
| <sup>1</sup> From direct $3\gamma$ decay search.                              |     |                         |          |                                     |

NODE=M001R27  
NODE=M001R27

NODE=M001R27;LINKAGE=A

$$\Gamma(\eta\pi^0)/\Gamma_{\text{total}}$$

$$\Gamma_{17}/\Gamma$$

| VALUE                                                                         | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------|-----|-------------|----------|-------------------------------------|
| Violates C conservation.                                                      |     |             |          |                                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                                     |
| <0.001                                                                        | 90  | ALDE        | 94B GAM2 | $38\pi^- p \rightarrow \eta\pi^0 n$ |

NODE=M001R25  
NODE=M001R25  
NODE=M001R25

$$[\Gamma(\eta\gamma) + \Gamma(\eta\pi^0)]/\Gamma(\pi^+\pi^-\pi^0) \quad (\Gamma_5 + \Gamma_{17})/\Gamma_1$$

| VALUE            | CL% | DOCUMENT ID         | TECN   | COMMENT                                                     |
|------------------|-----|---------------------|--------|-------------------------------------------------------------|
| <b>&lt;0.016</b> | 90  | <sup>1</sup> FLATTE | 66 HBC | $1.2 - 1.7 K^- p \rightarrow \Lambda \pi^+ \pi^- \text{MM}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.045 95 JACQUET 69B HLBC  $2.05 \pi^+ p \rightarrow \pi^+ p \omega$

<sup>1</sup> Restated by us using  $B(\eta \rightarrow \text{charged modes}) = 29.2\%$ .

NODE=M001R8  
NODE=M001R8

NODE=M001R8;LINKAGE=A

$$\Gamma(\eta\pi^0)/\Gamma(\pi^0\gamma) \quad \Gamma_{17}/\Gamma_2$$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID            | TECN    | COMMENT                             |
|--------------------------|-----|------------------------|---------|-------------------------------------|
| <b>&lt;2.6</b>           | 90  | <sup>1</sup> STAROSTIN | 09 CRYM | $\gamma p \rightarrow \eta \pi^0 p$ |

<sup>1</sup> STAROSTIN 09 reports  $[\Gamma(\omega(782) \rightarrow \eta \pi^0)/\Gamma(\omega(782) \rightarrow \pi^0 \gamma)] \times [B(\eta \rightarrow 2\gamma)] < 1.01 \times 10^{-3}$  which we divide by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

NODE=M001R35  
NODE=M001R35  
NODE=M001R35

NODE=M001R35;LINKAGE=ST

$$\Gamma(2\pi^0)/\Gamma(\pi^0\gamma) \quad \Gamma_{18}/\Gamma_2$$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                         |
|--------------------------|-----|-------------|---------|---------------------------------|
| <b>&lt;2.59</b>          | 90  | STAROSTIN   | 09 CRYM | $\gamma p \rightarrow 2\pi^0 p$ |

NODE=M001R36  
NODE=M001R36  
NODE=M001R36

$$\Gamma(3\pi^0)/\Gamma_{\text{total}} \quad \Gamma_{19}/\Gamma$$

| VALUE                          | CL% | DOCUMENT ID | TECN    | COMMENT                           |
|--------------------------------|-----|-------------|---------|-----------------------------------|
| <b>&lt;3 × 10<sup>-4</sup></b> | 90  | PROKOSHIN   | 95 GAM2 | $38 \pi^- p \rightarrow 3\pi^0 n$ |

NODE=M001R26  
NODE=M001R26  
NODE=M001R26

$$\Gamma(3\pi^0)/\Gamma(\pi^0\gamma) \quad \Gamma_{19}/\Gamma_2$$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                         |
|--------------------------|-----|-------------|---------|---------------------------------|
| <b>&lt;2.72</b>          | 90  | STAROSTIN   | 09 CRYM | $\gamma p \rightarrow 3\pi^0 p$ |

NODE=M001R37  
NODE=M001R37  
NODE=M001R37

$$\Gamma(3\pi^0)/\Gamma(\pi^+\pi^-\pi^0) \quad \Gamma_{19}/\Gamma_1$$

| VALUE            | CL% | DOCUMENT ID | TECN   | COMMENT                          |
|------------------|-----|-------------|--------|----------------------------------|
| <b>&lt;0.009</b> | 90  | BARBERIS    | 01 450 | $p p \rightarrow p_f 3\pi^0 p_s$ |

NODE=M001R31  
NODE=M001R31  
NODE=M001R31

$$\Gamma(\text{invisible})/\Gamma(\pi^+\pi^-\pi^0) \quad \Gamma_{20}/\Gamma_1$$

| VALUE                            | CL% | DOCUMENT ID | TECN     | COMMENT                                                               |
|----------------------------------|-----|-------------|----------|-----------------------------------------------------------------------|
| <b>&lt;8.1 × 10<sup>-5</sup></b> | 90  | ABLIKIM     | 18S BES3 | $J/\psi \rightarrow \omega \eta \rightarrow \omega \pi^+ \pi^- \pi^0$ |

NODE=M001R01  
NODE=M001R01

### PARAMETER $\Lambda$ IN $\omega \rightarrow \pi^0 \ell^+ \ell^-$ DECAY

NODE=M001230

In the pole approximation the electromagnetic transition form factor for a resonance of mass  $M$  is given by the expression:

$$|F|^2 = (1 - M^2/\Lambda^2)^{-2},$$

where for the parameter  $\Lambda$  vector dominance predicts  $\Lambda = M_p \approx 0.770$  GeV. The ARNALDI 09 measurement is in obvious conflict with this expectation. Note that for  $\eta \rightarrow \gamma \mu^+ \mu^-$  decay ARNALDI 09 and DZHELYADIN 80 obtain the value of  $\Lambda$  consistent with vector dominance.

NODE=M001230

### PARAMETER $\Lambda$ IN $\omega \rightarrow \pi^0 \mu^+ \mu^-$ DECAY

NODE=M001LAM  
NODE=M001LAM

| VALUE (GeV)                      | EVTS | DOCUMENT ID          | TECN    | COMMENT                      |
|----------------------------------|------|----------------------|---------|------------------------------|
| <b>0.670 ± 0.006 OUR AVERAGE</b> |      |                      |         |                              |
| 0.6707 ± 0.0039 ± 0.0056         |      | <sup>1</sup> ARNALDI | 16 NA60 | 400 GeV ( $p$ -A) collisions |

0.668 ± 0.009 ± 0.003 3k <sup>2</sup> ARNALDI 09 NA60 158A In-In collisions

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.65 ± 0.03 DZHELYADIN 81B CNTR 25-33  $\pi^- p \rightarrow \omega n$

<sup>1</sup> ARNALDI 16 reports  $\Lambda^{-2}(\omega) = 2.223 \pm 0.026 \pm 0.037 \text{ GeV}^{-2}$  which we converted to the quoted  $\Lambda$  value.

<sup>2</sup> ARNALDI 09 reports  $\Lambda^{-2}(\omega) = 2.24 \pm 0.06 \pm 0.02 \text{ GeV}^{-2}$  which we converted to the quoted  $\Lambda$  value.

NODE=M001LAM;LINKAGE=A

NODE=M001LAM;LINKAGE=B

**PARAMETER  $\Lambda$  IN  $\omega \rightarrow \pi^0 e^+ e^-$  DECAY**

| VALUE (GeV)                                                                                                                                      | EVTs | DOCUMENT ID           | TECN     | COMMENT                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------|----------|---------------------------------|
| <b>0.709 ± 0.037</b>                                                                                                                             | 1.1k | <sup>1</sup> ADLARSON | 17B A2MM | $\gamma p \rightarrow \omega p$ |
| <sup>1</sup> ADLARSON 17B reports $\Lambda^{-2}(\omega \pi^0) = 1.99 \pm 0.21 \text{ GeV}^{-2}$ that we converted to the quoted $\Lambda$ value. |      |                       |          |                                 |

NODE=M001A02  
 NODE=M001A02

NODE=M001A02;LINKAGE=A

**ENERGY DEPENDENCE OF  $\omega \rightarrow \pi^+ \pi^- \pi^0$  DALITZ PLOT**

The following experiments fit to one or more of the coefficients  $\alpha, \beta, \gamma$  for |matrix element|<sup>2</sup>  $\propto P (1 + 2\alpha Z + 2\beta Z^{3/2} \sin(3\phi) + 2\gamma Z^2 + O(Z^{5/2}))$  where  $P$  is the  $P$ -wave phase-space factor and  $Z, \phi$  are kinematical variables as defined in ADLARSON 17.

| VALUE                            | EVTs | DOCUMENT ID          | TECN      | COMMENT                                                                             |
|----------------------------------|------|----------------------|-----------|-------------------------------------------------------------------------------------|
| <b>0.133 ± 0.008 OUR AVERAGE</b> |      |                      |           |                                                                                     |
| 0.1321 ± 0.0067 ± 0.0046         | 260k | <sup>1</sup> ABLIKIM | 18AD BES3 | $J/\psi \rightarrow \omega \eta$                                                    |
| 0.147 ± 0.036                    | 44k  | ADLARSON             | 17 WASA   | $\alpha$ in $p d \rightarrow {}^3\text{He } \omega$ ,<br>$pp \rightarrow pp \omega$ |

NODE=M001A00

NODE=M001A00

NODE=M001A00

<sup>1</sup> Keeping a term linear in  $Z$  only. A fit with the terms proportional to  $Z$  and  $Z^{3/2}$  gives  $\alpha = 0.133 \pm 0.041$  and  $\beta = 0.037 \pm 0.054$ .

NODE=M001A00;LINKAGE=A

 **$\omega(782)$  REFERENCES**

|             |      |                                |                                          |                                |
|-------------|------|--------------------------------|------------------------------------------|--------------------------------|
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| ANDREEV     | 20   | EPJ C80 1189                   | V. Andreev <i>et al.</i>                 | (H1 Collab.)                   |
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| COLANGELO   | 19   | JHEP 1902 006                  | G. Colangelo, M. Hoferichter, P. Stoffer | (BERN+)                        |
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| ABLIKIM     | 18S  | PR D98 032001                  | M. Ablikim <i>et al.</i>                 | (BESIII Collab.)               |
| HANHART     | 18   | EPJ C78 450                    | C. Hanhart <i>et al.</i>                 |                                |
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| ANASTASI    | 17   | PL B767 485                    | A. Anastasi <i>et al.</i>                | (KLOE-2 Collab.)               |
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| AMBROSINO   | 11A  | PL B700 102                    | F. Ambrosino <i>et al.</i>               | (KLOE Collab.)                 |
| BENAYOUN    | 10   | EPJ C65 211                    | M. Benayoun <i>et al.</i>                |                                |
| ACHASOV     | 09A  | JETP 109 379                   | M.N. Achasov <i>et al.</i>               | (SND Collab.)                  |
| ARNALDI     | 09   | Translated from ZETF 136 442.  | R. Arnaldi <i>et al.</i>                 | (NA60 Collab.)                 |
| AUBERT      | 09AS | PRL 103 231801                 | B. Aubert <i>et al.</i>                  | (BABAR Collab.)                |
| STAROSTIN   | 09   | PR C79 065201                  | A. Starostin <i>et al.</i>               | (Crystal Ball Collab. at MAMI) |
| ACHASOV     | 08   | JETP 107 61                    | M.N. Achasov <i>et al.</i>               | (SND Collab.)                  |
| AMBROSINO   | 08G  | Translated from ZETF 134 80.   | F. Ambrosino <i>et al.</i>               | (KLOE Collab.)                 |
| ACHASOV     | 07B  | PL B669 223                    | M.N. Achasov <i>et al.</i>               | (SND Collab.)                  |
| AKHMETSHIN  | 07   | PR D76 077101                  | M.N. Achasov <i>et al.</i>               | (SND Collab.)                  |
| ACHASOV     | 06   | PL B648 28                     | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.)    |
| ACHASOV     | 06   | JETP 103 380                   | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| ACHASOV     | 06A  | Translated from ZETF 130 437.  | M.N. Achasov <i>et al.</i>               | (SND Collab.)                  |
| AULCHENKO   | 06   | PR D74 014016                  | M.N. Achasov <i>et al.</i>               | (SND Collab.)                  |
| ACHASOV     | 05A  | JETPL 84 413                   | V.M. Aulchenko <i>et al.</i>             | (Novosibirsk CMD-2 Collab.)    |
| ACHASOV     | 05A  | Translated from ZETF 84 491.   | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| AKHMETSHIN  | 05   | JETP 101 1053                  | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| AKHMETSHIN  | 05   | Translated from ZETF 128 1201. | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.)    |
| AKHMETSHIN  | 05A  | PL B605 26                     | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.)    |
| AULCHENKO   | 05   | PL B613 29                     | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.)    |
| AKHMETSHIN  | 04   | JETPL 82 743                   | V.M. Aulchenko <i>et al.</i>             | (Novosibirsk CMD-2 Collab.)    |
| AKHMETSHIN  | 04B  | Translated from ZETFP 82 841.  | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.)    |
| AUBERT,B    | 04N  | PL B578 285                    | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.)    |
| PDG         | 04   | PL B580 119                    | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.)    |
| ACHASOV     | 03   | PR D70 072004                  | B. Aubert <i>et al.</i>                  | (BABAR Collab.)                |
| ACHASOV     | 03D  | PL B592 1                      | S. Eidelman <i>et al.</i>                | (PDG Collab.)                  |
| ALOISIO     | 03   | PL B559 171                    | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| BENAYOUN    | 03   | PR D68 052006                  | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| ACHASOV     | 02F  | PL B561 55                     | A. Aloisio <i>et al.</i>                 | (KLOE Collab.)                 |
| ACHASOV     | 02E  | EPJ C29 397                    | M. Benayoun <i>et al.</i>                |                                |
| ACHASOV     | 02F  | PR D66 032001                  | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| AKHMETSHIN  | 02   | PL B537 201                    | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| ALOISIO     | 02D  | PL B527 161                    | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.)    |
| HEISTER     | 02C  | PL B537 21                     | A. Aloisio <i>et al.</i>                 | (KLOE Collab.)                 |
| ACHASOV     | 01E  | PL B528 19                     | A. Heister <i>et al.</i>                 | (ALEPH Collab.)                |
| AKHMETSHIN  | 01B  | PR D63 072002                  | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| BARBERIS    | 01   | PL B509 217                    | R.R. Akhmetshin <i>et al.</i>            | (Novosibirsk CMD-2 Collab.)    |
| ACHASOV     | 00   | PL B507 14                     | D. Barberis <i>et al.</i>                |                                |
| ACHASOV     | 00D  | EPJ C12 25                     | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| ACHASOV     | 00G  | JETPL 72 282                   | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| ACHASOV     | 00G  | Translated from ZETFP 72 411.  | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| ACHASOV     | 00G  | JETPL 71 355                   | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |
| ACHASOV     | 00G  | Translated from ZETFP 71 519.  | M.N. Achasov <i>et al.</i>               | (Novosibirsk SND Collab.)      |

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 REFID=48824  
 REFID=48564  
 REFID=48311  
 REFID=48167  
 REFID=48324  
 REFID=47417  
 REFID=47882  
 REFID=47929

|                                      |     |                                |                                             |                             |             |
|--------------------------------------|-----|--------------------------------|---------------------------------------------|-----------------------------|-------------|
| AKHMETSHIN                           | 00C | PL B476 33                     | R.R. Akhmetshin <i>et al.</i>               | (Novosibirsk CMD-2 Collab.) | REFID=47423 |
| AULCHENKO                            | 00A | JETP 90 927                    | V.M. Aulchenko <i>et al.</i>                | (Novosibirsk SND Collab.)   | REFID=47953 |
| CASE                                 | 00  | Translated from ZETF 117 1067. | T. Case <i>et al.</i>                       | (Crystal Barrel Collab.)    | REFID=47409 |
| ACHASOV                              | 99E | PR D61 032002                  | M.N. Achasov <i>et al.</i>                  | (Novosibirsk SND Collab.)   | REFID=47391 |
| GARDNER                              | 99  | PR D59 076002                  | S. Gardner, H.B. O'Connell                  |                             | REFID=46919 |
| BENAYOUN                             | 98  | EPJ C2 269                     | M. Benayoun <i>et al.</i>                   | (IPNP, NOVO, ADLD+)         | REFID=45859 |
| ABELE                                | 97E | PL B411 361                    | A. Abele <i>et al.</i>                      | (Crystal Barrel Collab.)    | REFID=45755 |
| BENAYOUN                             | 96  | ZPHY C72 221                   | M. Benayoun <i>et al.</i>                   | (IPNP, NOVO)                | REFID=45753 |
| PROKOSHKIN                           | 95  | PD 40 273                      | Y.D. Prokoshkin, V.D. Samoilenko            | (SERP)                      | REFID=44616 |
| WURZINGER                            | 95  | Translated from DANS 342 610.  | R. Wurzinger <i>et al.</i>                  | (BONN, ORSAY, SACL+)        | REFID=45209 |
| ALDE                                 | 94B | PR C51 443                     | D.M. Alde <i>et al.</i>                     | (SERP, BELG, LANL, LAPP+)   | REFID=44100 |
| AMSLER                               | 94C | PL B340 122                    | C. AMSler <i>et al.</i>                     | (Crystal Barrel Collab.)    | REFID=44091 |
| ALDE                                 | 93  | PL B327 425                    | D.M. Alde <i>et al.</i>                     | (SERP, LAPP, LANL, BELG+)   | REFID=43603 |
| Also                                 |     | PAN 56 1229                    |                                             |                             |             |
| AMSLER                               | 93B | Translated from YAF 56 137.    | D.M. Alde <i>et al.</i>                     | (SERP, LAPP, LANL, BELG+)   | REFID=43790 |
| WEIDENAUER                           | 93  | ZPHY C61 35                    | C. AMSler <i>et al.</i>                     | (Crystal Barrel Collab.)    | REFID=43602 |
| ANTONELLI                            | 92  | PL B311 362                    | P. Weidenauer <i>et al.</i>                 | (ASTERIX Collab.)           | REFID=43585 |
| DOLINSKY                             | 91  | ZPHY C59 387                   | A. Antonelli <i>et al.</i>                  | (DM2 Collab.)               | REFID=43168 |
| WEIDENAUER                           | 90  | PRPL 202 99                    | S.I. Dolinsky <i>et al.</i>                 | (NOVO)                      | REFID=41369 |
| DOLINSKY                             | 89  | ZPHY C47 353                   | P. Weidenauer <i>et al.</i>                 | (ASTERIX Collab.)           | REFID=41368 |
| BITYUKOV                             | 88B | ZPHY C42 511                   | S.I. Dolinsky <i>et al.</i>                 | (NOVO)                      | REFID=41003 |
|                                      |     | SJNP 47 800                    | S.I. Bitukov <i>et al.</i>                  | (SERP)                      | REFID=41021 |
| DOLINSKY                             | 88  | Translated from YAF 47 1258.   | S.I. Dolinsky <i>et al.</i>                 | (NOVO)                      | REFID=41022 |
|                                      |     | SJNP 48 277                    |                                             |                             |             |
| KURDADZE                             | 88  | Translated from YAF 48 442.    | L.M. Kurdadze <i>et al.</i>                 | (NOVO)                      | REFID=41121 |
|                                      |     | JETPL 47 512                   |                                             |                             |             |
| AULCHENKO                            | 87  | Translated from ZETFP 47 432.  | V.M. Aulchenko <i>et al.</i>                | (NOVO)                      | REFID=40007 |
| BARKOV                               | 87  | PL B186 432                    | L.M. Barkov <i>et al.</i>                   | (NOVO)                      | REFID=40280 |
|                                      |     | JETPL 46 164                   |                                             |                             |             |
| KURDADZE                             | 86  | Translated from ZETFP 46 132.  | L.M. Kurdadze <i>et al.</i>                 | (NOVO)                      | REFID=40287 |
|                                      |     | JETPL 43 643                   |                                             |                             |             |
| BARKOV                               | 85  | Translated from ZETFP 43 497.  | L.M. Barkov <i>et al.</i>                   | (NOVO)                      | REFID=20134 |
| DRUZHININ                            | 84  | NP B256 365                    | V.P. Druzhinin <i>et al.</i>                | (NOVO)                      | REFID=20561 |
| KURDADZE                             | 83B | PL 144B 136                    | A.M. Kurdadze <i>et al.</i>                 | (NOVO)                      | REFID=20244 |
|                                      |     | JETPL 36 274                   |                                             |                             |             |
| DZHELYADIN                           | 81B | Translated from ZETFP 36 221.  | R.I. Dzheilyadin <i>et al.</i>              | (SERP)                      | REFID=20242 |
| CORDIER                              | 80  | PL 102B 296                    | A. Cordier <i>et al.</i>                    | (LALO)                      | REFID=20240 |
| DZHELYADIN                           | 80  | NP B172 13                     | R.I. Dzheilyadin <i>et al.</i>              | (SERP)                      | REFID=10831 |
| ROOS                                 | 80  | PL 94B 548                     | M. Roos, A. Pellinen                        | (HELS)                      | REFID=20241 |
| BENKHEIRI                            | 79  | LNC 27 321                     | P. Benkheiri <i>et al.</i>                  | (EPOL, CERN, CDEF+)         | REFID=20238 |
| DZHELYADIN                           | 79  | NP B150 268                    | R.I. Dzheilyadin <i>et al.</i>              | (SERP)                      | REFID=20239 |
| COOPER                               | 78B | PL 84B 143                     | A.M. Cooper <i>et al.</i>                   | (TATA, CERN, CDEF+)         | REFID=20235 |
| QUENZER                              | 78  | NP B146 1                      | A. Quenzer <i>et al.</i>                    | (LALO)                      | REFID=20123 |
| VANAPEL...                           | 78  | PL 76B 512                     | G.W. van Apeldoorn <i>et al.</i>            | (ZEEM)                      | REFID=20234 |
| WICKLUND                             | 78  | NP B133 245                    | A.B. Wicklund <i>et al.</i>                 | (ANL)                       | REFID=20124 |
| ANDREWS                              | 77  | PR D17 1197                    | D.E. Andrews <i>et al.</i>                  | (ROCH)                      | REFID=20120 |
| GESSAROLI                            | 77  | PRL 38 198                     | R. Gessaroli <i>et al.</i>                  | (BGNA, FIRZ, GENO+)         | REFID=20230 |
| KEYNE                                | 76  | NP B126 382                    | J. Keyne <i>et al.</i>                      | (LOIC, SHMP)                | REFID=20226 |
| Also                                 |     | PR D14 28                      | D.M. Binnie <i>et al.</i>                   | (LOIC, SHMP)                | REFID=20216 |
| KALBFLEISCH                          | 75  | PR D8 2789                     | G.R. Kalbfleisch, R.C. Strand, J.W. Chapman | (BNL+)                      | REFID=20223 |
| AGUILAR-...                          | 72B | PR D11 987                     | M. Aguilar-Benitez <i>et al.</i>            | (BNL)                       | REFID=20205 |
| APEL                                 | 72B | PR D6 29                       | W.D. Apel <i>et al.</i>                     | (KARLK, KARLE, PISA)        | REFID=20206 |
| BASILE                               | 72B | PL 41B 234                     | M. Basile <i>et al.</i>                     | (CERN)                      | REFID=20207 |
| BENAKSAS                             | 72  | Phil. Conf. 153                | D. Benaksas <i>et al.</i>                   | (ORSAY)                     | REFID=20096 |
| BENAKSAS                             | 72B | PL 39B 289                     | D. Benaksas <i>et al.</i>                   | (ORSAY)                     | REFID=20209 |
| BENAKSAS                             | 72C | PL 42B 507                     | D. Benaksas <i>et al.</i>                   | (ORSAY)                     | REFID=20517 |
| BORENSTEIN                           | 72  | PL 42B 511                     | S.R. Borenstein <i>et al.</i>               | (BNL, MICH)                 | REFID=20215 |
| BROWN                                | 72  | PR D5 1559                     | R.M. Brown <i>et al.</i>                    | (ILL, ILLC)                 | REFID=20211 |
| DAKIN                                | 72  | PL 42B 117                     | J.T. Dakin <i>et al.</i>                    | (PRIN)                      | REFID=20212 |
| RATCLIFF                             | 72  | PR D6 2321                     | B.N. Ratcliff <i>et al.</i>                 | (SLAC)                      | REFID=20102 |
| ALVENSLEB...                         | 71C | PL 38B 345                     | H. Alvensleben <i>et al.</i>                | (DESY)                      | REFID=20193 |
| BALDIN                               | 71  | PRL 27 888                     | A.B. Baldin <i>et al.</i>                   | (ITEP)                      | REFID=20195 |
|                                      |     | SJNP 13 758                    |                                             |                             |             |
| BEHREND                              | 71  | Translated from YAF 13 1318.   | H.J. Behrend <i>et al.</i>                  | (ROCH, CORN, FNAL)          | REFID=20197 |
| BIZZARRI                             | 71  | PRL 27 61                      | R. Bizzarri <i>et al.</i>                   | (CERN, CDEF)                | REFID=20198 |
| COYNE                                | 71  | NP B27 140                     | D.G. Coyne <i>et al.</i>                    | (LRL)                       | REFID=20201 |
| MOFFEIT                              | 71  | NP B32 333                     | K.C. Moffeit <i>et al.</i>                  | (LRL, UCB, SLAC+)           | REFID=20204 |
| ABRAMOVI...                          | 70  | NP B29 349                     | M. Abramovich <i>et al.</i>                 | (CERN)                      | REFID=20180 |
| BIGGS                                | 70B | NP B20 209                     | P.J. Biggs <i>et al.</i>                    | (DARE)                      | REFID=20184 |
| BIZZARRI                             | 70  | PRL 24 1201                    | R. Bizzarri <i>et al.</i>                   | (ROMA, SYRA)                | REFID=20181 |
| ROOS                                 | 70  | PRL 25 1385                    | M. Roos                                     | (CERN)                      | REFID=20191 |
|                                      |     | DNPL/R7 173                    |                                             |                             |             |
| Proc. Daresbury Study Weekend No. 1. |     |                                |                                             |                             |             |
| AUGUSTIN                             | 69D | PL 28B 513                     | J.E. Augustin <i>et al.</i>                 | (ORSAY)                     | REFID=20169 |
| BIZZARRI                             | 69  | NP B14 169                     | R. Bizzarri <i>et al.</i>                   | (CERN, CDEF)                | REFID=20171 |
| DEINET                               | 69B | PL 30B 426                     | W. Deinet <i>et al.</i>                     | (KARL, CERN)                | REFID=20173 |
| JACQUET                              | 69B | NC 63A 743                     | F. Jacquet <i>et al.</i>                    | (EPOL, BERG)                | REFID=20176 |
| WILSON                               | 69  | Private Comm.                  | R. Wilson                                   | (HARV)                      | REFID=20179 |
| Also                                 |     | PR 178 2095                    | A.A. Wehmann <i>et al.</i>                  | (HARV, CASE, SLAC+)         | REFID=20084 |
| ASTVACAT...                          | 68C | PL 27B 45                      | R.G. Astvatsaturov <i>et al.</i>            | (JINR, MOSU)                | REFID=20055 |
| BOLLINI                              | 68C | NC 56A 531                     | D. Bollini <i>et al.</i>                    | (CERN, BGNA, STRB)          | REFID=20164 |
| GOUNARIS                             | 68  | PRL 21 244                     | G.J. Gounaris, J.J. Sakurai                 |                             | REFID=48054 |
| BARASH                               | 67B | PR 156 1399                    | N. Barash <i>et al.</i>                     | (COLU)                      | REFID=20160 |
| FELDMAN                              | 67C | PR 159 1219                    | M. Feldman <i>et al.</i>                    | (PENN)                      | REFID=20161 |
| DIGIUGNO                             | 66B | NC 44A 1272                    | G. Di Giugno <i>et al.</i>                  | (NAPL, FRAS, TRST)          | REFID=20156 |
| FLATTE                               | 66  | PR 145 1050                    | S.M. Flatte <i>et al.</i>                   | (LRL)                       | REFID=20157 |
| JAMES                                | 66  | PR 142 896                     | F.E. James, H.L. Kraybill                   | (YALE, BNL)                 | REFID=10770 |
| BARBARO...                           | 65  | PRL 14 279                     | A. Barbaro-Galtieri, R.D. Tripp             | (LRL)                       | REFID=20152 |
| BARMIN                               | 64  | JETP 18 1289                   | V.V. Barmin <i>et al.</i>                   | (ITEP)                      | REFID=20149 |
|                                      |     | Translated from ZETF 45 1879.  | R.W. Kraemer <i>et al.</i>                  | (JHU, NWES, WOOD)           | REFID=10755 |
| KRAEMER                              | 64  | PR 136 B496                    | B. Buschbeck <i>et al.</i>                  | (VIEN, CERN, ANIK)          | REFID=20146 |
| BUSCHBECK                            | 63  | Siena Conf. 1 166              |                                             |                             |             |

$\eta'(958)$ 

$$I^G(J^{PC}) = 0^+(0^-+)$$

NODE=M002

 $\eta'(958)$  MASS

NODE=M002M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | COMMENT                                                         |
|-------------------------------------------------------------------------------|------|------------------------|------|-----------------------------------------------------------------|
| <b>957.78 ±0.06 OUR AVERAGE</b>                                               |      |                        |      |                                                                 |
| 957.793±0.054±0.036                                                           | 3.9k | LIBBY                  | 08   | CLEO $J/\psi \rightarrow \gamma\eta'$                           |
| 957.9 ±0.2 ±0.6                                                               | 4800 | WURZINGER              | 96   | SPEC 1.68 $pd \rightarrow {}^3\text{He}\eta'$                   |
| 957.46 ±0.33                                                                  |      | DUANE                  | 74   | MMS $\pi^- p \rightarrow n\text{MM}$                            |
| 958.2 ±0.5                                                                    | 1414 | DANBURG                | 73   | HBC 2.2 $K^- p \rightarrow \Lambda\eta'$                        |
| 958 ±1                                                                        | 400  | JACOBS                 | 73   | HBC 2.9 $K^- p \rightarrow \Lambda\eta'$                        |
| 956.1 ±1.1                                                                    | 3415 | <sup>1</sup> BASILE    | 71   | CNTR 1.6 $\pi^- p \rightarrow n\eta'$                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |      |                                                                 |
| 957.5 ±0.2                                                                    |      | BAI                    | 04J  | BES2 $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$                |
| 959 ±1                                                                        | 630  | <sup>2</sup> BELADIDZE | 92C  | VES 36 $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$ |
| 958 ±1                                                                        | 340  | <sup>2</sup> ARMSTRONG | 91B  | OMEG 300 $pp \rightarrow pp\eta\pi^+\pi^-$                      |
| 958.2 ±0.4                                                                    | 622  | <sup>2</sup> AUGUSTIN  | 90   | DM2 $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$                   |
| 957.8 ±0.2                                                                    | 2420 | <sup>2</sup> AUGUSTIN  | 90   | DM2 $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$                 |
| 956.3 ±1.0                                                                    | 143  | <sup>2</sup> GIDAL     | 87   | MRK2 $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$                  |
| 957.4 ±1.4                                                                    | 535  | <sup>3</sup> BASILE    | 71   | CNTR 1.6 $\pi^- p \rightarrow n\eta'$                           |
| 957 ±1                                                                        |      | RITTENBERG             | 69   | HBC 1.7-2.7 $K^- p$                                             |

NODE=M002M

OCCUR=2

OCCUR=2

<sup>1</sup> Using all  $\eta'$  decays.<sup>2</sup> Systematic uncertainty not estimated.<sup>3</sup> Using  $\eta'$  decays into neutrals. Not independent of the other listed BASILE 71  $\eta'$  mass measurement.

NODE=M002M;LINKAGE=BS

NODE=M002M;LINKAGE=NS

NODE=M002M;LINKAGE=BA

 $\eta'(958)$  WIDTH

NODE=M002W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID | TECN | CHG  | COMMENT                                     |
|-------------------------------------------------------------------------------|------|-------------|------|------|---------------------------------------------|
| <b>0.188±0.006 OUR FIT</b>                                                    |      |             |      |      |                                             |
| <b>0.230±0.021 OUR AVERAGE</b>                                                |      |             |      |      |                                             |
| 0.226±0.017±0.014                                                             | 2300 | CZERWINSKI  | 10   | MMS  | $pp \rightarrow pp\eta'$                    |
| 0.40 ±0.22                                                                    | 4800 | WURZINGER   | 96   | SPEC | 1.68 $pd \rightarrow {}^3\text{He}\eta'$    |
| 0.28 ±0.10                                                                    | 1000 | BINNIE      | 79   | MMS  | 0 $\pi^- p \rightarrow n\text{MM}$          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |      |      |                                             |
| 0.20 ±0.04                                                                    |      | BAI         | 04J  | BES2 | $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$ |

NODE=M002W

 $\eta'(958)$  DECAY MODES

NODE=M002215;NODE=M002

| Mode                                                                        | Fraction ( $\Gamma_i/\Gamma$ )    | Confidence level |
|-----------------------------------------------------------------------------|-----------------------------------|------------------|
| $\Gamma_1$ $\pi^+\pi^-\eta$                                                 | (42.5 ±0.5 ) %                    |                  |
| $\Gamma_2$ $\rho^0\gamma$ (including non-resonant $\pi^+\pi^-\pi^-\gamma$ ) | (29.5 ±0.4 ) %                    |                  |
| $\Gamma_3$ $\rho^0\gamma$                                                   |                                   |                  |
| $\Gamma_4$ $\pi^0\pi^0\eta$                                                 | (22.4 ±0.5 ) %                    |                  |
| $\Gamma_5$ $\omega\gamma$                                                   | ( 2.52 ±0.07 ) %                  |                  |
| $\Gamma_6$ $\omega e^+e^-$                                                  | ( 2.0 ±0.4 ) × 10 <sup>-4</sup>   |                  |
| $\Gamma_7$ $\gamma\gamma$                                                   | ( 2.307±0.033 ) %                 |                  |
| $\Gamma_8$ $3\pi^0$                                                         | ( 2.50 ±0.17 ) × 10 <sup>-3</sup> |                  |
| $\Gamma_9$ $\mu^+\mu^-\gamma$                                               | ( 1.13 ±0.28 ) × 10 <sup>-4</sup> |                  |
| $\Gamma_{10}$ $\pi^+\pi^-\mu^+\mu^-$                                        | < 2.9 × 10 <sup>-5</sup>          | 90%              |
| $\Gamma_{11}$ $\pi^+\pi^-\pi^0$                                             | ( 3.61 ±0.17 ) × 10 <sup>-3</sup> |                  |
| $\Gamma_{12}$ $(\pi^+\pi^-\pi^0)$ S-wave                                    | ( 3.8 ±0.5 ) × 10 <sup>-3</sup>   |                  |
| $\Gamma_{13}$ $\pi^\mp\rho^\pm$                                             | ( 7.4 ±2.3 ) × 10 <sup>-4</sup>   |                  |
| $\Gamma_{14}$ $\pi^0\rho^0$                                                 | < 4 %                             | 90%              |
| $\Gamma_{15}$ $2(\pi^+\pi^-)$                                               | ( 8.4 ±0.9 ) × 10 <sup>-5</sup>   |                  |
| $\Gamma_{16}$ $\pi^+\pi^-2\pi^0$                                            | ( 1.8 ±0.4 ) × 10 <sup>-4</sup>   |                  |

DESIG=1

DESIG=9

DESIG=213

DESIG=2

DESIG=7

DESIG=205

DESIG=6

DESIG=8

DESIG=20

DESIG=201

DESIG=121

DESIG=211

DESIG=210

DESIG=18

DESIG=131

DESIG=202

|               |                                    |                                          |                  |     |           |
|---------------|------------------------------------|------------------------------------------|------------------|-----|-----------|
| $\Gamma_{17}$ | $2(\pi^+\pi^-)$ neutrals           | $< 1$                                    | %                | 95% | DESIG=132 |
| $\Gamma_{18}$ | $2(\pi^+\pi^-)\pi^0$               | $< 1.8$                                  | $\times 10^{-3}$ | 90% | DESIG=141 |
| $\Gamma_{19}$ | $2(\pi^+\pi^-)2\pi^0$              | $< 1$                                    | %                | 95% | DESIG=15  |
| $\Gamma_{20}$ | $3(\pi^+\pi^-)$                    | $< 3.1$                                  | $\times 10^{-5}$ | 90% | DESIG=203 |
| $\Gamma_{21}$ | $K^\pm\pi^\mp$                     | $< 4$                                    | $\times 10^{-5}$ | 90% | DESIG=207 |
| $\Gamma_{22}$ | $\pi^+\pi^-e^+e^-$                 | $(2.4 \pm_{-1.0}^{+1.3}) \times 10^{-3}$ |                  |     | DESIG=10  |
| $\Gamma_{23}$ | $\pi^+e^-\nu_e + \text{c.c.}$      | $< 2.1$                                  | $\times 10^{-4}$ | 90% | DESIG=204 |
| $\Gamma_{24}$ | $\gamma e^+e^-$                    | $(4.91 \pm 0.27) \times 10^{-4}$         |                  |     | DESIG=28  |
| $\Gamma_{25}$ | $\pi^0\gamma\gamma$                | $(3.20 \pm 0.24) \times 10^{-3}$         |                  |     | DESIG=24  |
| $\Gamma_{26}$ | $\pi^0\gamma\gamma$ (non resonant) | $(6.2 \pm 0.9) \times 10^{-4}$           |                  |     | DESIG=212 |
| $\Gamma_{27}$ | $\eta\gamma\gamma$                 | $< 1.33$                                 | $\times 10^{-4}$ | 90% | DESIG=214 |
| $\Gamma_{28}$ | $4\pi^0$                           | $< 4.94$                                 | $\times 10^{-5}$ | 90% | DESIG=26  |
| $\Gamma_{29}$ | $e^+e^-$                           | $< 5.6$                                  | $\times 10^{-9}$ | 90% | DESIG=150 |
| $\Gamma_{30}$ | invisible                          | $< 6$                                    | $\times 10^{-4}$ | 90% | DESIG=200 |

**Charge conjugation (C), Parity (P),  
Lepton family number (LF) violating modes**

NODE=M002;CLUMP=B

|               |                   |         |             |                  |     |           |
|---------------|-------------------|---------|-------------|------------------|-----|-----------|
| $\Gamma_{31}$ | $\pi^+\pi^-$      | $P, CP$ | $< 1.8$     | $\times 10^{-5}$ | 90% | DESIG=111 |
| $\Gamma_{32}$ | $\pi^0\pi^0$      | $P, CP$ | $< 4$       | $\times 10^{-4}$ | 90% | DESIG=25  |
| $\Gamma_{33}$ | $\pi^0e^+e^-$     | $C$     | [a] $< 1.4$ | $\times 10^{-3}$ | 90% | DESIG=16  |
| $\Gamma_{34}$ | $\eta e^+e^-$     | $C$     | [a] $< 2.4$ | $\times 10^{-3}$ | 90% | DESIG=17  |
| $\Gamma_{35}$ | $3\gamma$         | $C$     | $< 1.0$     | $\times 10^{-4}$ | 90% | DESIG=23  |
| $\Gamma_{36}$ | $\mu^+\mu^-\pi^0$ | $C$     | [a] $< 6.0$ | $\times 10^{-5}$ | 90% | DESIG=22  |
| $\Gamma_{37}$ | $\mu^+\mu^-\eta$  | $C$     | [a] $< 1.5$ | $\times 10^{-5}$ | 90% | DESIG=21  |
| $\Gamma_{38}$ | $e\mu$            | $LF$    | $< 4.7$     | $\times 10^{-4}$ | 90% | DESIG=27  |

[a] C parity forbids this to occur as a single-photon process.

LINKAGE=CS

### CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, 2 combinations of partial widths obtained from integrated cross section, and 19 branching ratios uses 51 measurements and one constraint to determine 9 parameters. The overall fit has a  $\chi^2 = 69.4$  for 43 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |       |       |       |       |          |          |
|----------|-------|-------|-------|-------|-------|-------|----------|----------|
| $x_2$    | -24   |       |       |       |       |       |          |          |
| $x_4$    | -74   | -42   |       |       |       |       |          |          |
| $x_5$    | -7    | -6    | -2    |       |       |       |          |          |
| $x_7$    | -11   | -7    | 9     | -1    |       |       |          |          |
| $x_8$    | -17   | -9    | 19    | 0     | 2     |       |          |          |
| $x_{11}$ | -1    | -1    | -1    | 0     | 0     | 0     |          |          |
| $x_{22}$ | -9    | -7    | -7    | -1    | -2    | -2    | 0        |          |
| $\Gamma$ | 11    | -10   | -1    | 1     | -40   | 0     | 0        | 2        |
|          | $x_1$ | $x_2$ | $x_4$ | $x_5$ | $x_7$ | $x_8$ | $x_{11}$ | $x_{22}$ |

| Mode          |                                                             | Rate (MeV)                               |           |
|---------------|-------------------------------------------------------------|------------------------------------------|-----------|
| $\Gamma_1$    | $\pi^+\pi^-\eta$                                            | $0.0799 \pm 0.0029$                      | DESIG=1   |
| $\Gamma_2$    | $\rho^0\gamma$ (including non-resonant $\pi^+\pi^-\gamma$ ) | $0.0554 \pm 0.0019$                      | DESIG=9   |
| $\Gamma_4$    | $\pi^0\pi^0\eta$                                            | $0.0421 \pm 0.0017$                      | DESIG=2   |
| $\Gamma_5$    | $\omega\gamma$                                              | $0.00474 \pm 0.00020$                    | DESIG=7   |
| $\Gamma_7$    | $\gamma\gamma$                                              | $0.00434 \pm 0.00013$                    | DESIG=6   |
| $\Gamma_8$    | $3\pi^0$                                                    | $(4.7 \pm 0.4) \times 10^{-4}$           | DESIG=8   |
| $\Gamma_{11}$ | $\pi^+\pi^-\pi^0$                                           | $(6.8 \pm 0.4) \times 10^{-4}$           | DESIG=121 |
| $\Gamma_{22}$ | $\pi^+\pi^-e^+e^-$                                          | $(4.4 \pm_{-1.8}^{+2.3}) \times 10^{-4}$ | DESIG=10  |

$\eta'(958)$  PARTIAL WIDTHS

NODE=M002220

 $\Gamma(\gamma\gamma)$  $\Gamma_7$ 

| VALUE (keV)                                                                   | EVTS | DOCUMENT ID           | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------|------|-----------------------|----------|---------------------------------------------|
| <b>4.34±0.14 OUR FIT</b>                                                      |      |                       |          |                                             |
| <b>4.28±0.19 OUR AVERAGE</b>                                                  |      |                       |          |                                             |
| 4.17±0.10±0.27                                                                | 2000 | <sup>1</sup> ACCIARRI | 98Q L3   | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\gamma$ |
| 4.53±0.29±0.51                                                                | 266  | KARCH                 | 92 CBAL  | $e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$   |
| 3.61±0.13±0.48                                                                |      | <sup>2</sup> BEHREND  | 91 CELL  | $e^+e^- \rightarrow e^+e^-\eta'(958)$       |
| 4.6 ±1.1 ±0.6                                                                 | 23   | BARU                  | 90 MD1   | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\gamma$ |
| 4.57±0.25±0.44                                                                |      | BUTLER                | 90 MRK2  | $e^+e^- \rightarrow e^+e^-\eta'(958)$       |
| 5.08±0.24±0.71                                                                | 547  | <sup>3</sup> ROE      | 90 ASP   | $e^+e^- \rightarrow e^+e^-2\gamma$          |
| 3.8 ±0.7 ±0.6                                                                 | 34   | AIHARA                | 88C TPC  | $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$   |
| 4.9 ±0.5 ±0.5                                                                 | 136  | <sup>4</sup> WILLIAMS | 88 CBAL  | $e^+e^- \rightarrow e^+e^-2\gamma$          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |          |                                             |
| 4.7 ±0.6 ±0.9                                                                 | 143  | <sup>5</sup> GIDAL    | 87 MRK2  | $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$   |
| 4.0 ±0.9                                                                      |      | <sup>6</sup> BARTEL   | 85E JADE | $e^+e^- \rightarrow e^+e^-2\gamma$          |

<sup>1</sup> No non-resonant  $\pi^+\pi^-$  contribution found.<sup>2</sup> Reevaluated by us using  $B(\eta' \rightarrow \rho(770)\gamma) = (30.2 \pm 1.3)\%$ .<sup>3</sup> Reevaluated by us using  $B(\eta' \rightarrow \gamma\gamma) = (2.11 \pm 0.13)\%$ .<sup>4</sup> Reevaluated by us using  $B(\eta' \rightarrow \gamma\gamma) = (2.11 \pm 0.13)\%$ .<sup>5</sup> Superseded by BUTLER 90.<sup>6</sup> Systematic error not evaluated.NODE=M002W4  
NODE=M002W4NODE=M002W4;LINKAGE=AC  
NODE=M002W4;LINKAGE=K1  
NODE=M002W4;LINKAGE=K2  
NODE=M002W4;LINKAGE=K3  
NODE=M002W4;LINKAGE=C  
NODE=M002W4;LINKAGE=A $\Gamma(e^+e^-)$  $\Gamma_{29}$ 

| VALUE (eV)                                                                    | CL% | DOCUMENT ID             | TECN    | COMMENT                                   |
|-------------------------------------------------------------------------------|-----|-------------------------|---------|-------------------------------------------|
| <b>&lt;1.1 × 10<sup>-3</sup></b>                                              | 90  | <sup>1,2</sup> ACHASOV  | 15 SND  | 0.958 $e^+e^- \rightarrow \pi\pi\eta$     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                         |         |                                           |
| <2.0 × 10 <sup>-3</sup>                                                       | 90  | <sup>2</sup> ACHASOV    | 15 SND  | 0.958 $e^+e^- \rightarrow \pi\pi\eta$     |
| <2.4 × 10 <sup>-3</sup>                                                       | 90  | <sup>2</sup> AKHMETSHIN | 15 CMD3 | 0.958 $e^+e^- \rightarrow \pi^+\pi^-\eta$ |
| <sup>1</sup> Combining data of ACHASOV 15 and AKHMETSHIN 15.                  |     |                         |         |                                           |
| <sup>2</sup> Using $\eta$ and $\eta'$ branching fractions from PDG 14.        |     |                         |         |                                           |

NODE=M002W1  
NODE=M002W1

OCCUR=2

NODE=M002W1;LINKAGE=A  
NODE=M002W1;LINKAGE=B $\eta'(958) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$ 

NODE=M002223

This combination of a partial width with the partial width into  $\gamma\gamma$  and with the total width is obtained from the integrated cross section into channel(i) in the  $\gamma\gamma$  annihilation.

NODE=M002223

 $\Gamma(\gamma\gamma) \times \Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))/\Gamma_{\text{total}}$  $\Gamma_7\Gamma_2/\Gamma$ 

| VALUE (keV)                                                                   | EVTS | DOCUMENT ID | TECN     | COMMENT                                      |
|-------------------------------------------------------------------------------|------|-------------|----------|----------------------------------------------|
| <b>1.28±0.04 OUR FIT</b>                                                      |      |             |          |                                              |
| <b>1.26±0.07 OUR AVERAGE</b>                                                  |      |             |          | Error includes scale factor of 1.2.          |
| 1.09±0.04±0.13                                                                |      | BEHREND     | 91 CELL  | $e^+e^- \rightarrow e^+e^-\rho(770)^0\gamma$ |
| 1.35±0.09±0.21                                                                |      | AIHARA      | 87 TPC   | $e^+e^- \rightarrow e^+e^-\rho\gamma$        |
| 1.13±0.04±0.13                                                                | 867  | ALBRECHT    | 87B ARG  | $e^+e^- \rightarrow e^+e^-\rho\gamma$        |
| 1.53±0.09±0.21                                                                |      | ALTHOFF     | 84E TASS | $e^+e^- \rightarrow e^+e^-\rho\gamma$        |
| 1.14±0.08±0.11                                                                | 243  | BERGER      | 84B PLUT | $e^+e^- \rightarrow e^+e^-\rho\gamma$        |
| 1.73±0.34±0.35                                                                | 95   | JENNI       | 83 MRK2  | $e^+e^- \rightarrow e^+e^-\rho\gamma$        |
| 1.49±0.13±0.027                                                               | 213  | BARTEL      | 82B JADE | $e^+e^- \rightarrow e^+e^-\rho\gamma$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |                                              |
| 1.85±0.31±0.24                                                                | 43   | BEHREND     | 82C CELL | $e^+e^- \rightarrow e^+e^-\rho\gamma$        |

NODE=M002G1  
NODE=M002G1 $\Gamma(\gamma\gamma) \times \Gamma(\pi^0\pi^0\eta)/\Gamma_{\text{total}}$  $\Gamma_7\Gamma_4/\Gamma$ 

| VALUE (keV)                                                                                                                           | DOCUMENT ID               | TECN    | COMMENT                                   |
|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------|---------|-------------------------------------------|
| <b>0.97±0.04 OUR FIT</b>                                                                                                              |                           |         | Error includes scale factor of 1.1.       |
| <b>0.92±0.06±0.11</b>                                                                                                                 | <sup>1</sup> KARCH        | 92 CBAL | $e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                         |                           |         |                                           |
| 0.95±0.05±0.08                                                                                                                        | <sup>2</sup> KARCH        | 90 CBAL | $e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$ |
| 1.00±0.08±0.10                                                                                                                        | <sup>2,3</sup> ANTREASYAN | 87 CBAL | $e^+e^- \rightarrow e^+e^-\eta\pi^0\pi^0$ |
| <sup>1</sup> Reevaluated by us using $B(\eta \rightarrow \gamma\gamma) = (39.21 \pm 0.34)\%$ . Supersedes ANTREASYAN 87 and KARCH 90. |                           |         |                                           |
| <sup>2</sup> Superseded by KARCH 92.                                                                                                  |                           |         |                                           |
| <sup>3</sup> Using $BR(\eta \rightarrow 2\gamma) = (38.9 \pm 0.5)\%$ .                                                                |                           |         |                                           |

NODE=M002G2  
NODE=M002G2

NODE=M002G2;LINKAGE=K4

NODE=M002G2;LINKAGE=A  
NODE=M002G2;LINKAGE=D



$\eta'(958) \Gamma(i) \Gamma(e^+ e^-) / \Gamma(\text{total})$ 

NODE=M002224

 $\Gamma(\pi^+ \pi^- \eta) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_1 \Gamma_{29} / \Gamma$ 

| VALUE ( $10^{-3}$ eV)                                                                                                                                                                                                                                                                                              | CL% | DOCUMENT ID                | TECN | COMMENT                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------------|------|----------------------------------------------|
| <b>&lt;1.0</b>                                                                                                                                                                                                                                                                                                     | 90  | <sup>1</sup> AKHMETSHIN 15 | CMD3 | $0.958 e^+ e^- \rightarrow \pi^+ \pi^- \eta$ |
| <sup>1</sup> AKHMETSHIN 15 reports $[\Gamma(\eta'(958) \rightarrow \pi^+ \pi^- \eta) \times \Gamma(\eta'(958) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(\eta \rightarrow 2\gamma)] < 4.1 \times 10^{-4}$ eV which we divide by our best value $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ . |     |                            |      |                                              |

NODE=M002G01  
NODE=M002G01

NODE=M002G01;LINKAGE=A

 $\eta'(958)$  BRANCHING RATIOS

NODE=M002230

 $\Gamma(\pi^+ \pi^- \eta) / \Gamma_{\text{total}}$  $\Gamma_1 / \Gamma$ 

| VALUE (units $10^{-2}$ )                                                                   | EVTS                                | DOCUMENT ID         | TECN    | COMMENT                           |
|--------------------------------------------------------------------------------------------|-------------------------------------|---------------------|---------|-----------------------------------|
| <b>42.5 <math>\pm</math> 0.5 OUR FIT</b>                                                   | Error includes scale factor of 1.1. |                     |         |                                   |
| <b>41.24 <math>\pm</math> 0.08 <math>\pm</math> 1.24</b>                                   | 312k                                | ABLIKIM             | 19T BES | $J/\psi \rightarrow \gamma \eta'$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •              |                                     |                     |         |                                   |
| 42.4 $\pm$ 1.1 $\pm$ 0.4                                                                   | 1.2k                                | <sup>1</sup> PEDLAR | 09 CLEO | $J/\psi \rightarrow \gamma \eta'$ |
| <sup>1</sup> Not independent of other $\eta'$ branching fractions and ratios in PEDLAR 09. |                                     |                     |         |                                   |

NODE=M002R47  
NODE=M002R47

NODE=M002R47;LINKAGE=PE

 $\Gamma(\pi^+ \pi^- \eta(\text{charged decay})) / \Gamma_{\text{total}}$  $0.2789 \Gamma_1 / \Gamma$ 

| VALUE                                                                         | EVTS | DOCUMENT ID | TECN    | COMMENT                                              |
|-------------------------------------------------------------------------------|------|-------------|---------|------------------------------------------------------|
| <b>0.1185±0.0015 OUR FIT</b> Error includes scale factor of 1.1.              |      |             |         |                                                      |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |             |         |                                                      |
| 0.123 ±0.014                                                                  | 107  | RITTENBERG  | 69 HBC  | 1.7–2.7 $K^- p$                                      |
| 0.10 ±0.04                                                                    | 10   | LONDON      | 66 HBC  | 2.24 $K^- p \rightarrow \Lambda 2\pi^+ 2\pi^- \pi^0$ |
| 0.07 ±0.04                                                                    | 7    | BADIER      | 65B HBC | 3 $K^- p$                                            |

NODE=M002R3  
NODE=M002R3 $\Gamma(\pi^+ \pi^- \eta(\text{neutral decay})) / \Gamma_{\text{total}}$  $0.7212 \Gamma_1 / \Gamma$ 

| <u>VALUE</u>                                                                  | <u>EVTS</u>                         | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>           |
|-------------------------------------------------------------------------------|-------------------------------------|--------------------|-------------|--------------------------|
| <b>0.306±0.004 OUR FIT</b>                                                    | Error includes scale factor of 1.1. |                    |             |                          |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                                     |                    |             |                          |
| 0.314±0.026                                                                   | 281                                 | RITTENBERG 69      | HBC         | 1.7-2.7 K <sup>-</sup> p |

NODE=M002R1  
NODE=M002R1 $\Gamma(\rho^0 \gamma(\text{including non-resonant } \pi^+ \pi^- \gamma)) / \Gamma_{\text{total}}$  $\Gamma_2 / \Gamma$ 

| VALUE (units $10^{-2}$ )                                                      | EVTS                                | DOCUMENT ID         | TECN    | COMMENT                                             |
|-------------------------------------------------------------------------------|-------------------------------------|---------------------|---------|-----------------------------------------------------|
| <b>29.5 <math>\pm</math> 0.4 OUR FIT</b>                                      | Error includes scale factor of 1.1. |                     |         |                                                     |
| <b>29.90 <math>\pm</math> 0.03 <math>\pm</math> 0.55</b>                      | 913k                                | ABLIKIM             | 19T BES | $J/\psi \rightarrow \gamma \eta'$                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |                     |         |                                                     |
| 28.7 $\pm$ 0.7 $\pm$ 0.4                                                      | 0.2k                                | <sup>1</sup> PEDLAR | 09 CLEO | $J/\psi \rightarrow \gamma \eta'$                   |
| 32.9 $\pm$ 3.3                                                                | 298                                 | RITTENBERG          | 69 HBC  | $1.7\text{--}2.7 K^- p$                             |
| 20 $\pm$ 10                                                                   | 20                                  | LONDON              | 66 HBC  | $2.24 K^- p \rightarrow \Lambda \pi^+ \pi^- \gamma$ |
| 34 $\pm$ 9                                                                    | 35                                  | BADIER              | 65B HBC | $3 K^- p$                                           |

NODE=M002R6  
NODE=M002R6<sup>1</sup> Not independent of other  $\eta'$  branching fractions and ratios in PEDLAR 09.

NODE=M002R6;LINKAGE=PE

 $\Gamma(\rho^0 \gamma) / \Gamma_{\text{total}}$  $\Gamma_3 / \Gamma$ 

| VALUE (%)                                                                     | EVTS | DOCUMENT ID          | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |          |                                             |
| 33.34 $\pm$ 0.06 $\pm$ 1.60                                                   | 970k | <sup>1</sup> ABLIKIM | 18C BES3 | $\eta'(958) \rightarrow \gamma \pi^+ \pi^-$ |
| 34.43 $\pm$ 0.52 $\pm$ 1.97                                                   | 970k | <sup>2</sup> ABLIKIM | 18C BES3 | $\eta'(958) \rightarrow \gamma \pi^+ \pi^-$ |

NODE=M002R66  
NODE=M002R66

OCCUR=2

<sup>1</sup> From a fit to  $\pi^+ \pi^-$  mass using  $\rho(770)$ ,  $\omega(782)$ , and box anomaly components.<sup>2</sup> From a fit to  $\pi^+ \pi^-$  mass using  $\rho(770)$ ,  $\omega(782)$ , and  $\rho(1450)$  components.NODE=M002R66;LINKAGE=A  
NODE=M002R66;LINKAGE=B $\Gamma(\rho^0 \gamma(\text{including non-resonant } \pi^+ \pi^- \gamma)) / \Gamma(\pi^+ \pi^- \eta)$  $\Gamma_2 / \Gamma_1$ 

| VALUE                                           | DOCUMENT ID                         | TECN     | COMMENT                           |
|-------------------------------------------------|-------------------------------------|----------|-----------------------------------|
| <b>0.694 <math>\pm</math> 0.014 OUR FIT</b>     | Error includes scale factor of 1.1. |          |                                   |
| <b>0.683 <math>\pm</math> 0.020 OUR AVERAGE</b> |                                     |          |                                   |
| 0.677 $\pm$ 0.024 $\pm$ 0.011                   | PEDLAR                              | 09 CLE3  | $J/\psi \rightarrow \eta' \gamma$ |
| 0.69 $\pm$ 0.03                                 | ABLIKIM                             | 06E BES2 | $J/\psi \rightarrow \eta' \gamma$ |

NODE=M002R43  
NODE=M002R43

$$\Gamma(\rho^0 \gamma (\text{including non-resonant } \pi^+ \pi^- \gamma)) / \Gamma(\pi^+ \pi^- \eta (\text{neutral decay}))$$

$$\Gamma_2 / 0.714 \Gamma_1$$

| VALUE                          | EVTS                                | DOCUMENT ID | TECN     | COMMENT                                                     |
|--------------------------------|-------------------------------------|-------------|----------|-------------------------------------------------------------|
| <b>0.972 ± 0.020 OUR FIT</b>   | Error includes scale factor of 1.1. |             |          |                                                             |
| <b>0.97 ± 0.09 OUR AVERAGE</b> |                                     |             |          |                                                             |
| 0.70 ± 0.22                    |                                     | AMSLER      | 04B CBAR | 0 $\bar{p} p \rightarrow \pi^+ \pi^- \eta$                  |
| 1.07 ± 0.17                    |                                     | BELADIDZE   | 92C VES  | 36 $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$ |
| 0.92 ± 0.14                    | 473                                 | DANBURG     | 73 HBC   | 2.2 $K^- p \rightarrow \Lambda X^0$                         |
| 1.11 ± 0.18                    | 192                                 | JACOBS      | 73 HBC   | 2.9 $K^- p \rightarrow \Lambda X^0$                         |

NODE=M002R27  
NODE=M002R27

$$\Gamma(\pi^0 \pi^0 \eta) / \Gamma_{\text{total}}$$

$$\Gamma_4 / \Gamma$$

| VALUE (units $10^{-2}$ )                                                      | EVTS                                | DOCUMENT ID         | TECN    | COMMENT                           |
|-------------------------------------------------------------------------------|-------------------------------------|---------------------|---------|-----------------------------------|
| <b>22.4 ± 0.6 OUR FIT</b>                                                     | Error includes scale factor of 1.1. |                     |         |                                   |
| <b>21.36 ± 0.10 ± 0.92</b>                                                    | 52k                                 | ABLIKIM             | 19T BES | $J/\psi \rightarrow \gamma \eta'$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |                     |         |                                   |
| 23.5 ± 1.3 ± 0.4                                                              | 3.2k                                | <sup>1</sup> PEDLAR | 09 CLEO | $J/\psi \rightarrow \gamma \eta'$ |

NODE=M002R48  
NODE=M002R48

<sup>1</sup> Not independent of other  $\eta'$  branching fractions and ratios in PEDLAR 09.

NODE=M002R48;LINKAGE=PE

$$\Gamma(\pi^0 \pi^0 \eta (3\pi^0 \text{ decay})) / \Gamma_{\text{total}}$$

$$0.321 \Gamma_4 / \Gamma$$

| <u>VALUE</u>                                                                  | <u>EVTS</u>                         | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|-------------------------------------------------------------------------------|-------------------------------------|--------------------|-------------|----------------|
| <b>0.0718±0.0018 OUR FIT</b>                                                  | Error includes scale factor of 1.1. |                    |             |                |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                                     |                    |             |                |
| 0.11 ±0.06                                                                    | 4                                   | BENSINGER          | 70 DBC      | 2.2 $\pi^+ d$  |

NODE=M002R26  
NODE=M002R26

$$\Gamma(\pi^0 \pi^0 \eta) / \Gamma(\pi^+ \pi^- \eta)$$

$$\Gamma_4 / \Gamma_1$$

| VALUE                        | DOCUMENT ID                         | TECN    | COMMENT                           |
|------------------------------|-------------------------------------|---------|-----------------------------------|
| <b>0.527 ± 0.019 OUR FIT</b> | Error includes scale factor of 1.1. |         |                                   |
| <b>0.555 ± 0.043 ± 0.013</b> | PEDLAR                              | 09 CLE3 | $J/\psi \rightarrow \eta' \gamma$ |

NODE=M002R45  
NODE=M002R45

$$\Gamma(\rho^0 \gamma (\text{including non-resonant } \pi^+ \pi^- \gamma)) / \Gamma(\pi \pi \eta)$$

$$\Gamma_2 / (\Gamma_1 + \Gamma_4)$$

| VALUE                                                                         | DOCUMENT ID                         | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------|-------------------------------------|----------|-------------------------------------|
| <b>0.454±0.009 OUR FIT</b>                                                    | Error includes scale factor of 1.1. |          |                                     |
| <b>0.43 ±0.02 ±0.02</b>                                                       | BARBERIS                            | 98C OMEG | 450 $p p \rightarrow p_f \eta' p_s$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |          |                                     |
| 0.31 ±0.15                                                                    | DAVIS                               | 68 HBC   | 5.5 $K^- p$                         |

NODE=M002R7  
NODE=M002R7

$$\Gamma(\omega \gamma) / \Gamma_{\text{total}}$$

$$\Gamma_5 / \Gamma$$

| VALUE (units $10^{-2}$ )                                                      | EVTS  | DOCUMENT ID          | TECN      | COMMENT                           |
|-------------------------------------------------------------------------------|-------|----------------------|-----------|-----------------------------------|
| <b>2.52 ± 0.07 OUR FIT</b>                                                    |       |                      |           |                                   |
| <b>2.50 ± 0.07 OUR AVERAGE</b>                                                |       |                      |           |                                   |
| 2.489 ± 0.018 ± 0.074                                                         | 23k   | ABLIKIM              | 19T BES   | $J/\psi \rightarrow \gamma \eta'$ |
| 2.55 ± 0.03 ± 0.16                                                            | 33.2k | <sup>1</sup> ABLIKIM | 15AD BES3 | $J/\psi \rightarrow \eta' \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                      |           |                                   |
| 2.34 ± 0.30 ± 0.04                                                            | 70    | <sup>2</sup> PEDLAR  | 09 CLEO   | $J/\psi \rightarrow \gamma \eta'$ |

NODE=M002R49  
NODE=M002R49

<sup>1</sup> Using  $B(J/\psi \rightarrow \eta' \gamma) = (5.15 \pm 0.16) \times 10^{-3}$  and  $B(\omega \rightarrow \pi^+ \pi^- \pi^0) = (89.2 \pm 0.7)\%$ .

<sup>2</sup> Not independent of other  $\eta'$  branching fractions and ratios in PEDLAR 09.

NODE=M002R49;LINKAGE=A  
NODE=M002R49;LINKAGE=PE

$$\Gamma(\omega \gamma) / \Gamma(\pi^+ \pi^- \eta)$$

$$\Gamma_5 / \Gamma_1$$

| VALUE                                                                         | EVTS                                | DOCUMENT ID | TECN    | COMMENT                           |
|-------------------------------------------------------------------------------|-------------------------------------|-------------|---------|-----------------------------------|
| <b>0.0593 ± 0.0018 OUR FIT</b>                                                | Error includes scale factor of 1.1. |             |         |                                   |
| <b>0.055 ± 0.007 ± 0.001</b>                                                  |                                     | PEDLAR      | 09 CLE3 | $J/\psi \rightarrow \eta' \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |             |         |                                   |
| 0.068 ± 0.013                                                                 | 68                                  | ZANFINO     | 77 ASPK | 8.4 $\pi^- p$                     |

NODE=M002R17  
NODE=M002R17

$$\Gamma(\omega \gamma) / \Gamma(\pi^0 \pi^0 \eta)$$

$$\Gamma_5 / \Gamma_4$$

| VALUE                        | DOCUMENT ID | TECN     | COMMENT                             |
|------------------------------|-------------|----------|-------------------------------------|
| <b>0.113 ± 0.004 OUR FIT</b> |             |          |                                     |
| <b>0.147 ± 0.016</b>         | ALDE        | 87B GAM2 | 38 $\pi^- p \rightarrow n 4 \gamma$ |

NODE=M002R33  
NODE=M002R33

$$\Gamma(\omega e^+ e^-) / \Gamma(\omega \gamma)$$

$$\Gamma_6 / \Gamma_5$$

| VALUE (units $10^{-3}$ )                                                      | DOCUMENT ID          | TECN      | COMMENT                           |
|-------------------------------------------------------------------------------|----------------------|-----------|-----------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |           |                                   |
| 7.71 ± 1.34 ± 0.54                                                            | <sup>1</sup> ABLIKIM | 15AD BES3 | $J/\psi \rightarrow \eta' \gamma$ |

NODE=M002R60  
NODE=M002R60

<sup>1</sup> Obtained from other ABLIKIM 15AD measurements with common systematics taken into account.

NODE=M002R60;LINKAGE=A

$$\Gamma(\omega e^+ e^-)/\Gamma_{\text{total}}$$

$$\Gamma_6/\Gamma$$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN      | COMMENT                           |
|--------------------------|------|----------------------|-----------|-----------------------------------|
| <b>1.97±0.34±0.17</b>    | 66   | <sup>1</sup> ABLIKIM | 15AD BES3 | $J/\psi \rightarrow \eta' \gamma$ |

<sup>1</sup> Using  $B(J/\psi \rightarrow \eta' \gamma) = (5.15 \pm 0.16) \times 10^{-3}$  and  $B(\omega \rightarrow \pi^+ \pi^- \pi^0) = (89.2 \pm 0.7)\%$ .

NODE=M002R59  
NODE=M002R59

NODE=M002R59;LINKAGE=A

$$\Gamma(\rho^0 \gamma (\text{including non-resonant } \pi^+ \pi^- \gamma)) / [\Gamma(\pi^+ \pi^- \eta) + \Gamma(\pi^0 \pi^0 \eta) + \Gamma(\omega \gamma)]$$

$$\Gamma_2/(\Gamma_1+\Gamma_4+\Gamma_5)$$

| VALUE                      | DOCUMENT ID                         | TECN | COMMENT |
|----------------------------|-------------------------------------|------|---------|
| <b>0.437±0.008 OUR FIT</b> | Error includes scale factor of 1.1. |      |         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.25 ±0.14 DAUBER 64 HBC 1.95  $K^- p$

NODE=M002R18  
NODE=M002R18

$$[\Gamma(\pi^0 \pi^0 \eta (\text{charged decay})) + \Gamma(\omega (\text{charged decay}) \gamma)] / \Gamma_{\text{total}}$$

$$(0.286\Gamma_4+0.89\Gamma_5)/\Gamma$$

| VALUE                        | EVTS                                | DOCUMENT ID | TECN | COMMENT |
|------------------------------|-------------------------------------|-------------|------|---------|
| <b>0.0864±0.0017 OUR FIT</b> | Error includes scale factor of 1.1. |             |      |         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.045 ±0.029 42 RITTENBERG 69 HBC 1.7–2.7  $K^- p$

NODE=M002R4  
NODE=M002R4

$$\Gamma(\pi^+ \pi^- \text{ neutrals}) / \Gamma_{\text{total}} \quad (0.714\Gamma_1+0.286\Gamma_4+0.89\Gamma_5)/\Gamma$$

| VALUE                        | EVTS                                | DOCUMENT ID | TECN | COMMENT |
|------------------------------|-------------------------------------|-------------|------|---------|
| <b>0.3897±0.0028 OUR FIT</b> | Error includes scale factor of 1.1. |             |      |         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.4 ±0.1 39 LONDON 66 HBC 2.24  $K^- p \rightarrow \Lambda \pi^+ \pi^- \text{ neutrals}$   
0.35 ±0.06 33 BADIER 65B HBC 3  $K^- p$

NODE=M002R2  
NODE=M002R2

$$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$$

$$\Gamma_7/\Gamma$$

| VALUE (units $10^{-2}$ )   | EVTS                                | DOCUMENT ID | TECN | COMMENT |
|----------------------------|-------------------------------------|-------------|------|---------|
| <b>2.307±0.035 OUR FIT</b> | Error includes scale factor of 1.1. |             |      |         |

**2.31 ±0.06 OUR AVERAGE** Error includes scale factor of 1.8.

2.331±0.012±0.035 71k ABLIKIM 19T BES  $J/\psi \rightarrow \gamma \eta'$   
1.99  $^{+0.31}_{-0.27}$  ±0.07 114 <sup>1</sup> WICHT 08 BELL  $B^\pm \rightarrow K^\pm \gamma \gamma$   
2.00 ±0.18 <sup>2</sup> STANTON 80 SPEC 8.45  $\pi^- p \rightarrow n \pi^+ \pi^- 2\gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.25 ±0.16 ±0.03 0.3k <sup>3</sup> PEDLAR 09 CLEO  $J/\psi \rightarrow \gamma \eta'$   
1.8 ±0.2 6000 <sup>4</sup> APEL 79 NICE 15–40  $\pi^- p \rightarrow n 2\gamma$   
2.5 ±0.7 DUANE 74 MMS  $\pi^- p \rightarrow n \text{MM}$   
1.71 ±0.33 68 DALPIAZ 72 CNTR 1.6  $\pi^- p \rightarrow n X^0$   
2.0  $^{+0.8}_{-0.6}$  31 HARVEY 71 OSPK 3.65  $\pi^- p \rightarrow n X^0$

<sup>1</sup> WICHT 08 reports  $[\Gamma(\eta'(958) \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta' K^+)] = (1.40^{+0.16+0.15}_{-0.15-0.12}) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \eta' K^+) = (7.04 \pm 0.25) \times 10^{-5}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Includes APEL 79 result.

<sup>3</sup> Not independent of other  $\eta'$  branching fractions and ratios in PEDLAR 09.

<sup>4</sup> Data is included in STANTON 80 evaluation.

NODE=M002R19  
NODE=M002R19

NODE=M002R19;LINKAGE=WI

NODE=M002R19;LINKAGE=S  
NODE=M002R19;LINKAGE=PE  
NODE=M002R19;LINKAGE=A

$$\Gamma(\gamma\gamma)/\Gamma(\pi^+ \pi^- \eta)$$

$$\Gamma_7/\Gamma_1$$

| VALUE                        | DOCUMENT ID                         | TECN | COMMENT                           |
|------------------------------|-------------------------------------|------|-----------------------------------|
| <b>0.0543±0.0012 OUR FIT</b> | Error includes scale factor of 1.1. |      |                                   |
| <b>0.053 ±0.004 ±0.001</b>   | PEDLAR 09                           | CLE3 | $J/\psi \rightarrow \eta' \gamma$ |

NODE=M002R46  
NODE=M002R46

$$\Gamma(\gamma\gamma)/\Gamma(\rho^0 \gamma (\text{including non-resonant } \pi^+ \pi^- \gamma))$$

$$\Gamma_7/\Gamma_2$$

| VALUE                        | DOCUMENT ID                         | TECN | COMMENT                           |
|------------------------------|-------------------------------------|------|-----------------------------------|
| <b>0.0783±0.0016 OUR FIT</b> | Error includes scale factor of 1.1. |      |                                   |
| <b>0.080 ±0.008</b>          | ABLIKIM 06E                         | BES2 | $J/\psi \rightarrow \eta' \gamma$ |

NODE=M002R42  
NODE=M002R42

$$\Gamma(\gamma\gamma)/\Gamma(\pi^0 \pi^0 \eta)$$

$$\Gamma_7/\Gamma_4$$

| VALUE                        | DOCUMENT ID | TECN | COMMENT |
|------------------------------|-------------|------|---------|
| <b>0.1031±0.0028 OUR FIT</b> |             |      |         |

**0.105 ±0.010 OUR AVERAGE** Error includes scale factor of 1.9.

0.091 ±0.009 AMSLER 93 CBAR 0.0  $\bar{p} p$   
0.112 ±0.002 ±0.006 ALDE 87B GAM2 38  $\pi^- p \rightarrow n 2\gamma$

NODE=M002R38  
NODE=M002R38

$\Gamma(\gamma\gamma)/\Gamma(\pi^0\pi^0\eta(\text{neutral decay}))$  $\Gamma_7/0.714\Gamma_4$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.144±0.004 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |    |      |    |      |                                 |
|-------------|----|------|----|------|---------------------------------|
| 0.188±0.058 | 16 | APEL | 72 | OSPK | $3.8\pi^-p \rightarrow n\chi^0$ |
|-------------|----|------|----|------|---------------------------------|

NODE=M002R28  
 NODE=M002R28

 $\Gamma(\text{neutrals})/\Gamma_{\text{total}}$  $(0.714\Gamma_4+0.09\Gamma_5+\Gamma_7)/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.185±0.004 OUR FIT** Error includes scale factor of 1.1.

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |     |            |    |      |                                 |
|-------------|-----|------------|----|------|---------------------------------|
| 0.185±0.022 | 535 | BASILE     | 71 | CNTR | $1.6\pi^-p \rightarrow n\chi^0$ |
| 0.189±0.026 | 123 | RITTENBERG | 69 | HBC  | $1.7\text{--}2.7 K^-p$          |

NODE=M002R5  
 NODE=M002R5

 $\Gamma(3\pi^0)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.50 ±0.17 OUR FIT****3.57 ±0.26 OUR AVERAGE**

|                   |      |                      |     |      |                                     |
|-------------------|------|----------------------|-----|------|-------------------------------------|
| 3.522±0.082±0.254 | 2015 | ABLIKIM              | 17  | BES3 | $J/\psi \rightarrow \gamma(3\pi^0)$ |
| 4.79 ±0.59 ±1.14  | 183  | <sup>1</sup> ABLIKIM | 15P | BES3 | $J/\psi \rightarrow K^+K^-3\pi$     |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                  |     |                      |     |      |                                     |
|------------------|-----|----------------------|-----|------|-------------------------------------|
| 3.56 ±0.22 ±0.34 | 309 | <sup>2</sup> ABLIKIM | 12E | BES3 | $J/\psi \rightarrow \gamma(3\pi^0)$ |
|------------------|-----|----------------------|-----|------|-------------------------------------|

<sup>1</sup>We have added all systematic uncertainties in quadrature to a single value.<sup>2</sup>Superseded by ABLIKIM 17.

NODE=M002R55  
 NODE=M002R55

 $\Gamma(3\pi^0)/\Gamma(\pi^0\pi^0\eta)$  $\Gamma_8/\Gamma_4$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**112± 8 OUR FIT****78±10 OUR AVERAGE**

|       |     |       |     |      |                                            |
|-------|-----|-------|-----|------|--------------------------------------------|
| 86±19 | 235 | BLIK  | 08  | GAMS | $32\pi^-p \rightarrow \eta' n$             |
| 74±15 |     | ALDE  | 87B | GAM2 | $38\pi^-p \rightarrow n6\gamma$            |
| 75±18 |     | BINON | 84  | GAM2 | $30\text{--}40\pi^-p \rightarrow n6\gamma$ |

NODE=M002R55;LINKAGE=A  
 NODE=M002R55;LINKAGE=B

NODE=M002R32  
 NODE=M002R32

 $\Gamma(\mu^+\mu^-\gamma)/\Gamma(\gamma\gamma)$  $\Gamma_9/\Gamma_7$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**4.9±1.2** 33 VIKTOROV 80 CNTR  $25,33\pi^-p \rightarrow 2\mu\gamma$ 

NODE=M002R29  
 NODE=M002R29

 $\Gamma(\pi^+\pi^-\mu^+\mu^-)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                      |     |      |                                  |
|-------|----|----------------------|-----|------|----------------------------------|
| <0.29 | 90 | <sup>1</sup> ABLIKIM | 130 | BES3 | $J/\psi \rightarrow \gamma\eta'$ |
| <2.4  | 90 | <sup>2</sup> NAIK    | 09  | CLEO | $J/\psi \rightarrow \gamma\eta'$ |

<sup>1</sup>Using  $\Gamma_2/\Gamma = (29.3 \pm 0.6)\%$  from PDG 12.<sup>2</sup>Not independent of measured value of  $\Gamma_{10}/\Gamma_1$  from NAIK 09.

NODE=M002R50  
 NODE=M002R50

NODE=M002R50;LINKAGE=A  
 NODE=M002R50;LINKAGE=NA

 $\Gamma(\pi^+\pi^-\mu^+\mu^-)/\Gamma(\pi^+\pi^-\eta)$  $\Gamma_{10}/\Gamma_1$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

**<0.5** 90 <sup>1</sup>NAIK 09 CLEO  $J/\psi \rightarrow \gamma\eta'$ <sup>1</sup>NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\mu^+\mu^-)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] < 1.3 \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

NODE=M002R03  
 NODE=M002R03

NODE=M002R03;LINKAGE=NA

 $\Gamma(\pi^+\pi^-\mu^+\mu^-)/\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))$  $\Gamma_{10}/\Gamma_2$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

**<1.0** 90 ABLIKIM 130 BES3  $J/\psi \rightarrow \gamma\eta'$ 

NODE=M002R57  
 NODE=M002R57

 $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**3.61 ±0.18 OUR FIT****3.61 ±0.18 OUR AVERAGE**

|                                          |      |                      |     |      |                                              |
|------------------------------------------|------|----------------------|-----|------|----------------------------------------------|
| 3.591±0.054±0.174                        | 6067 | ABLIKIM              | 17  | BES3 | $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^0)$ |
| 4.28 ±0.49 ±1.11                         | 78   | <sup>1</sup> ABLIKIM | 15P | BES3 | $J/\psi \rightarrow K^+K^-3\pi$              |
| 3.7 <sup>+1.1</sup> <sub>-0.9</sub> ±0.4 |      | <sup>2</sup> NAIK    | 09  | CLEO | $J/\psi \rightarrow \gamma\eta'$             |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                  |      |                      |     |      |                                              |
|------------------|------|----------------------|-----|------|----------------------------------------------|
| 3.83 ±0.15 ±0.39 | 1014 | <sup>3</sup> ABLIKIM | 12E | BES3 | $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^0)$ |
|------------------|------|----------------------|-----|------|----------------------------------------------|

NODE=M002R21  
 NODE=M002R21

<sup>1</sup> We have added all systematic uncertainties in quadrature to a single value.

<sup>2</sup> Not independent of measured value of  $\Gamma_{11}/\Gamma_1$  from NAIK 09.

<sup>3</sup> Superseded by ABLIKIM 17.

### $\Gamma((\pi^+\pi^-\pi^0) \text{ S-wave})/\Gamma_{\text{total}}$

| VALUE (units $10^{-4}$ )                    | EVTS | DOCUMENT ID          | TECN | COMMENT                                           |
|---------------------------------------------|------|----------------------|------|---------------------------------------------------|
| <b><math>37.63 \pm 0.77 \pm 5.00</math></b> | 6580 | <sup>1</sup> ABLIKIM | 17   | BES3 $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^0)$ |

<sup>1</sup> We have added all systematic uncertainties in quadrature .

### $\Gamma(\pi^\mp \rho^\pm)/\Gamma_{\text{total}}$

| VALUE (units $10^{-4}$ )                   | EVTS | DOCUMENT ID          | TECN | COMMENT                                            |
|--------------------------------------------|------|----------------------|------|----------------------------------------------------|
| <b><math>7.44 \pm 0.60 \pm 2.23</math></b> | 1231 | <sup>1</sup> ABLIKIM | 17   | BES3 $J/\psi \rightarrow \gamma(\pi^\mp \rho^\pm)$ |

<sup>1</sup> We have added all systematic uncertainties in quadrature .

### $\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi^+\pi^-\eta)$

| VALUE (units $10^{-3}$ )                          | EVTS | DOCUMENT ID       | TECN | COMMENT                               |
|---------------------------------------------------|------|-------------------|------|---------------------------------------|
| <b><math>8.5 \pm 0.4</math> OUR FIT</b>           |      |                   |      | Error includes scale factor of 1.1.   |
| <b><math>8.28^{+2.49}_{-2.12} \pm 0.04</math></b> | 20   | <sup>1</sup> NAIK | 09   | CLEO $J/\psi \rightarrow \gamma\eta'$ |

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\pi^0)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] = (21^{+6}_{-5} \pm 2) \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

### $\Gamma(\pi^0\rho^0)/\Gamma_{\text{total}}$

| VALUE                        | CL% | DOCUMENT ID | TECN | COMMENT         |
|------------------------------|-----|-------------|------|-----------------|
| <b><math>&lt;0.04</math></b> | 90  | RITTENBERG  | 65   | HBC $2.7 K^- p$ |

### $\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$

| VALUE (units $10^{-5}$ )                | CL% | EVTS | DOCUMENT ID          | TECN | COMMENT                               |
|-----------------------------------------|-----|------|----------------------|------|---------------------------------------|
| <b><math>8.4 \pm 0.9 \pm 0.1</math></b> |     | 199  | <sup>1</sup> ABLIKIM | 14M  | BES3 $J/\psi \rightarrow \gamma\eta'$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |    |                   |    |      |                                  |
|----------|----|-------------------|----|------|----------------------------------|
| $< 24$   | 90 | <sup>2</sup> NAIK | 09 | CLEO | $J/\psi \rightarrow \gamma\eta'$ |
| $< 1000$ | 90 | RITTENBERG        | 69 | HBC  | $1.7\text{--}2.7 K^- p$          |

<sup>1</sup> ABLIKIM 14M reports  $[\Gamma(\eta'(958) \rightarrow 2(\pi^+\pi^-))/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta'(958))]$   $= (4.40 \pm 0.35 \pm 0.30) \times 10^{-7}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = (5.25 \pm 0.07) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Not independent of measured value of  $\Gamma_{15}/\Gamma_1$  from NAIK 09.

### $\Gamma(2(\pi^+\pi^-))/\Gamma(\pi^+\pi^-\eta)$

| VALUE (units $10^{-3}$ )    | CL% | DOCUMENT ID       | TECN | COMMENT                               |
|-----------------------------|-----|-------------------|------|---------------------------------------|
| <b><math>&lt;0.6</math></b> | 90  | <sup>1</sup> NAIK | 09   | CLEO $J/\psi \rightarrow \gamma\eta'$ |

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow 2(\pi^+\pi^-))/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] < 1.4 \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

### $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$

| VALUE (units $10^{-4}$ )                   | CL% | EVTS | DOCUMENT ID          | TECN | COMMENT                               |
|--------------------------------------------|-----|------|----------------------|------|---------------------------------------|
| <b><math>1.79 \pm 0.38 \pm 0.02</math></b> |     | 84   | <sup>1</sup> ABLIKIM | 14M  | BES3 $J/\psi \rightarrow \gamma\eta'$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |                   |    |      |                                  |
|--------|----|-------------------|----|------|----------------------------------|
| $< 27$ | 90 | <sup>2</sup> NAIK | 09 | CLEO | $J/\psi \rightarrow \gamma\eta'$ |
|--------|----|-------------------|----|------|----------------------------------|

<sup>1</sup> ABLIKIM 14M reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta'(958))]$   $= (9.38 \pm 1.79 \pm 0.89) \times 10^{-7}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = (5.25 \pm 0.07) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Not independent of measured value of  $\Gamma_{16}/\Gamma_1$  from NAIK 09.

### $\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\pi^+\pi^-\eta)$

| VALUE (units $10^{-3}$ )  | CL% | DOCUMENT ID       | TECN | COMMENT                               |
|---------------------------|-----|-------------------|------|---------------------------------------|
| <b><math>&lt;6</math></b> | 90  | <sup>1</sup> NAIK | 09   | CLEO $J/\psi \rightarrow \gamma\eta'$ |

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\pi^0)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] < 15 \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

NODE=M002R21;LINKAGE=A  
NODE=M002R21;LINKAGE=NA  
NODE=M002R21;LINKAGE=B

NODE=M002R63  
NODE=M002R63

NODE=M002R63;LINKAGE=A

NODE=M002R62  
NODE=M002R62

NODE=M002R62;LINKAGE=A

NODE=M002R01  
NODE=M002R01

NODE=M002R01;LINKAGE=NA

NODE=M002R10  
NODE=M002R10

NODE=M002R24  
NODE=M002R24

NODE=M002R24;LINKAGE=A

NODE=M002R24;LINKAGE=NA

NODE=M002R04  
NODE=M002R04

NODE=M002R04;LINKAGE=NA

NODE=M002R51  
NODE=M002R51

NODE=M002R51;LINKAGE=A

NODE=M002R51;LINKAGE=NA

NODE=M002R05  
NODE=M002R05

NODE=M002R05;LINKAGE=NA

$\Gamma(2(\pi^+\pi^-)\text{ neutrals})/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID   | TECN | COMMENT                             |
|-------------------------------------------------------------------------------|-----|---------------|------|-------------------------------------|
| <b>&lt;0.01</b>                                                               | 95  | DANBURG 73    | HBC  | $2.2 K^- p \rightarrow \Lambda X^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |               |      |                                     |
| <0.01                                                                         | 90  | RITTENBERG 69 | HBC  | $1.7\text{--}2.7 K^- p$             |

NODE=M002R22  
 NODE=M002R22

 $\Gamma(2(\pi^+\pi^-)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID          | TECN | COMMENT                          |
|-------------------------------------------------------------------------------|-----|----------------------|------|----------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                      |      |                                  |
| <0.002                                                                        | 90  | <sup>1</sup> NAIK 09 | CLEO | $J/\psi \rightarrow \gamma\eta'$ |
| <0.01                                                                         | 90  | RITTENBERG 69        | HBC  | $1.7\text{--}2.7 K^- p$          |

NODE=M002R23  
 NODE=M002R23

<sup>1</sup> Not independent of measured value of  $\Gamma_{18}/\Gamma_1$  from NAIK 09.

NODE=M002R23;LINKAGE=NA

 $\Gamma(2(\pi^+\pi^-)\pi^0)/\Gamma(\pi^+\pi^-\eta)$  $\Gamma_{18}/\Gamma_1$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID          | TECN | COMMENT                          |
|--------------------------|-----|----------------------|------|----------------------------------|
| <b>&lt;4</b>             | 90  | <sup>1</sup> NAIK 09 | CLEO | $J/\psi \rightarrow \gamma\eta'$ |

NODE=M002R06  
 NODE=M002R06

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow 2(\pi^+\pi^-)\pi^0)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)]$   
 $< 11 \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

NODE=M002R06;LINKAGE=NA

 $\Gamma(2(\pi^+\pi^-)2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID     | TECN | COMMENT                                      |
|-------------------------------------------------------------------------------|-----|-----------------|------|----------------------------------------------|
| <b>&lt;0.01</b>                                                               | 95  | KALBFLEISCH 64B | HBC  | $K^- p \rightarrow \Lambda 2(\pi^+\pi^-)+MM$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                 |      |                                              |
| <0.01                                                                         | 90  | LONDON 66       | HBC  | Compilation                                  |

NODE=M002R16  
 NODE=M002R16

 $\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{20}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | DOCUMENT ID              | TECN | COMMENT                                   |
|-------------------------------------------------------------------------------|-----|--------------------------|------|-------------------------------------------|
| <b>&lt; 3.1</b>                                                               | 90  | <sup>1</sup> ABLIKIM 13U | BES3 | $J/\psi \rightarrow \gamma 3(\pi^+\pi^-)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                          |      |                                           |
| < 53                                                                          | 90  | <sup>2</sup> NAIK 09     | CLEO | $J/\psi \rightarrow \gamma\eta'$          |
| <500                                                                          | 95  | KALBFLEISCH 64B          | HBC  | $K^- p \rightarrow \Lambda 2(\pi^+\pi^-)$ |

NODE=M002R07  
 NODE=M002R07

<sup>1</sup> Using  $B(J/\psi \rightarrow \gamma\eta'(958)) = (5.16 \pm 0.15) \times 10^{-3}$ .

<sup>2</sup> Not independent of measured value of  $\Gamma_{20}/\Gamma_1$  from NAIK 09.

NODE=M002R07;LINKAGE=A  
 NODE=M002R07;LINKAGE=NA

 $\Gamma(3(\pi^+\pi^-))/\Gamma(\pi^+\pi^-\eta)$  $\Gamma_{20}/\Gamma_1$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID          | TECN | COMMENT                          |
|--------------------------|-----|----------------------|------|----------------------------------|
| <b>&lt;1.2</b>           | 90  | <sup>1</sup> NAIK 09 | CLEO | $J/\psi \rightarrow \gamma\eta'$ |

NODE=M002R08  
 NODE=M002R08

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow 3(\pi^+\pi^-))/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)]$   
 $< 3.0 \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

NODE=M002R08;LINKAGE=NA

 $\Gamma(K^\pm\pi^\mp)/\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))$  $\Gamma_{21}/\Gamma_2$ 

| VALUE                                      | CL% | DOCUMENT ID | TECN | COMMENT                                                |
|--------------------------------------------|-----|-------------|------|--------------------------------------------------------|
| <b>&lt;1.3 <math>\times 10^{-4}</math></b> | 90  | ABLIKIM 16M | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \text{hadrons}$ |

NODE=M002R61  
 NODE=M002R61

 $\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{22}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

NODE=M002R12  
 NODE=M002R12

**2.4  $\pm 1.3$   
 $-0.9$  OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |     |                          |      |                                  |
|--------------------------|-----|--------------------------|------|----------------------------------|
| $2.11 \pm 0.12 \pm 0.14$ | 429 | <sup>1</sup> ABLIKIM 130 | BES3 | $J/\psi \rightarrow \gamma\eta'$ |
| $2.5 \pm 1.2 \pm 0.5$    |     | <sup>2</sup> NAIK 09     | CLEO | $J/\psi \rightarrow \gamma\eta'$ |
| <6                       | 90  | RITTENBERG 65            | HBC  | $2.7 K^- p$                      |

<sup>1</sup> Using  $\Gamma_2/\Gamma = (29.3 \pm 0.6)\%$  from PDG 12.

<sup>2</sup> Not independent of measured value of  $\Gamma_{22}/\Gamma_1$  from NAIK 09.

NODE=M002R12;LINKAGE=A  
 NODE=M002R12;LINKAGE=NA

$$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma(\pi^+\pi^-\eta)$$

$$\Gamma_{22}/\Gamma_1$$

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

NODE=M002R02  
NODE=M002R02

**5.5  $^{+3.0}_{-2.3}$  OUR FIT**

**5.52 $^{+3.00}_{-2.30} \pm 0.03$**  8 1 NAIK 09 CLEO  $J/\psi \rightarrow \gamma\eta'$

1 NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\pi^+\pi^-)/\Gamma(\eta'(958) \rightarrow \pi^+\pi^-\eta)] / [B(\eta \rightarrow 2\gamma)] = (14^{+7}_{-5} \pm 3) \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M002R02;LINKAGE=NA

$$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma(\rho^0\gamma(\text{including non-resonant } \pi^+\pi^-\gamma))$$

$$\Gamma_{22}/\Gamma_2$$

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

NODE=M002R56  
NODE=M002R56

**7.2 $\pm 0.4 \pm 0.5$**  429 ABLIKIM 130 BES3  $J/\psi \rightarrow \gamma\eta'$

$$\Gamma(\pi^+\pi^-\nu_e + \text{c.c.})/\Gamma(\pi^+\pi^-\eta)$$

$$\Gamma_{23}/\Gamma_1$$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

NODE=M002R54  
NODE=M002R54

**<5.0** 90 ABLIKIM 13G BES3  $J/\psi \rightarrow \phi\eta'$

$$\Gamma(\gamma e^+ e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{24}/\Gamma$$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

NODE=M002R40  
NODE=M002R40

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.9 90 BRIERE 00 CLEO  $10.6 e^+ e^-$

$$\Gamma(\gamma e^+ e^-)/\Gamma(\gamma\gamma)$$

$$\Gamma_{24}/\Gamma_7$$

| VALUE (units $10^{-2}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

NODE=M002R00  
NODE=M002R00

**2.13 $\pm 0.09 \pm 0.07$**  864 ABLIKIM 150 BES3  $J/\psi \rightarrow \gamma e^+ e^-$  |

$$\Gamma(\pi^0\gamma\gamma)/\Gamma_{\text{total}}$$

$$\Gamma_{25}/\Gamma$$

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

NODE=M002R64  
NODE=M002R64

**3.20 $\pm 0.07 \pm 0.23$**  3.4k ABLIKIM 17T BES3  $J/\psi \rightarrow \gamma\eta'$  |

$$\Gamma(\pi^0\gamma\gamma(\text{non resonant}))/\Gamma_{\text{total}}$$

$$\Gamma_{26}/\Gamma$$

| VALUE (units $10^{-4}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

NODE=M002R65  
NODE=M002R65

**6.16 $\pm 0.64 \pm 0.67$**  655 ABLIKIM 17T BES3  $J/\psi \rightarrow \gamma\eta'$  |

$$\Gamma(\pi^0\gamma\gamma)/\Gamma(\pi^0\pi^0\eta)$$

$$\Gamma_{25}/\Gamma_4$$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

NODE=M002R35  
NODE=M002R35

**<37** 90 ALDE 87B GAM2  $38 \pi^- p \rightarrow n4\gamma$

$$\Gamma(\eta\gamma\gamma)/\Gamma_{\text{total}}$$

$$\Gamma_{27}/\Gamma$$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

NODE=M002R67  
NODE=M002R67

**<1.33  $\times 10^{-4}$**  90 ABLIKIM 19AW BES3  $J/\psi \rightarrow \gamma\eta' \rightarrow \gamma\gamma\gamma 2\gamma$  |

$$\Gamma(4\pi^0)/\Gamma_{\text{total}}$$

$$\Gamma_{28}/\Gamma$$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

NODE=M002R58  
NODE=M002R58

**<4.94  $\times 10^{-5}$  (CL = 90%)** [ $<3.2 \times 10^{-4}$  (CL = 90%) OUR 2020 BEST LIMIT]

**<4.94  $\times 10^{-5}$**  90 ABLIKIM 20E BES3  $J/\psi \rightarrow \eta'\gamma$  |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<3.2  $\times 10^{-4}$  90 DONSKOV 14 GAM4  $32.5 \pi^- p \rightarrow \eta' n$  |

$$\Gamma(4\pi^0)/\Gamma(\pi^0\pi^0\eta)$$

$$\Gamma_{28}/\Gamma_4$$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

NODE=M002R37  
NODE=M002R37

• • • We do not use the following data for averages, fits, limits, etc. • • •

<23 90 ALDE 87B GAM2  $38 \pi^- p \rightarrow n8\gamma$

$$\Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{29}/\Gamma$$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

NODE=M002R39  
NODE=M002R39

**< 5.6  $\times 10^{-9}$**  90 1 ACHASOV 15 SND  $0.958 e^+ e^- \rightarrow \pi\pi\eta$  |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<12  $\times 10^{-9}$  90 2 AKHMETSHIN 15 CMD3  $0.958 e^+ e^- \rightarrow \pi^+\pi^-\eta$  |

< 2.1  $\times 10^{-7}$  90 VOROBYEV 88 ND  $e^+ e^- \rightarrow \pi^+\pi^-\eta$

<sup>1</sup> Combining data of ACHASOV 15 and AKHMETSHIN 15 and using  $\Gamma(\eta') = 0.198 \pm 0.009$  MeV.

<sup>2</sup> Using  $\Gamma(\eta'(958)) = 198 \pm 9$  keV,  $B(\eta'(958) \rightarrow \pi^+ \pi^- \eta) = (42.9 \pm 0.7)\%$ , and  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.20)\%$ .

### $\Gamma(\text{invisible})/\Gamma_{\text{total}}$

$\Gamma_{30}/\Gamma$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                   |    |                                       |
|------|----|-------------------|----|---------------------------------------|
| <9.5 | 90 | <sup>1</sup> NAIK | 09 | CLEO $J/\psi \rightarrow \gamma\eta'$ |
|------|----|-------------------|----|---------------------------------------|

<sup>1</sup> Not independent of measured value of  $\Gamma_{30}/\Gamma_1$  from NAIK 09.

### $\Gamma(\text{invisible})/\Gamma(\gamma\gamma)$

$\Gamma_{30}/\Gamma_7$

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

<2.4 90 ABLIKIM 13 BES3  $J/\psi \rightarrow \phi\eta'$

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |         |     |                                    |
|-------|----|---------|-----|------------------------------------|
| <6.69 | 90 | ABLIKIM | 06Q | BES $J/\psi \rightarrow \phi\eta'$ |
|-------|----|---------|-----|------------------------------------|

### $\Gamma(\text{invisible})/\Gamma(\pi^+ \pi^- \eta)$

$\Gamma_{30}/\Gamma_1$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                   |    |                                       |
|------|----|-------------------|----|---------------------------------------|
| <2.1 | 90 | <sup>1</sup> NAIK | 09 | CLEO $J/\psi \rightarrow \gamma\eta'$ |
|------|----|-------------------|----|---------------------------------------|

<sup>1</sup> NAIK 09 reports  $[\Gamma(\eta'(958) \rightarrow \text{invisible})/\Gamma(\eta'(958) \rightarrow \pi^+ \pi^- \eta)] / [B(\eta \rightarrow 2\gamma)] < 5.4 \times 10^{-3}$  which we multiply by our best value  $B(\eta \rightarrow 2\gamma) = 39.41 \times 10^{-2}$ .

### $\Gamma(\pi^+ \pi^-)/\Gamma_{\text{total}}$

$\Gamma_{31}/\Gamma$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

< 0.18 90 <sup>1</sup> AAIJ 17D LHCB  $D_{(s)}^+ \rightarrow \pi^+ \pi^- \pi^+$

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                      |     |                                             |
|-------|----|----------------------|-----|---------------------------------------------|
| < 0.5 | 90 | <sup>2</sup> ABLIKIM | 11G | BES3 $J/\psi \rightarrow \gamma\pi^+ \pi^-$ |
|-------|----|----------------------|-----|---------------------------------------------|

|      |    |                   |     |                                             |
|------|----|-------------------|-----|---------------------------------------------|
| < 29 | 90 | <sup>3</sup> MORI | 07A | BELL $\gamma\gamma \rightarrow \pi^+ \pi^-$ |
|------|----|-------------------|-----|---------------------------------------------|

|       |    |                   |     |                                             |
|-------|----|-------------------|-----|---------------------------------------------|
| < 3.3 | 90 | <sup>4</sup> MORI | 07A | BELL $\gamma\gamma \rightarrow \pi^+ \pi^-$ |
|-------|----|-------------------|-----|---------------------------------------------|

|      |    |         |    |                                         |
|------|----|---------|----|-----------------------------------------|
| <800 | 95 | DANBURG | 73 | HBC $2.2 K^- p \rightarrow \Lambda X^0$ |
|------|----|---------|----|-----------------------------------------|

|      |    |            |    |                     |
|------|----|------------|----|---------------------|
| <200 | 90 | RITTENBERG | 69 | HBC $1.7-2.7 K^- p$ |
|------|----|------------|----|---------------------|

<sup>1</sup> Using branching fractions of  $D_{(s)}^+$  decays from PDG 15.

<sup>2</sup> ABLIKIM 11G reports  $[\Gamma(\eta'(958) \rightarrow \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta'(958))] < 2.84 \times 10^{-7}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = 5.25 \times 10^{-3}$ .

<sup>3</sup> Taking into account interference with the  $\gamma\gamma \rightarrow \pi^+ \pi^-$  continuum.

<sup>4</sup> Without interference with the  $\gamma\gamma \rightarrow \pi^+ \pi^-$  continuum.

### $\Gamma(\pi^0 \pi^0)/\Gamma_{\text{total}}$

$\Gamma_{32}/\Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

<  $4 \times 10^{-4}$  90 <sup>1</sup> ABLIKIM 11G BES3  $J/\psi \rightarrow \gamma\pi^0 \pi^0$

<sup>1</sup> ABLIKIM 11G reports  $[\Gamma(\eta'(958) \rightarrow \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta'(958))] < 2.84 \times 10^{-7}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma\eta'(958)) = 5.25 \times 10^{-3}$ .

### $\Gamma(\pi^0 \pi^0)/\Gamma(\pi^0 \pi^0 \eta)$

$\Gamma_{32}/\Gamma_4$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

<45 90 ALDE 87B GAM2  $38 \pi^- p \rightarrow n4\gamma$

### $\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$

$\Gamma_{33}/\Gamma$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

< 1.4 90 BRIERE 00 CLEO  $10.6 e^+ e^-$

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |            |    |                 |
|-----|----|------------|----|-----------------|
| <13 | 90 | RITTENBERG | 65 | HBC $2.7 K^- p$ |
|-----|----|------------|----|-----------------|

### $\Gamma(\eta e^+ e^-)/\Gamma_{\text{total}}$

$\Gamma_{34}/\Gamma$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

< 2.4 90 BRIERE 00 CLEO  $10.6 e^+ e^-$

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |            |    |                 |
|-----|----|------------|----|-----------------|
| <11 | 90 | RITTENBERG | 65 | HBC $2.7 K^- p$ |
|-----|----|------------|----|-----------------|

NODE=M002R39;LINKAGE=B

NODE=M002R39;LINKAGE=A

NODE=M002R52  
NODE=M002R52

NODE=M002R52;LINKAGE=NA

NODE=M002R44  
NODE=M002R44

NODE=M002R09  
NODE=M002R09

NODE=M002R09;LINKAGE=NA

NODE=M002R20  
NODE=M002R20

OCCUR=2

NODE=M002R20;LINKAGE=A  
NODE=M002R20;LINKAGE=AL

NODE=M002R20;LINKAGE=MO  
NODE=M002R20;LINKAGE=MR

NODE=M002R53  
NODE=M002R53

NODE=M002R53;LINKAGE=AL

NODE=M002R36  
NODE=M002R36

NODE=M002R8  
NODE=M002R8

NODE=M002R9  
NODE=M002R9



$\Gamma(3\gamma)/\Gamma(\pi^0\pi^0\eta)$  $\Gamma_{35}/\Gamma_4$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|--------------------------|-----|-------------|------|-----------------------------------------|
| <4.6                     | 90  | ALDE        | 87B  | GAM2 $38 \pi^- p \rightarrow n 3\gamma$ |

NODE=M002R34  
 NODE=M002R34

 $\Gamma(\mu^+\mu^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                               |
|--------------------------|-----|-------------|------|---------------------------------------|
| <6.0                     | 90  | DZHELYADIN  | 81   | CNTR $30 \pi^- p \rightarrow \eta' n$ |

NODE=M002R31  
 NODE=M002R31

 $\Gamma(\mu^+\mu^-\eta)/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                               |
|--------------------------|-----|-------------|------|---------------------------------------|
| <1.5                     | 90  | DZHELYADIN  | 81   | CNTR $30 \pi^- p \rightarrow \eta' n$ |

NODE=M002R30  
 NODE=M002R30

 $\Gamma(e\mu)/\Gamma_{\text{total}}$  $\Gamma_{38}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT             |
|--------------------------|-----|-------------|------|---------------------|
| <4.7                     | 90  | BRIERE      | 00   | CLEO $10.6 e^+ e^-$ |

NODE=M002R41  
 NODE=M002R41

 $\eta'(958) \rightarrow \eta\pi\pi$  DECAY PARAMETERS

NODE=M002225

$$|\text{MATRIX ELEMENT}|^2 = |1 + \alpha Y|^2 + CX + DX^2$$

$X$  and  $Y$  are Dalitz variables;  $\alpha$  is complex and  $C$ , and  $D$  are real-valued. Parameters  $C$  and  $D$  are not necessarily equal to  $c$  and  $d$ , respectively, in the generalized parameterization following this one. May be different for  $\eta'(958) \rightarrow \eta\pi^+\pi^-$  and  $\eta'(958) \rightarrow \eta\pi^0\pi^0$  decays. Because of different initial assumptions and strong correlations of the parameters we do not average the parameters in the section below.

NODE=M002225

 $\text{Re}(\alpha)$  decay parameter

| VALUE                                                                         | EVTS | DOCUMENT ID                | TECN | COMMENT                                              |
|-------------------------------------------------------------------------------|------|----------------------------|------|------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                            |      |                                                      |
| $-0.034 \pm 0.002 \pm 0.002$                                                  | 351k | ABLIKIM                    | 18   | BES3 $\eta' \rightarrow \eta\pi^+\pi^-$              |
| $-0.054 \pm 0.004 \pm 0.001$                                                  | 56k  | ABLIKIM                    | 18   | BES3 $\eta' \rightarrow \eta\pi^0\pi^0$              |
| $-0.033 \pm 0.005 \pm 0.003$                                                  | 44k  | <sup>1</sup> ABLIKIM       | 11   | BES3 $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$       |
| $-0.072 \pm 0.012 \pm 0.006$                                                  | 7k   | <sup>2</sup> AMELIN        | 05A  | VES $28 \pi^- A \rightarrow \eta\pi^+\pi^-\pi^- A^*$ |
| $-0.021 \pm 0.018 \pm 0.017$                                                  | 6.7k | <sup>3</sup> BRIERE        | 00   | CLEO $10.6 e^+ e^- \rightarrow \eta\pi^+\pi^- X$     |
| $-0.058 \pm 0.013 \pm 0.003$                                                  | 5.4k | <sup>4</sup> ALDE          | 86   | GAM2 $38 \pi^- p \rightarrow n\eta\pi^0\pi^0$        |
| $-0.08 \pm 0.03$                                                              |      | <sup>4,5</sup> KALBFLEISCH | 74   | RVUE $\eta' \rightarrow \eta\pi^+\pi^-$              |

NODE=M002A0  
 NODE=M002A0

OCCUR=2

<sup>1</sup> See ABLIKIM 11 for the full correlation matrix.

<sup>2</sup> Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

<sup>3</sup> Assuming  $\text{Im}(\alpha) = 0$ ,  $C = 0$ , and  $D = 0$ .

<sup>4</sup> Assuming  $C = 0$ .

<sup>5</sup> From the data of DAUBER 64, RITTENBERG 69, AGUILAR-BENITEZ 72B, JACOBS 73, and DANBURG 73.

NODE=M002A0;LINKAGE=AB  
 NODE=M002A0;LINKAGE=AM

NODE=M002A0;LINKAGE=BR  
 NODE=M002A0;LINKAGE=A  
 NODE=M002A0;LINKAGE=KA

 $\text{Im}(\alpha)$  decay parameter

| VALUE                                                                         | EVTS | DOCUMENT ID                | TECN | COMMENT                                              |
|-------------------------------------------------------------------------------|------|----------------------------|------|------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                            |      |                                                      |
| $0.000 \pm 0.019 \pm 0.001$                                                   | 351k | ABLIKIM                    | 18   | BES3 $\eta' \rightarrow \eta\pi^+\pi^-$              |
| $0.000 \pm 0.038 \pm 0.002$                                                   | 56k  | ABLIKIM                    | 18   | BES3 $\eta' \rightarrow \eta\pi^0\pi^0$              |
| $0.000 \pm 0.049 \pm 0.001$                                                   | 44k  | <sup>1</sup> ABLIKIM       | 11   | BES3 $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$       |
| $0.0 \pm 0.1 \pm 0.0$                                                         | 7k   | <sup>2</sup> AMELIN        | 05A  | VES $28 \pi^- A \rightarrow \eta\pi^+\pi^-\pi^- A^*$ |
| $-0.00 \pm 0.13 \pm 0.00$                                                     | 5.4k | <sup>3</sup> ALDE          | 86   | GAM2 $38 \pi^- p \rightarrow n\eta\pi^0\pi^0$        |
| $0.0 \pm 0.3$                                                                 |      | <sup>3,4</sup> KALBFLEISCH | 74   | RVUE $\eta' \rightarrow \eta\pi^+\pi^-$              |

NODE=M002IA0  
 NODE=M002IA0

OCCUR=2

<sup>1</sup> See ABLIKIM 11 for the full correlation matrix.

<sup>2</sup> Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

<sup>3</sup> Assuming  $C = 0$ .

<sup>4</sup> From the data of DAUBER 64, RITTENBERG 69, AGUILAR-BENITEZ 72B, JACOBS 73, and DANBURG 73.

NODE=M002IA0;LINKAGE=AB  
 NODE=M002IA0;LINKAGE=AM

NODE=M002IA0;LINKAGE=A  
 NODE=M002IA0;LINKAGE=KA

**C decay parameter**

| VALUE                                                                         | EVTS | DOCUMENT ID          | TECN    | COMMENT                                             |
|-------------------------------------------------------------------------------|------|----------------------|---------|-----------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                      |         |                                                     |
| $0.0027 \pm 0.0024 \pm 0.0015$                                                | 351k | ABLIKIM              | 18 BES3 | $\eta' \rightarrow \eta \pi^+ \pi^-$                |
| $0.018 \pm 0.009 \pm 0.003$                                                   | 44k  | <sup>1</sup> ABLIKIM | 11 BES3 | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$        |
| $0.020 \pm 0.018 \pm 0.004$                                                   | 7k   | <sup>2</sup> AMELIN  | 05A VES | $28 \pi^- A \rightarrow \eta \pi^+ \pi^- \pi^- A^*$ |

<sup>1</sup> See ABLIKIM 11 for the full correlation matrix.

<sup>2</sup> Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

NODE=M002C0  
NODE=M002C0

NODE=M002C0;LINKAGE=AB  
NODE=M002C0;LINKAGE=AM

**D decay parameter**

| VALUE                                                                         | EVTS | DOCUMENT ID                | TECN    | COMMENT                                             |
|-------------------------------------------------------------------------------|------|----------------------------|---------|-----------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                            |         |                                                     |
| $-0.053 \pm 0.004 \pm 0.004$                                                  | 351k | ABLIKIM                    | 18 BES3 | $\eta' \rightarrow \eta \pi^+ \pi^-$                |
| $-0.061 \pm 0.009 \pm 0.005$                                                  | 56k  | ABLIKIM                    | 18 BES3 | $\eta' \rightarrow \eta \pi^0 \pi^0$                |
| $-0.059 \pm 0.012 \pm 0.004$                                                  | 44k  | <sup>1</sup> ABLIKIM       | 11 BES3 | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$        |
| $-0.066 \pm 0.030 \pm 0.015$                                                  | 7k   | <sup>2</sup> AMELIN        | 05A VES | $28 \pi^- A \rightarrow \eta \pi^+ \pi^- \pi^- A^*$ |
| $0.00 \pm 0.03 \pm 0.00$                                                      | 5.4k | <sup>3</sup> ALDE          | 86 GAM2 | $38 \pi^- p \rightarrow n \eta \pi^0 \pi^0$         |
| 0                                                                             |      | <sup>3,4</sup> KALBFLEISCH | 74 RVUE | $\eta' \rightarrow \eta \pi^+ \pi^-$                |

<sup>1</sup> See ABLIKIM 11 for the full correlation matrix.

<sup>2</sup> Superseded by DOROFEEV 07, which found this parameterization unacceptable. See below.

<sup>3</sup> Assuming  $C = 0$ .

<sup>4</sup> From the data of DAUBER 64, RITTENBERG 69, AGUILAR-BENITEZ 72B, JA-COBS 73, and DANBURG 73.

NODE=M002D0  
NODE=M002D0

OCCUR=2

NODE=M002D0;LINKAGE=AB  
NODE=M002D0;LINKAGE=AM

NODE=M002D0;LINKAGE=AL  
NODE=M002D0;LINKAGE=KA

 **$\eta'(958) \rightarrow \eta \pi \pi$  DECAY PARAMETERS**

$$|\text{MATRIX ELEMENT}|^2 \propto 1 + a Y + b Y^2 + c X + d X^2$$

X and Y are Dalitz variables and a, b, c, and d are real-valued parameters. May be different for  $\eta'(958) \rightarrow \eta \pi^+ \pi^-$  and  $\eta'(958) \rightarrow \eta \pi^0 \pi^0$  decays.

We do not average measurements in the section below because parameter values from each experiment are strongly correlated.

NODE=M002227

NODE=M002227

**a decay parameter**

| VALUE                                                                         | EVTS | DOCUMENT ID                  | TECN     | COMMENT                                                               |
|-------------------------------------------------------------------------------|------|------------------------------|----------|-----------------------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                              |          |                                                                       |
| $-0.056 \pm 0.004 \pm 0.002$                                                  | 351k | ABLIKIM                      | 18 BES3  | $\eta' \rightarrow \eta \pi^+ \pi^-$                                  |
| $-0.087 \pm 0.009 \pm 0.006$                                                  | 56k  | ABLIKIM                      | 18 BES3  | $\eta' \rightarrow \eta \pi^0 \pi^0$                                  |
| $-0.074 \pm 0.008 \pm 0.006$                                                  | 124k | ADLARSON                     | 18A A2MM | $\eta' \rightarrow \eta \pi^0 \pi^0$                                  |
| $-0.072 \pm 0.007 \pm 0.008$                                                  |      | <sup>1</sup> GONZALEZ-S..18A | RVUE     | $\eta' \rightarrow \eta \pi^0 \pi^0$                                  |
| $-0.047 \pm 0.011 \pm 0.003$                                                  | 44k  | <sup>2</sup> ABLIKIM         | 11 BES3  | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$                          |
| $-0.066 \pm 0.016 \pm 0.003$                                                  | 15k  | <sup>3</sup> BLIK            | 09 GAM4  | $32.5 \pi^- p \rightarrow \eta' n$                                    |
| $-0.127 \pm 0.016 \pm 0.008$                                                  | 20k  | <sup>4</sup> DOROFEEV        | 07 VES   | $27 \pi^- p \rightarrow \eta' n, \pi^- A \rightarrow \eta' \pi^- A^*$ |

<sup>1</sup> Theoretical analysis of ADLARSON 18A using resonance chiral perturbation theory to one loop.

<sup>2</sup> See ABLIKIM 11 for the full correlation matrix.

<sup>3</sup> From  $\eta' \rightarrow \eta \pi^0 \pi^0$  decay.

<sup>4</sup> From  $\eta' \rightarrow \eta \pi^+ \pi^-$  decay.

NODE=M002DPA  
NODE=M002DPA

OCCUR=2

NODE=M002DPA;LINKAGE=A

NODE=M002DPA;LINKAGE=AB  
NODE=M002DPA;LINKAGE=BL  
NODE=M002DPA;LINKAGE=DO

**b decay parameter**

| VALUE                                                                         | EVTS | DOCUMENT ID                  | TECN     | COMMENT                                                               |
|-------------------------------------------------------------------------------|------|------------------------------|----------|-----------------------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                              |          |                                                                       |
| $-0.049 \pm 0.006 \pm 0.006$                                                  | 351k | ABLIKIM                      | 18 BES3  | $\eta' \rightarrow \eta \pi^+ \pi^-$                                  |
| $-0.073 \pm 0.014 \pm 0.005$                                                  | 56k  | ABLIKIM                      | 18 BES3  | $\eta' \rightarrow \eta \pi^0 \pi^0$                                  |
| $-0.063 \pm 0.014 \pm 0.005$                                                  | 124k | ADLARSON                     | 18A A2MM | $\eta' \rightarrow \eta \pi^0 \pi^0$                                  |
| $-0.052 \pm 0.001 \pm 0.002$                                                  |      | <sup>1</sup> GONZALEZ-S..18A | RVUE     | $\eta' \rightarrow \eta \pi^0 \pi^0$                                  |
| $-0.069 \pm 0.019 \pm 0.009$                                                  | 44k  | <sup>2</sup> ABLIKIM         | 11 BES3  | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$                          |
| $-0.063 \pm 0.028 \pm 0.004$                                                  | 15k  | <sup>3</sup> BLIK            | 09 GAM4  | $32.5 \pi^- p \rightarrow \eta' n$                                    |
| $-0.106 \pm 0.028 \pm 0.014$                                                  | 20k  | <sup>4</sup> DOROFEEV        | 07 VES   | $27 \pi^- p \rightarrow \eta' n, \pi^- A \rightarrow \eta' \pi^- A^*$ |

<sup>1</sup> Theoretical analysis of ADLARSON 18A using resonance chiral perturbation theory to one loop.

<sup>2</sup> See ABLIKIM 11 for the full correlation matrix.

<sup>3</sup> From  $\eta' \rightarrow \eta \pi^0 \pi^0$  decay.

<sup>4</sup> From  $\eta' \rightarrow \eta \pi^+ \pi^-$  decay.

NODE=M002DPB  
NODE=M002DPB

OCCUR=2

NODE=M002DPB;LINKAGE=A

NODE=M002DPB;LINKAGE=AB  
NODE=M002DPB;LINKAGE=BL  
NODE=M002DPB;LINKAGE=DO

**c decay parameter**

| VALUE                                                                         | EVTS | DOCUMENT ID           | TECN | COMMENT                                                                        |
|-------------------------------------------------------------------------------|------|-----------------------|------|--------------------------------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                       |      |                                                                                |
| $0.0027 \pm 0.0024 \pm 0.0018$                                                | 351k | ABLIKIM               | 18   | BES3 $\eta' \rightarrow \eta \pi^+ \pi^-$                                      |
| $0.019 \pm 0.011 \pm 0.003$                                                   | 44k  | <sup>1</sup> ABLIKIM  | 11   | BES3 $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$                              |
| $-0.107 \pm 0.096 \pm 0.003$                                                  | 15k  | <sup>2</sup> BLIK     | 09   | GAM4 $32.5 \pi^- p \rightarrow \eta' n$                                        |
| $0.015 \pm 0.011 \pm 0.014$                                                   | 20k  | <sup>3</sup> DOROFEEV | 07   | VES $27 \pi^- p \rightarrow \eta' n,$<br>$\pi^- A \rightarrow \eta' \pi^- A^*$ |

<sup>1</sup> See ABLIKIM 11 for the full correlation matrix.<sup>2</sup> From  $\eta' \rightarrow \eta \pi^0 \pi^0$  decay.<sup>3</sup> From  $\eta' \rightarrow \eta \pi^+ \pi^-$  decay.NODE=M002DPC  
NODE=M002DPCNODE=M002DPC;LINKAGE=AB  
NODE=M002DPC;LINKAGE=BL  
NODE=M002DPC;LINKAGE=DO**d decay parameter**

| VALUE                                                                         | EVTS | DOCUMENT ID                | TECN | COMMENT                                                                        |
|-------------------------------------------------------------------------------|------|----------------------------|------|--------------------------------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                            |      |                                                                                |
| $-0.063 \pm 0.004 \pm 0.003$                                                  | 351k | ABLIKIM                    | 18   | BES3 $\eta' \rightarrow \eta \pi^+ \pi^-$                                      |
| $-0.074 \pm 0.009 \pm 0.004$                                                  | 56k  | ABLIKIM                    | 18   | BES3 $\eta' \rightarrow \eta \pi^0 \pi^0$                                      |
| $-0.050 \pm 0.009 \pm 0.005$                                                  | 124k | ADLARSON                   | 18A  | A2MM $\eta' \rightarrow \eta \pi^0 \pi^0$                                      |
| $-0.051 \pm 0.008 \pm 0.006$                                                  |      | <sup>1</sup> GONZALEZ-S... | 18A  | RVUE $\eta' \rightarrow \eta \pi^0 \pi^0$                                      |
| $-0.073 \pm 0.012 \pm 0.003$                                                  | 44k  | <sup>2</sup> ABLIKIM       | 11   | BES3 $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$                              |
| $0.018 \pm 0.078 \pm 0.006$                                                   | 15k  | <sup>3</sup> BLIK          | 09   | GAM4 $32.5 \pi^- p \rightarrow \eta' n$                                        |
| $-0.082 \pm 0.017 \pm 0.008$                                                  | 20k  | <sup>4</sup> DOROFEEV      | 07   | VES $27 \pi^- p \rightarrow \eta' n,$<br>$\pi^- A \rightarrow \eta' \pi^- A^*$ |

<sup>1</sup> Theoretical analysis of ADLARSON 18A using resonance chiral perturbation theory to one loop.<sup>2</sup> See ABLIKIM 11 for the full correlation matrix.<sup>3</sup> From  $\eta' \rightarrow \eta \pi^0 \pi^0$  decay. If  $c \equiv 0$  from Bose-Einstein symmetry,  $d = -0.067 \pm 0.020 \pm 0.003$ .<sup>4</sup> From  $\eta' \rightarrow \eta \pi^+ \pi^-$  decay.NODE=M002DPD  
NODE=M002DPD

OCCUR=2

NODE=M002DPD;LINKAGE=A

NODE=M002DPD;LINKAGE=AB  
NODE=M002DPD;LINKAGE=BL

NODE=M002DPD;LINKAGE=DO

$$\eta'(958) \beta \text{ PARAMETER}$$

$$|\text{MATRIX ELEMENT}|^2 = (1 + 2\beta Z)$$

See the "Note on  $\eta$  Decay Parameters" in our 1994 edition Physical Review D50 1173 (1994), p. 1454.

NODE=M002226

NODE=M002226

 **$\beta$  decay parameter**

| VALUE                                          | EVTS | DOCUMENT ID                         | TECN | COMMENT                                              |
|------------------------------------------------|------|-------------------------------------|------|------------------------------------------------------|
| <b><math>-0.61 \pm 0.08</math> OUR AVERAGE</b> |      | Error includes scale factor of 1.2. |      |                                                      |
| $-0.640 \pm 0.046 \pm 0.047$                   | 1.8k | ABLIKIM                             | 15G  | BES3 $J/\psi \rightarrow \gamma (\pi^0 \pi^0 \pi^0)$ |
| $-0.59 \pm 0.18$                               | 235  | BLIK                                | 08   | GAMS $32 \pi^- p \rightarrow \eta' n$                |
| $-0.1 \pm 0.3$                                 |      | ALDE                                | 87B  | GAM2 $38 \pi^- p \rightarrow n 3 \pi^0$              |

NODE=M002B0  
NODE=M002B0 **$\eta'(958)$  C-NONCONSERVING DECAY PARAMETER**See the note on  $\eta$  decay parameters in the Stable Particle Particle Listings for definition of this parameter.

NODE=M002235

NODE=M002235

**DECAY ASYMMETRY PARAMETER FOR  $\pi^+ \pi^- \gamma$** 

| VALUE                                                                         | EVTS | DOCUMENT ID | TECN | COMMENT                                                 |
|-------------------------------------------------------------------------------|------|-------------|------|---------------------------------------------------------|
| <b><math>-0.03 \pm 0.04</math> OUR AVERAGE</b>                                |      |             |      |                                                         |
| $-0.019 \pm 0.056$                                                            |      | AIHARA      | 87   | TPC $2\gamma \rightarrow \pi^+ \pi^- \gamma$            |
| $-0.069 \pm 0.078$                                                            | 295  | GRIGORIAN   | 75   | STRC $2.1 \pi^- p$                                      |
| $0.00 \pm 0.10$                                                               | 103  | KALBFLEISCH | 75   | HBC $2.18 K^- p \rightarrow \Lambda \pi^+ \pi^- \gamma$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |             |      |                                                         |
| $0.07 \pm 0.08$                                                               | 152  | RITTENBERG  | 65   | HBC $2.1-2.7 K^- p$                                     |

NODE=M002A  
NODE=M002A **$\eta'(958) \rightarrow \gamma \ell^+ \ell^-$  TRANSITION FORM FACTOR SLOPE**Related to the effective virtual meson mass  $\Lambda$ , via slope  $\approx \Lambda^{-2}$ . See e.g. LANDSBERG 85, eq. (3.8), for a detailed definition.

| VALUE (GeV <sup>-2</sup> )                    | EVTS | DOCUMENT ID           | TECN | COMMENT                                  |
|-----------------------------------------------|------|-----------------------|------|------------------------------------------|
| <b><math>1.62 \pm 0.17</math> OUR AVERAGE</b> |      |                       |      |                                          |
| $1.60 \pm 0.17 \pm 0.08$                      | 864  | <sup>1</sup> ABLIKIM  | 150  | BES3 $J/\psi \rightarrow \gamma e^+ e^-$ |
| $1.7 \pm 0.4$                                 | 33   | <sup>1</sup> VIKTOROV | 80   | 25,33 $\pi^- p \rightarrow 2\mu \gamma$  |

<sup>1</sup> In the single-pole Ansatz where slope =  $1/(\Lambda^2 + \gamma^2)$  with  $\Lambda$ ,  $\gamma$  being a Breit-Wigner mass, width for the effective contributing vector meson.NODE=M002FFL  
NODE=M002FFL

NODE=M002FFL

NODE=M002FFL;LINKAGE=A

$\eta'(958)$  REFERENCES

NODE=M002

|               |      |                         |                                             |                             |                      |
|---------------|------|-------------------------|---------------------------------------------|-----------------------------|----------------------|
| ABLIKIM       | 20E  | PR D101 032001          | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=60252          |
| ABLIKIM       | 19AW | PR D100 052015          | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=60000          |
| ABLIKIM       | 19T  | PRL 122 142002          | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=59773          |
| ABLIKIM       | 18   | PR D97 012003           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=58711          |
| ABLIKIM       | 18C  | PRL 120 242003          | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=58843          |
| ADLARSON      | 18A  | PR D98 012001           | P. Adlarson <i>et al.</i>                   | (A2 Collab. at MAMI)        | REFID=58957          |
| GONZALEZ-S... | 18A  | EPJ C78 758             | S. Gonzalez-Solis, E. Passemar              | (BEIJ, IND+)                | REFID=59316          |
| AAJ           | 17D  | PL B764 233             | R. Aaij <i>et al.</i>                       | (LHCb Collab.)              | REFID=57702          |
| ABLIKIM       | 17   | PRL 118 012001          | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=57650          |
| ABLIKIM       | 17T  | PR D96 012005           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=58013          |
| ABLIKIM       | 16M  | PR D93 072008           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=57511          |
| ABLIKIM       | 15AD | PR D92 051101           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=56983          |
| ABLIKIM       | 15G  | PR D92 012014           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=56602          |
| ABLIKIM       | 150  | PR D92 012001           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=56780          |
| ABLIKIM       | 15P  | PR D92 012007           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=56781          |
| ACHASOV       | 15   | PR D91 092010           | M.N. Achasov <i>et al.</i>                  | (SND Collab.)               | REFID=56788          |
| AKHMETSHIN    | 15   | PL B740 273             | R.R. Akhmetshin <i>et al.</i>               | (CMD-3 Collab.)             | REFID=56386          |
| PDG           | 15   | RPP 2015 at pdg.lbl.gov |                                             | (PDG Collab.)               | REFID=56977; ERROR=5 |
| ABLIKIM       | 14M  | PRL 112 251801          | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=55904          |
| DONSKOV       | 14   | MPL A29 1450213         | S. Donskov <i>et al.</i>                    | (GAMS-4 $\pi$ Collab.)      | REFID=56321          |
| PDG           | 14   | CP C38 070001           | K. Olive <i>et al.</i>                      | (PDG Collab.)               | REFID=55687          |
| ABLIKIM       | 13   | PR D87 012009           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=54829          |
| ABLIKIM       | 13G  | PR D87 032006           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=54952          |
| ABLIKIM       | 130  | PR D87 092011           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=55388          |
| ABLIKIM       | 13U  | PR D88 091502           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=55582          |
| ABLIKIM       | 12E  | PRL 108 182001          | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=54270          |
| PDG           | 12   | PR D86 010001           | J. Beringer <i>et al.</i>                   | (PDG Collab.)               | REFID=54066          |
| ABLIKIM       | 11   | PR D83 012003           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=53646          |
| ABLIKIM       | 11G  | PR D84 032006           | M. Ablikim <i>et al.</i>                    | (BESIII Collab.)            | REFID=53711          |
| CZERWINSKI    | 10   | PRL 105 122001          | E. Czerwinski <i>et al.</i>                 | (COSY-11 Collab.)           | REFID=53364          |
| BLIK          | 09   | PAN 72 231              | A.M. Blik <i>et al.</i>                     | (IHEP (Protvino))           | REFID=52727          |
| NAIK          | 09   | PRL 102 061801          | P. Naik <i>et al.</i>                       | (CLEO Collab.)              | REFID=52678          |
| PEDLAR        | 09   | PR D79 111101           | T.K. Pedlar <i>et al.</i>                   | (CLEO Collab.)              | REFID=52998          |
| BLIK          | 08   | PAN 71 2124             | A. Blik <i>et al.</i>                       | (GAMS-4 $\pi$ Collab.)      | REFID=52663          |
| LIBBY         | 08   | PRL 101 182002          | J. Libby <i>et al.</i>                      | (CLEO Collab.)              | REFID=52591          |
| WICHT         | 08   | PL B662 323             | J. Wicht <i>et al.</i>                      | (BELLE Collab.)             | REFID=52204          |
| DOROFEEV      | 07   | PL B651 22              | V. Dorofeev <i>et al.</i>                   | (VES Collab.)               | REFID=51711          |
| MORI          | 07A  | JPSJ 76 074102          | T. Mori <i>et al.</i>                       | (BELLE Collab.)             | REFID=51691          |
| ABLIKIM       | 06E  | PR D73 052008           | M. Ablikim <i>et al.</i>                    | (BES Collab.)               | REFID=51057          |
| ABLIKIM       | 06Q  | PRL 97 202002           | M. Ablikim <i>et al.</i>                    | (BES Collab.)               | REFID=51487          |
| AMELIN        | 05A  | PAN 68 372              | D.V. Amelin <i>et al.</i>                   | (VES Collab.)               | REFID=50766          |
| AMSLER        | 04B  | EPJ C33 23              | C. Amsler <i>et al.</i>                     | (Crystal Barrel Collab.)    | REFID=51079          |
| BAI           | 04J  | PL B594 47              | J.Z. Bai <i>et al.</i>                      | (BES Collab.)               | REFID=50167          |
| BRIERE        | 00   | PRL 84 26               | R. Briere <i>et al.</i>                     | (CLEO Collab.)              | REFID=47410          |
| ACCIARRI      | 98Q  | PL B418 399             | M. Acciarri <i>et al.</i>                   | (L3 Collab.)                | REFID=46316          |
| BARBERIS      | 98C  | PL B440 225             | D. Barberis <i>et al.</i>                   | (WA 102 Collab.)            | REFID=46346          |
| WURZINGER     | 96   | PL B374 283             | R. Wurzinger <i>et al.</i>                  | (BONN, ORSAY, SACL+)        | REFID=44992          |
| PDG           | 94   | PR D50 1173             | L. Montanet <i>et al.</i>                   | (CERN, LBL, BOST+)          | REFID=43653          |
| AMSLER        | 93   | ZPHY C58 175            | C. Amsler <i>et al.</i>                     | (Crystal Barrel Collab.)    | REFID=43311          |
| BELADIDZE     | 92C  | SJNP 55 1535            | G.M. Beladidze, S.I. Bitukov, G.V. Borisov  | (SERP+)                     | REFID=43175          |
| KARCH         | 92   | ZPHY C54 33             | K. Karch <i>et al.</i>                      | (Crystal Ball Collab.)      | REFID=42170          |
| ARMSTRONG     | 91B  | ZPHY C52 389            | T.A. Armstrong <i>et al.</i>                | (ATHU, BARI, BIRM+)         | REFID=41862          |
| BEHREND       | 91   | ZPHY C49 401            | H.J. Behrend <i>et al.</i>                  | (CELLO Collab.)             | REFID=41497          |
| AUGUSTIN      | 90   | PR D42 10               | J.E. Augustin <i>et al.</i>                 | (DM2 Collab.)               | REFID=41352          |
| BARU          | 90   | ZPHY C48 581            | S.E. Baru <i>et al.</i>                     | (MD-1 Collab.)              | REFID=41366          |
| BUTLER        | 90   | PR D42 1368             | F. Butler <i>et al.</i>                     | (Mark II Collab.)           | REFID=41363          |
| KARCH         | 90   | PL B249 353             | K. Karch <i>et al.</i>                      | (Crystal Ball Collab.)      | REFID=41377          |
| ROE           | 90   | PR D41 17               | N.A. Roe <i>et al.</i>                      | (ASP Collab.)               | REFID=41014          |
| AIHARA        | 88C  | PR D38 1                | H. Aihara <i>et al.</i>                     | (TPC-2 $\gamma$ Collab.)    | REFID=40564          |
| VOROBYEV      | 88   | SJNP 48 273             | P.V. Vorobiev <i>et al.</i>                 | (NOVO)                      | REFID=41023          |
| WILLIAMS      | 88   | PR D38 1365             | D.A. Williams <i>et al.</i>                 | (Crystal Ball Collab.)      | REFID=40567          |
| AIHARA        | 87   | PR D35 2650             | H. Aihara <i>et al.</i>                     | (TPC-2 $\gamma$ Collab.) JP | REFID=40009          |
| ALBRECHT      | 87B  | PL B199 457             | H. Albrecht <i>et al.</i>                   | (ARGUS Collab.)             | REFID=40265          |
| ALDE          | 87B  | ZPHY C36 603            | D.M. Alde <i>et al.</i>                     | (LANL, BELG, SERP, LAPP)    | REFID=40236          |
| ANTREASYAN    | 87   | PR D36 2633             | D. Antreasyan <i>et al.</i>                 | (Crystal Ball Collab.)      | REFID=40008          |
| GIDAL         | 87   | PRL 59 2012             | G. Gidal <i>et al.</i>                      | (LBL, SLAC, HARV)           | REFID=40223          |
| ALDE          | 86   | PL B177 115             | D.M. Alde <i>et al.</i>                     | (SERP, BELG, LANL, LAPP)    | REFID=20310          |
| BARTEL        | 85E  | PL 160B 421             | W. Bartel <i>et al.</i>                     | (JADE Collab.)              | REFID=10843          |
| LANDSBERG     | 85   | PRPL 128 301            | L.G. Landsberg                              | (SERP)                      | REFID=10844          |
| ALTHOFF       | 84E  | PL 147B 487             | M. Althoff <i>et al.</i>                    | (TASSO Collab.)             | REFID=20305          |
| BERGER        | 84B  | PL 142B 125             | C. Berger                                   | (PLUTO Collab.)             | REFID=20306          |
| BINON         | 84   | PL 140B 264             | F.G. Binon <i>et al.</i>                    | (SERP, BELG, LAPP+)         | REFID=20307          |
| JENNI         | 83   | PR D27 1031             | P. Jenni <i>et al.</i>                      | (SLAC, LBL)                 | REFID=20304          |
| BARTEL        | 82B  | PL 113B 190             | W. Bartel <i>et al.</i>                     | (JADE Collab.)              | REFID=20300          |
| BEHREND       | 82C  | PL 114B 378             | H.J. Behrend <i>et al.</i>                  | (CELLO Collab.)             | REFID=20303          |
| Also          |      | PL 125B 518 (erratum)   | H.J. Behrend <i>et al.</i>                  | (CELLO Collab.)             | REFID=20302          |
| DZHELYADIN    | 81   | PL 105B 239             | R.I. Dzheilyadin <i>et al.</i>              | (SERP)                      | REFID=10836          |
| STANTON       | 80   | PL B92 353              | N.R. Stanton <i>et al.</i>                  | (OSU, CARL, MCGI+)          | REFID=40294          |
| VIKTOROV      | 80   | SJNP 32 520             | V.A. Viktorov <i>et al.</i>                 | (SERP)                      | REFID=20298          |
| APEL          | 79   | PL 83B 131              | W.D. Apel, K.H. Augenstein, E. Bertolucci   | (KARLK+)                    | REFID=20295          |
| BINNIE        | 79   | PL 83B 141              | D.M. Binnie <i>et al.</i>                   | (LOIC)                      | REFID=20296          |
| ZANFINO       | 77   | PRL 38 930              | C. Zanfino <i>et al.</i>                    | (CARL, MCGI, OHIO+)         | REFID=20293          |
| GRIGORIAN     | 75   | NP B91 232              | A. Grigorian <i>et al.</i>                  | (+)                         | REFID=20287          |
| KALBFLEISCH   | 75   | PR D11 987              | G.R. Kalbfleisch, R.C. Strand, J.W. Chapman | (BNL+)                      | REFID=20223          |
| DUANE         | 74   | PRL 32 425              | A. Duane <i>et al.</i>                      | (LOIC, SHMP)                | REFID=20284          |
| KALBFLEISCH   | 74   | PR D10 916              | G.R. Kalbfleisch                            | (BNL)                       | REFID=20286          |
| DANBURG       | 73   | PR D8 3744              | J.S. Danburg <i>et al.</i>                  | (BNL, MICH) JP              | REFID=20280          |
| JACOBS        | 73   | PR D8 18                | S.M. Jacobs <i>et al.</i>                   | (BRAN, UMD, SYRA+)          | REFID=20281          |
| AGUILAR-...   | 72B  | PR D6 29                | M. Aguilar-Benitez <i>et al.</i>            | (BNL)                       | REFID=20205          |
| APEL          | 72   | PL 40B 680              | W.D. Apel <i>et al.</i>                     | (KARLK, KARLE, PISA)        | REFID=20275          |
| DALPIAZ       | 72   | PL 42B 377              | P.F. Dalpiaz <i>et al.</i>                  | (CERN)                      | REFID=20278          |
| BASILE        | 71   | NC 3A 371               | M. Basile <i>et al.</i>                     | (CERN, BGNA, STRB)          | REFID=20270          |
| HARVEY        | 71   | PRL 27 885              | E.H. Harvey <i>et al.</i>                   | (MINN, MICH)                | REFID=20272          |
| BENSINGER     | 70   | PL 33B 505              | J.R. Bensinger <i>et al.</i>                | (WISC)                      | REFID=20268          |
| RITTENBERG    | 69   | Thesis UCRL 18863       | A. Rittenberg                               | (LRL) I                     | REFID=20266          |
| DAVIS         | 68   | PL 27B 532              | R. Davis <i>et al.</i>                      | (NWES, ANL)                 | REFID=20263          |
| LONDON        | 66   | PR 143 1034             | G.W. London <i>et al.</i>                   | (BNL, SYRA) IJP             | REFID=11774          |
| BADIER        | 65B  | PL 17 337               | J. Badier <i>et al.</i>                     | (EPOL, SACL, AMST)          | REFID=20253          |
| RITTENBERG    | 65   | PRL 15 556              | A. Rittenberg, G.R. Kalbfleisch             | (LRL, BNL)                  | REFID=10761          |
| DAUBER        | 64   | PRL 13 449              | P.M. Dauber <i>et al.</i>                   | (UCLA) JP                   | REFID=20247          |
| KALBFLEISCH   | 64B  | PRL 13 349              | G.R. Kalbfleisch, O.I. Dahl, A. Rittenberg  | (LRL) JP                    | REFID=20252          |

$f_0(980)$ 

$$I^G(J^{PC}) = 0^+(0^{++})$$

See the review on "Scalar Mesons below 2 GeV."

NODE=M003

NODE=M003

NODE=M003PP

NODE=M003PP

OCCUR=2

NODE=M003PP;LINKAGE=B

NODE=M003PP;LINKAGE=C

NODE=M003PP;LINKAGE=A

NODE=M003M1

NODE=M003M1  
→ UNCHECKED ← **$f_0(980)$  T-MATRIX POLE  $\sqrt{s}$** 

| VALUE (MeV)                                                                                                                                                            | DOCUMENT ID                 | TECN | COMMENT                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------|-----------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                          |                             |      |                             |
| $(1003^{+5}_{-27}) - i(21^{+10}_{-8})$                                                                                                                                 | <sup>1</sup> GARCIA-MAR..11 | RVUE | Compilation                 |
| $(996 \pm 7) - i(25^{+10}_{-6})$                                                                                                                                       | <sup>2</sup> GARCIA-MAR..11 | RVUE | Compilation                 |
| $(973^{+39}_{-127}) - i(11^{+189}_{-11})$                                                                                                                              | <sup>3</sup> PELAEZ 04A     | RVUE | $\pi\pi \rightarrow \pi\pi$ |
| <sup>1</sup> Reanalysis of the $K_{e4}$ data of BATLEY 10C and the $\pi N \rightarrow \pi\pi N$ data of HYAMS 73, GRAYER 74, and PROTOPOPESCU 73 using Roy equations.  |                             |      |                             |
| <sup>2</sup> Reanalysis of the $K_{e4}$ data of BATLEY 10C and the $\pi N \rightarrow \pi\pi N$ data of HYAMS 73, GRAYER 74, and PROTOPOPESCU 73 using GKPY equations. |                             |      |                             |
| <sup>3</sup> Reanalysis of data from PROTOPOPESCU 73, ESTABROOKS 74, GRAYER 74, and COHEN 80 in the unitarized ChPT model.                                             |                             |      |                             |

 **$f_0(980)$  MASS**

| VALUE (MeV)                                                                   | EVTS         | DOCUMENT ID                  | TECN | COMMENT                                                                     |
|-------------------------------------------------------------------------------|--------------|------------------------------|------|-----------------------------------------------------------------------------|
| <b>990 ± 20 OUR ESTIMATE</b>                                                  |              |                              |      |                                                                             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                              |      |                                                                             |
| $992.8 \pm 0.8 \pm 1.0$                                                       |              | <sup>1</sup> ALBRECHT 20     | RVUE | $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| $992.0^{+8.5}_{-7.5} \pm 8.6$                                                 |              | <sup>2</sup> AAIJ 19H        | LHCB | $p\bar{p} \rightarrow D^\pm X$                                              |
| $989.4 \pm 1.3$                                                               | 424          | ABLIKIM 15P                  | BES3 | $J/\psi \rightarrow K^+ K^- 3\pi$                                           |
| $989.9 \pm 0.4$                                                               | 706          | ABLIKIM 12E                  | BES3 | $J/\psi \rightarrow \gamma 3\pi$                                            |
| $996^{+4}_{-14}$                                                              |              | <sup>3</sup> MOUSSALLAM11    | RVUE | Compilation                                                                 |
| $981 \pm 43$                                                                  |              | <sup>4</sup> MENNESSIER 10   | RVUE | Compilation                                                                 |
| $1030^{+30}_{-10}$                                                            |              | <sup>5</sup> ANISOVICH 09    | RVUE | $0.0 \bar{p}p, \pi N$                                                       |
| $977^{+11}_{-9} \pm 1$                                                        | 44           | <sup>6</sup> ECKLUND 09      | CLEO | $4.17 e^+ e^- \rightarrow D_s^- D_s^{*+} + \text{c.c.}$                     |
| $982.2 \pm 1.0^{+8.1}_{-8.0}$                                                 |              | <sup>7</sup> UEHARA 08A      | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$                              |
| $976.8 \pm 0.3^{+10.1}_{-0.6}$                                                | 64k          | <sup>8</sup> AMBROSINO 07    | KLOE | $1.02 e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                               |
| $984.7 \pm 0.4^{+2.4}_{-3.7}$                                                 | 64k          | <sup>9</sup> AMBROSINO 07    | KLOE | $1.02 e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                               |
| $973 \pm 3$                                                                   | $262 \pm 30$ | <sup>10</sup> AUBERT 07AK    | BABR | $10.6 e^+ e^- \rightarrow \phi \pi^+ \pi^- \gamma$                          |
| $970 \pm 7$                                                                   | $54 \pm 9$   | <sup>10</sup> AUBERT 07AK    | BABR | $10.6 e^+ e^- \rightarrow \phi \pi^0 \pi^0 \gamma$                          |
| $953 \pm 20$                                                                  | 2.6k         | <sup>11</sup> BONVICINI 07   | CLEO | $D^+ \rightarrow \pi^- \pi^+ \pi^+$                                         |
| $985.6^{+1.2}_{-1.5} \pm 1.1$                                                 |              | <sup>12</sup> MORI 07        | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^-$                              |
| $983.0 \pm 0.6^{+4.0}_{-3.0}$                                                 |              | <sup>13</sup> AMBROSINO 06B  | KLOE | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \gamma$                               |
| $977.3 \pm 0.9^{+3.7}_{-4.3}$                                                 |              | <sup>14</sup> AMBROSINO 06B  | KLOE | $1.02 e^+ e^- \rightarrow \pi^+ \pi^- \gamma$                               |
| $950 \pm 9$                                                                   | 4286         | <sup>15</sup> GARMASH 06     | BELL | $B^+ \rightarrow K^+ \pi^+ \pi^-$                                           |
| $965 \pm 10$                                                                  |              | <sup>16</sup> ABLIKIM 05     | BES2 | $J/\psi \rightarrow \phi \pi^+ \pi^-, \phi K^+ K^-$                         |
| $1031 \pm 8$                                                                  |              | <sup>17</sup> ANISOVICH 03   | RVUE |                                                                             |
| $1037 \pm 31$                                                                 |              | TIKHOMIROV 03                | SPEC | $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$                              |
| $973 \pm 1$                                                                   | 2438         | <sup>18</sup> ALOISIO 02D    | KLOE | $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                                    |
| $977 \pm 3 \pm 2$                                                             | 848          | <sup>19</sup> AITALA 01A     | E791 | $D_s^+ \rightarrow \pi^- \pi^+ \pi^+$                                       |
| $969.8 \pm 4.5$                                                               | 419          | <sup>20</sup> ACHASOV 00H    | SND  | $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                                    |
| $985^{+16}_{-12}$                                                             | 419          | <sup>21,22</sup> ACHASOV 00H | SND  | $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                                    |
| $976 \pm 5 \pm 6$                                                             |              | <sup>23</sup> AKHMETSHIN 99B | CMD2 | $e^+ e^- \rightarrow \pi^+ \pi^- \gamma$                                    |
| $977 \pm 3 \pm 6$                                                             | 268          | <sup>23</sup> AKHMETSHIN 99C | CMD2 | $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                                    |
| $975 \pm 4 \pm 6$                                                             |              | <sup>24</sup> AKHMETSHIN 99C | CMD2 | $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$                                    |

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=2

|                         |     |    |             |     |      |                                                                                                                                 |         |
|-------------------------|-----|----|-------------|-----|------|---------------------------------------------------------------------------------------------------------------------------------|---------|
| 975 $\pm 4 \pm 6$       |     | 25 | AKHMETSHIN  | 99C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma,$<br>$\pi^0\pi^0\gamma$                                                                    | OCCUR=3 |
| 985 $\pm 10$            |     |    | BARBERIS    | 99  | OMEG | 450 $pp \rightarrow$<br>$p_s p_f K^+ K^-$                                                                                       |         |
| 982 $\pm 3$             |     |    | BARBERIS    | 99B | OMEG | 450 $pp \rightarrow p_s p_f \pi^+ \pi^-$                                                                                        |         |
| 982 $\pm 3$             |     |    | BARBERIS    | 99C | OMEG | 450 $pp \rightarrow p_s p_f \pi^0 \pi^0$                                                                                        |         |
| 987 $\pm 6 \pm 6$       |     | 26 | BARBERIS    | 99D | OMEG | 450 $pp \rightarrow K^+ K^-,$<br>$\pi^+ \pi^-$                                                                                  |         |
| 989 $\pm 15$            |     |    | BELLAZZINI  | 99  | GAM4 | 450 $pp \rightarrow pp \pi^0 \pi^0$                                                                                             |         |
| 991 $\pm 3$             |     | 27 | KAMINSKI    | 99  | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, \sigma\sigma$                                                                             |         |
| ~ 980                   |     | 27 | OLLER       | 99  | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                           |         |
| ~ 993.5                 |     |    | OLLER       | 99B | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                           |         |
| ~ 987                   |     | 27 | OLLER       | 99C | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, \eta\eta$                                                                                 |         |
| 957 $\pm 6$             |     | 28 | ACKERSTAFF  | 98Q | OPAL | $Z \rightarrow f_0 X$                                                                                                           |         |
| 960 $\pm 10$            |     |    | ALDE        | 98  | GAM4 |                                                                                                                                 |         |
| 1015 $\pm 15$           |     | 27 | ANISOVICH   | 98B | RVUE | Compilation                                                                                                                     |         |
| 1008                    |     | 29 | LOCHER      | 98  | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                           |         |
| 955 $\pm 10$            |     | 28 | ALDE        | 97  | GAM2 | 450 $pp \rightarrow pp \pi^0 \pi^0$                                                                                             |         |
| 994 $\pm 9$             |     | 30 | BERTIN      | 97C | OBLX | 0.0 $\bar{p}p \rightarrow \pi^+ \pi^- \pi^0$                                                                                    |         |
| 993.2 $\pm 6.5 \pm 6.9$ |     | 31 | ISHIDA      | 96  | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                           |         |
| 1006                    |     |    | TORNQVIST   | 96  | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi,$<br>$\eta\pi$                                                                       |         |
| 997 $\pm 5$             | 3k  | 32 | ALDE        | 95B | GAM2 | 38 $\pi^- p \rightarrow \pi^0 \pi^0 n$                                                                                          |         |
| 960 $\pm 10$            | 10k | 33 | ALDE        | 95B | GAM2 | 38 $\pi^- p \rightarrow \pi^0 \pi^0 n$                                                                                          | OCCUR=2 |
| 994 $\pm 5$             |     |    | AMSLER      | 95B | CBAR | 0.0 $\bar{p}p \rightarrow 3\pi^0$                                                                                               |         |
| ~ 996                   |     | 34 | AMSLER      | 95D | CBAR | 0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \pi^0,$<br>$\pi^0 \eta\eta, \pi^0 \pi^0 \eta$                                             |         |
| 987 $\pm 6$             |     | 35 | ANISOVICH   | 95  | RVUE |                                                                                                                                 |         |
| 1015                    |     |    | JANSSEN     | 95  | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                           |         |
| 983                     |     | 36 | BUGG        | 94  | RVUE | $\bar{p}p \rightarrow \eta 2\pi^0$                                                                                              |         |
| 973 $\pm 2$             |     | 37 | KAMINSKI    | 94  | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                           |         |
| 988                     |     | 38 | ZOU         | 94B | RVUE |                                                                                                                                 |         |
| 988 $\pm 10$            |     | 39 | MORGAN      | 93  | RVUE | $\pi\pi(K\bar{K}) \rightarrow \pi\pi(K\bar{K}),$<br>$J/\psi \rightarrow \phi\pi\pi(K\bar{K}),$<br>$D_s \rightarrow \pi(\pi\pi)$ |         |
| 971.1 $\pm 4.0$         |     | 28 | AGUILAR-... | 91  | EHS  | 400 $pp$                                                                                                                        |         |
| 979 $\pm 4$             |     | 40 | ARMSTRONG   | 91  | OMEG | 300 $pp \rightarrow pp\pi\pi,$<br>$ppK\bar{K}$                                                                                  |         |
| 956 $\pm 12$            |     |    | BREAKSTONE  | 90  | SFM  | $pp \rightarrow pp\pi^+ \pi^-$                                                                                                  |         |
| 959.4 $\pm 6.5$         |     | 28 | AUGUSTIN    | 89  | DM2  | $J/\psi \rightarrow \omega\pi^+ \pi^-$                                                                                          |         |
| 978 $\pm 9$             |     | 28 | ABACHI      | 86B | HRS  | $e^+e^- \rightarrow \pi^+ \pi^- X$                                                                                              |         |
| 985.0 $^{+9.0}_{-39.0}$ |     |    | ETKIN       | 82B | MPS  | 23 $\pi^- p \rightarrow n 2K_S^0$                                                                                               |         |
| 974 $\pm 4$             |     | 40 | GIDAL       | 81  | MRK2 | $J/\psi \rightarrow \pi^+ \pi^- X$                                                                                              |         |
| 975                     |     | 41 | ACHASOV     | 80  | RVUE |                                                                                                                                 |         |
| 986 $\pm 10$            |     | 40 | AGUILAR-... | 78  | HBC  | 0.7 $\bar{p}p \rightarrow K_S^0 K_S^0$                                                                                          |         |
| 969 $\pm 5$             |     | 40 | LEEPER      | 77  | ASPK | 2-2.4 $\pi^- p \rightarrow$<br>$\pi^+ \pi^- n, K^+ K^- n$                                                                       |         |
| 987 $\pm 7$             |     | 40 | BINNIE      | 73  | CNTR | $\pi^- p \rightarrow nMM$                                                                                                       |         |
| 1012 $\pm 6$            |     | 42 | GRAYER      | 73  | ASPK | 17 $\pi^- p \rightarrow \pi^+ \pi^- n$                                                                                          |         |
| 1007 $\pm 20$           |     | 42 | HYAMS       | 73  | ASPK | 17 $\pi^- p \rightarrow \pi^+ \pi^- n$                                                                                          |         |
| 997 $\pm 6$             |     | 42 | PROTOPOP... | 73  | HBC  | 7 $\pi^+ p \rightarrow \pi^+ p\pi^+ \pi^-$                                                                                      |         |

<sup>1</sup> T-matrix pole, 5 poles, 5 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ), and BINON 84C ( $\eta\eta'$ ). Second solution  $977.8 \pm 0.6 \pm 1.6$  MeV.

<sup>2</sup> From the  $D^\pm \rightarrow K^\pm K^+ K^-$  Dalitz plot fit with the Triple-M amplitude in the multi-meson model of AOUDE 18.

<sup>3</sup> Pole position. Used Roy equations.

<sup>4</sup> Average of the analyses of three data sets in the K-matrix model. Uses the data of BATLEY 08A, HYAMS 73, and GRAYER 74, partially of COHEN 80 or ETKIN 82B.

<sup>5</sup> On sheet II in a 2-pole solution. The other pole is found on sheet III at (850–100i) MeV

<sup>6</sup> Using a relativistic Breit-Wigner function and taking into account the finite  $D_s$  mass.

<sup>7</sup> Breit-Wigner mass. Using finite width corrections according to FLATTE 76 and ACHASOV 05, and the ratio  $g_{f_0 K K}/g_{f_0 \pi\pi} = 0$ .

<sup>8</sup> In the kaon-loop fit.

<sup>9</sup> In the no-structure fit.

<sup>10</sup> Systematic errors not estimated.

<sup>11</sup> FLATTE 76 parameterization.  $g_{f_0 \pi\pi} = 329 \pm 96$  MeV/c<sup>2</sup> assuming  $g_{f_0 K\bar{K}}/g_{f_0 \pi\pi} = 2$ .

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- 12 Breit-Wigner mass. Using finite width corrections according to FLATTE 76 and ACHASOV 05, and the ratio  $g_{f_0 K K} / g_{f_0 \pi \pi} = 4.21 \pm 0.25 \pm 0.21$  from ABLIKIM 05.
- 13 In the kaon-loop fit following formalism of ACHASOV 89.
- 14 In the no-structure fit assuming a direct coupling of  $\phi$  to  $f_0 \gamma$ .
- 15 FLATTE 76 parameterization. Supersedes GARMASH 05.
- 16 FLATTE 76 parameterization,  $g_{f_0 K \bar{K}} / g_{f_0 \pi \pi} = 4.21 \pm 0.25 \pm 0.21$ .
- 17 K-matrix pole from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K \bar{K} n$ ,  $\pi^+ \pi^- \rightarrow \pi^+ \pi^-$ ,  $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \eta \eta$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^0$ ,  $K^+ K_S^0 \pi^-$  at rest,  $\bar{p} n \rightarrow \pi^- \pi^- \pi^+$ ,  $K_S^0 K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^-$  at rest.
- 18 From the negative interference with the  $f_0(500)$  meson of AITALA 01B using the ACHASOV 89 parameterization for the  $f_0(980)$ , a Breit-Wigner for the  $f_0(500)$ , and ACHASOV 01F for the  $\rho\pi$  contribution.
- 19 Coupled-channel Breit-Wigner, couplings  $g_\pi = 0.09 \pm 0.01 \pm 0.01$ ,  $g_K = 0.02 \pm 0.04 \pm 0.03$ .
- 20 Supersedes ACHASOV 98i. Using the model of ACHASOV 89.
- 21 Supersedes ACHASOV 98i.
- 22 In the “narrow resonance” approximation.
- 23 Assuming  $\Gamma(f_0) = 40$  MeV.
- 24 From a narrow pole fit taking into account  $f_0(980)$  and  $f_0(1200)$  intermediate mechanisms.
- 25 From the combined fit of the photon spectra in the reactions  $e^+ e^- \rightarrow \pi^+ \pi^- \gamma$ ,  $\pi^0 \pi^0 \gamma$ .
- 26 Supersedes BARBERIS 99 and BARBERIS 99B.
- 27 T-matrix pole.
- 28 From invariant mass fit.
- 29 On sheet II in a 2 pole solution. The other pole is found on sheet III at  $(1039-93i)$  MeV.
- 30 On sheet II in a 2 pole solution. The other pole is found on sheet III at  $(963-29i)$  MeV.
- 31 Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.
- 32 At high  $|t|$ .
- 33 At low  $|t|$ .
- 34 On sheet II in a 4-pole solution, the other poles are found on sheet III at  $(953-55i)$  MeV and on sheet IV at  $(938-35i)$  MeV.
- 35 Combined fit of ALDE 95B, ANISOVICH 94, AMSLER 94D.
- 36 On sheet II in a 2 pole solution. The other pole is found on sheet III at  $(996-103i)$  MeV.
- 37 From sheet II pole position.
- 38 On sheet II in a 2 pole solution. The other pole is found on sheet III at  $(797-185i)$  MeV and can be interpreted as a shadow pole.
- 39 On sheet II in a 2 pole solution. The other pole is found on sheet III at  $(978-28i)$  MeV.
- 40 From coupled channel analysis.
- 41 Coupled channel analysis with finite width corrections.
- 42 Included in AGUILAR-BENITEZ 78 fit.

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 NODE=M003M;LINKAGE=R

## $f_0(980)$ WIDTH

Width determination very model dependent. Peak width in  $\pi\pi$  is about 50 MeV, but decay width can be much larger.

NODE=M003W1

NODE=M003W1

| VALUE (MeV)                                                                   | EVTS     | DOCUMENT ID    | TECN      | COMMENT                                                                               |
|-------------------------------------------------------------------------------|----------|----------------|-----------|---------------------------------------------------------------------------------------|
| <b>10 to 100 OUR ESTIMATE</b>                                                 |          |                |           |                                                                                       |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |          |                |           |                                                                                       |
| 61.3 ± 1.3 ± 4.4                                                              |          | 1 ALBRECHT     | 20 RVUE   | 0.9 $\bar{p} p \rightarrow \pi^0 \pi^0 \eta$ ,<br>$\pi^0 \eta \eta$ , $\pi^0 K^+ K^-$ |
| 15.3 ± 4.7                                                                    | 424      | ABLIKIM        | 15P BES3  | $J/\psi \rightarrow K^+ K^- 3\pi$                                                     |
| 9.5 ± 1.1                                                                     | 706      | ABLIKIM        | 12E BES3  | $J/\psi \rightarrow \gamma 3\pi$                                                      |
| 48 $\pm \frac{22}{6}$                                                         |          | 2 MOUSSALLAM11 | RVUE      | Compilation                                                                           |
| 36 ± 22                                                                       |          | 3 MENNESSIER   | 10 RVUE   | Compilation                                                                           |
| 70 $\pm \frac{20}{32}$                                                        |          | 4 ANISOVICH    | 09 RVUE   | 0.0 $\bar{p} p$ , $\pi N$                                                             |
| 91 $\pm \frac{30}{22}$ ± 3                                                    | 44       | 5 ECKLUND      | 09 CLEO   | 4.17 $e^+ e^- \rightarrow D_s^- D_s^{*+} + \text{c.c.}$                               |
| 66.9 ± 2.2 $\pm \frac{17.6}{-12.5}$                                           |          | 6 UEHARA       | 08A BELL  | 10.6 $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$                                        |
| 65 ± 13                                                                       | 262 ± 30 | 7 AUBERT       | 07AK BABR | 10.6 $e^+ e^- \rightarrow \phi \pi^+ \pi^- \gamma$                                    |

NODE=M003W1

→ UNCHECKED ←

|                                                 |        |                |           |                                                                                                                        |         |
|-------------------------------------------------|--------|----------------|-----------|------------------------------------------------------------------------------------------------------------------------|---------|
| 81 ± 21                                         | 54 ± 9 | 7 AUBERT       | 07AK BABR | 10.6 $e^+e^- \rightarrow \phi \pi^0 \pi^0 \gamma$                                                                      | OCCUR=2 |
| 51.3 <sup>+20.8+13.2</sup> <sub>-17.7-3.8</sub> |        | 8 MORI         | 07 BELL   | 10.6 $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$                                                                             |         |
| 61 ± 9 <sup>+14</sup> <sub>-8</sub>             | 2584   | 9 GARMASH      | 05 BELL   | $B^+ \rightarrow K^+\pi^+\pi^-$                                                                                        |         |
| 64 ± 16                                         |        | 10 ANISOVICH   | 03 RVUE   |                                                                                                                        |         |
| 121 ± 23                                        |        | TIKHOMIROV     | 03 SPEC   | 40.0 $\pi^- \rightarrow K_S^0 K_S^0 K_L^0 X$                                                                           |         |
| ~ 70                                            |        | 11 BRAMON      | 02 RVUE   | 1.02 $e^+e^- \rightarrow \pi^0 \pi^0 \gamma$                                                                           |         |
| 44 ± 2 ± 2                                      | 848    | 12 AITALA      | 01A E791  | $D_s^+ \rightarrow \pi^-\pi^+\pi^+$                                                                                    |         |
| 201 ± 28                                        | 419    | 13 ACHASOV     | 00H SND   | $e^+e^- \rightarrow \pi^0 \pi^0 \gamma$                                                                                | OCCUR=2 |
| 122 ± 13                                        | 419    | 14,15 ACHASOV  | 00H SND   | $e^+e^- \rightarrow \pi^0 \pi^0 \gamma$                                                                                |         |
| 56 ± 20                                         |        | 16 AKHMETSHIN  | 99C CMD2  | $e^+e^- \rightarrow \pi^0 \pi^0 \gamma$                                                                                |         |
| 65 ± 20                                         |        | BARBERIS       | 99 OMEG   | 450 $pp \rightarrow p_s p_f K^+ K^-$                                                                                   |         |
| 80 ± 10                                         |        | BARBERIS       | 99B OMEG  | 450 $pp \rightarrow p_s p_f \pi^+ \pi^-$                                                                               |         |
| 80 ± 10                                         |        | BARBERIS       | 99C OMEG  | 450 $pp \rightarrow p_s p_f \pi^0 \pi^0$                                                                               |         |
| 48 ± 12 ± 8                                     |        | 17 BARBERIS    | 99D OMEG  | 450 $pp \rightarrow K^+ K^-, \pi^+ \pi^-$                                                                              |         |
| 65 ± 25                                         |        | BELLAZZINI     | 99 GAM4   | 450 $pp \rightarrow pp\pi^0 \pi^0$                                                                                     |         |
| 71 ± 14                                         |        | 18 KAMINSKI    | 99 RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}, \sigma\sigma$                                                                    |         |
| ~ 28                                            |        | 18 OLLER       | 99 RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  |         |
| ~ 25                                            |        | OLLER          | 99B RVUE  | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  |         |
| ~ 14                                            |        | 18 OLLER       | 99C RVUE  | $\pi\pi \rightarrow \pi\pi, K\bar{K}, \eta\eta$                                                                        |         |
| 70 ± 20                                         |        | ALDE           | 98 GAM4   |                                                                                                                        |         |
| 86 ± 16                                         |        | 18 ANISOVICH   | 98B RVUE  | Compilation                                                                                                            |         |
| 54                                              |        | 19 LOCHER      | 98 RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  |         |
| 69 ± 15                                         |        | 20 ALDE        | 97 GAM2   | 450 $pp \rightarrow pp\pi^0 \pi^0$                                                                                     |         |
| 38 ± 20                                         |        | 21 BERTIN      | 97C OBLX  | 0.0 $\bar{p}p \rightarrow \pi^+ \pi^- \pi^0$                                                                           |         |
| ~ 100                                           |        | 22 ISHIDA      | 96 RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  |         |
| 34                                              |        | TORNQVIST      | 96 RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$                                                                   |         |
| 48 ± 10                                         | 3k     | 23 ALDE        | 95B GAM2  | 38 $\pi^- p \rightarrow \pi^0 \pi^0 n$                                                                                 | OCCUR=2 |
| 95 ± 20                                         | 10k    | 24 ALDE        | 95B GAM2  | 38 $\pi^- p \rightarrow \pi^0 \pi^0 n$                                                                                 |         |
| 26 ± 10                                         |        | AMSLER         | 95B CBAR  | 0.0 $\bar{p}p \rightarrow 3\pi^0$                                                                                      |         |
| ~ 112                                           |        | 25 AMSLER      | 95D CBAR  | 0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta\eta, \pi^0 \pi^0 \eta$                                         |         |
| 80 ± 12                                         |        | 26 ANISOVICH   | 95 RVUE   |                                                                                                                        |         |
| 30                                              |        | JANSSEN        | 95 RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  |         |
| 74                                              |        | 27 BUGG        | 94 RVUE   | $\bar{p}p \rightarrow \eta 2\pi^0$                                                                                     |         |
| 29 ± 2                                          |        | 28 KAMINSKI    | 94 RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                                                                  |         |
| 46                                              |        | 29 ZOU         | 94B RVUE  |                                                                                                                        |         |
| 48 ± 12                                         |        | 30 MORGAN      | 93 RVUE   | $\pi\pi(K\bar{K}) \rightarrow \pi\pi(K\bar{K}), J/\psi \rightarrow \phi \pi\pi(K\bar{K}), D_s \rightarrow \pi(\pi\pi)$ |         |
| 37.4 ± 10.6                                     |        | 20 AGUILAR-... | 91 EHS    | 400 $pp$                                                                                                               |         |
| 72 ± 8                                          |        | 31 ARMSTRONG   | 91 OMEG   | 300 $pp \rightarrow pp\pi\pi, ppK\bar{K}$                                                                              |         |
| 110 ± 30                                        |        | BREAKSTONE     | 90 SFM    | $pp \rightarrow pp\pi^+\pi^-$                                                                                          |         |
| 29 ± 13                                         |        | 20 ABACHI      | 86B HRS   | $e^+e^- \rightarrow \pi^+\pi^- X$                                                                                      |         |
| 120 ± 281 ± 20                                  |        | ETKIN          | 82B MPS   | 23 $\pi^- p \rightarrow n 2K_S^0$                                                                                      |         |
| 28 ± 10                                         |        | 31 GIDAL       | 81 MRK2   | $J/\psi \rightarrow \pi^+\pi^- X$                                                                                      |         |
| 70 to 300                                       |        | 32 ACHASOV     | 80 RVUE   |                                                                                                                        |         |
| 100 ± 80                                        |        | 33 AGUILAR-... | 78 HBC    | 0.7 $\bar{p}p \rightarrow K_S^0 K_S^0$                                                                                 |         |
| 30 ± 8                                          |        | 31 LEEPER      | 77 ASPK   | 2-2.4 $\pi^- p \rightarrow \pi^+\pi^- n, K^+ K^- n$                                                                    |         |
| 48 ± 14                                         |        | 31 BINNIE      | 73 CNTR   | $\pi^- p \rightarrow nMM$                                                                                              |         |
| 32 ± 10                                         |        | 34 GRAYER      | 73 ASPK   | 17 $\pi^- p \rightarrow \pi^+\pi^- n$                                                                                  |         |
| 30 ± 10                                         |        | 34 HYAMS       | 73 ASPK   | 17 $\pi^- p \rightarrow \pi^+\pi^- n$                                                                                  |         |
| 54 ± 16                                         |        | 34 PROTOPOP... | 73 HBC    | 7 $\pi^+ p \rightarrow \pi^+ p\pi^+\pi^-$                                                                              |         |



- <sup>1</sup> T-matrix pole, 5 poles, 5 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ), and BINON 84C ( $\eta\eta'$ ). Second solution  $97.8 \pm 1.2 \pm 5.4$  MeV.
- <sup>2</sup> Pole position. Used Roy equations.
- <sup>3</sup> Average of the analyses of three data sets in the K-matrix model. Uses the data of BATLEY 08A, HYAMS 73, and GRAYER 74, partially of COHEN 80 or ETKIN 82B.
- <sup>4</sup> On sheet II in a 2-pole solution. The other pole is found on sheet III at (850–100*i*) MeV
- <sup>5</sup> Using a relativistic Breit-Wigner function and taking into account the finite  $D_S$  mass.
- <sup>6</sup> Breit-Wigner  $\pi\pi$  width. Using finite width corrections according to FLATTE 76 and ACHASOV 05, and the ratio  $g_{f_0}^2 K K / g_{f_0}^2 \pi\pi = 0$ .
- <sup>7</sup> Systematic errors not estimated.
- <sup>8</sup> Breit-Wigner  $\pi\pi$  width. Using finite width corrections according to FLATTE 76 and ACHASOV 05, and the ratio  $g_{f_0}^2 K K / g_{f_0}^2 \pi\pi = 4.21 \pm 0.25 \pm 0.21$  from ABLIKIM 05.
- <sup>9</sup> Breit-Wigner, solution 1, PWA ambiguous.
- <sup>10</sup> K-matrix pole from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K \bar{K} n$ ,  $\pi^+ \pi^- \rightarrow \pi^+ \pi^-$ ,  $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \eta \eta$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^0$ ,  $K^+ K_S^0 \pi^-$  at rest,  $\bar{p} n \rightarrow \pi^- \pi^- \pi^+$ ,  $K_S^0 K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^-$  at rest.
- <sup>11</sup> Using the data of AKHMETSHIN 99C, ACHASOV 00H, and ALOISIO 02D.
- <sup>12</sup> Breit-Wigner width.
- <sup>13</sup> Supersedes ACHASOV 98i. Using the model of ACHASOV 89.
- <sup>14</sup> Supersedes ACHASOV 98i.
- <sup>15</sup> In the “narrow resonance” approximation.
- <sup>16</sup> From the combined fit of the photon spectra in the reactions  $e^+ e^- \rightarrow \pi^+ \pi^- \gamma$ ,  $\pi^0 \pi^0 \gamma$ .
- <sup>17</sup> Supersedes BARBERIS 99 and BARBERIS 99B
- <sup>18</sup> T-matrix pole.
- <sup>19</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (1039–93*i*) MeV.
- <sup>20</sup> From invariant mass fit.
- <sup>21</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (963–29*i*) MeV.
- <sup>22</sup> Reanalysis of data from HYAMS 73, GRAYER 74, SRINIVASAN 75, and ROSSELET 77 using the interfering amplitude method.
- <sup>23</sup> At high  $|t|$ .
- <sup>24</sup> At low  $|t|$ .
- <sup>25</sup> On sheet II in a 4-pole solution, the other poles are found on sheet III at (953–55*i*) MeV and on sheet IV at (938–35*i*) MeV.
- <sup>26</sup> Combined fit of ALDE 95B, ANISOVICH 94,
- <sup>27</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (996–103*i*) MeV.
- <sup>28</sup> From sheet II pole position.
- <sup>29</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (797–185*i*) MeV and can be interpreted as a shadow pole.
- <sup>30</sup> On sheet II in a 2 pole solution. The other pole is found on sheet III at (978–28*i*) MeV.
- <sup>31</sup> From coupled channel analysis.
- <sup>32</sup> Coupled channel analysis with finite width corrections.
- <sup>33</sup> From coupled channel fit to the HYAMS 73 and PROTOPODESCU 73 data. With a simultaneous fit to the  $\pi\pi$  phase-shifts, inelasticity and to the  $K_S^0 K_S^0$  invariant mass.
- <sup>34</sup> Included in AGUILAR-BENITEZ 78 fit.

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## $f_0(980)$ DECAY MODES

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi\pi$       | seen                           |
| $\Gamma_2 \quad K\bar{K}$     | seen                           |
| $\Gamma_3 \quad \gamma\gamma$ | seen                           |
| $\Gamma_4 \quad e^+ e^-$      |                                |

## $f_0(980)$ PARTIAL WIDTHS

 $\Gamma(\gamma\gamma)$  $\Gamma_3$ 

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**0.31  $\pm 0.05$  OUR AVERAGE**  
 $-0.04$

|                                        |                     |     |      |                                                |
|----------------------------------------|---------------------|-----|------|------------------------------------------------|
| 0.32 $\pm 0.05$                        | <sup>1</sup> DAI    | 14A | RVUE | Compilation                                    |
| 0.286 $\pm 0.017$ $^{+0.211}_{-0.070}$ | <sup>2</sup> UEHARA | 08A | BELL | 10.6 $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$ |
| 0.205 $^{+0.095+0.147}_{-0.083-0.117}$ | <sup>3</sup> MORI   | 07  | BELL | 10.6 $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^-$ |
| 0.42 $\pm 0.06 \pm 0.18$               | <sup>4</sup> OEST   | 90  | JADE | $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$      |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                               |                              |      |                                                   |
|-----------------------------------------------|------------------------------|------|---------------------------------------------------|
| 0.16 ± 0.01                                   | <sup>5</sup> MENNESSIER 11   | RVUE |                                                   |
| 0.29 ± 0.21 <sup>+0.02</sup> <sub>-0.07</sub> | <sup>6</sup> MOUSSALLAM11    | RVUE | Compilation                                       |
| 0.42                                          | <sup>7,8</sup> PENNINGTON 08 | RVUE | Compilation                                       |
| 0.10                                          | <sup>8,9</sup> PENNINGTON 08 | RVUE | Compilation                                       |
| 0.28 <sup>+0.09</sup> <sub>-0.13</sub>        | <sup>10</sup> BOGLIONE 99    | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |
| 0.29 ± 0.07 ± 0.12                            | <sup>11,12</sup> BOYER 90    | MRK2 | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 0.31 ± 0.14 ± 0.09                            | <sup>11,12</sup> MARSISKE 90 | CBAL | $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$             |
| 0.63 ± 0.14                                   | <sup>13</sup> MORGAN 90      | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |

OCCUR=2

<sup>1</sup> Using dispersive analysis with phases from GARCIA-MARTIN 11A and BUETTIKER 04 as input.

NODE=M003W4;LINKAGE=D

<sup>2</sup> Using finite width corrections according to FLATTE 76 and ACHASOV 05, and the ratio  $g_{f_0} K K / g_{f_0} \pi \pi = 0$ .

NODE=M003W4;LINKAGE=UE

<sup>3</sup> Using finite width corrections according to FLATTE 76 and ACHASOV 05, and the ratio  $g_{f_0} K K / g_{f_0} \pi \pi = 4.21 \pm 0.25 \pm 0.21$  from ABLIKIM 05.

NODE=M003W4;LINKAGE=MO

<sup>4</sup> OEST 90 quote systematic errors <sup>+0.08</sup><sub>-0.18</sub>. We use ±0.18. Observed 60 events.

NODE=M003W4;LINKAGE=H

<sup>5</sup> Uses an analytic K-matrix model. Compilation.

NODE=M003W4;LINKAGE=ME

<sup>6</sup> Using dispersion integral with phase input from Roy equations and data from MARSISKE 90, BOYER 90, BEHREND 92, UEHARA 08A, and MORI 07.

NODE=M003W4;LINKAGE=MU

<sup>7</sup> Solution A (preferred solution based on  $\chi^2$ -analysis).

NODE=M003W4;LINKAGE=P1

<sup>8</sup> Dispersion theory based amplitude analysis of BOYER 90, MARSISKE 90, BEHREND 92, and MORI 07.

NODE=M003W4;LINKAGE=P3

<sup>9</sup> Solution B (worse than solution A; still acceptable when systematic uncertainties are included).

NODE=M003W4;LINKAGE=P2

<sup>10</sup> Supersedes MORGAN 90.

NODE=M003W4;LINKAGE=BL

<sup>11</sup> From analysis allowing arbitrary background unconstrained by unitarity.

NODE=M003W4;LINKAGE=B

<sup>12</sup> Data included in MORGAN 90, BOGLIONE 99 analyses.

NODE=M003W4;LINKAGE=C

<sup>13</sup> From amplitude analysis of BOYER 90 and MARSISKE 90, data corresponds to resonance parameters  $m = 989$  MeV,  $\Gamma = 61$  MeV.

NODE=M003W4;LINKAGE=A

$\Gamma(e^+e^-)$

$\Gamma_4$

| VALUE (eV)     | CL% | DOCUMENT ID | TECN  | COMMENT                         |
|----------------|-----|-------------|-------|---------------------------------|
| <b>&lt;8.4</b> | 90  | VOROBYEV    | 88 ND | $e^+e^- \rightarrow \pi^0\pi^0$ |

NODE=M003W3  
NODE=M003W3

### $f_0(980)$ BRANCHING RATIOS

NODE=M003225

$\Gamma(\pi\pi) / [\Gamma(\pi\pi) + \Gamma(K\bar{K})]$

$\Gamma_1 / (\Gamma_1 + \Gamma_2)$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

NODE=M003R1  
NODE=M003R1

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                        |      |                        |     |      |                                                           |
|----------------------------------------|------|------------------------|-----|------|-----------------------------------------------------------|
| 0.52 ± 0.12                            | 9.9k | <sup>1</sup> AUBERT    | 060 | BABR | $B^\pm \rightarrow K^\pm \pi^\pm \pi^\mp$                 |
| 0.75 <sup>+0.11</sup> <sub>-0.13</sub> |      | <sup>2</sup> ABLIKIM   | 05Q | BES2 | $\chi_{c0} \rightarrow 2\pi^+ 2\pi^-, \pi^+\pi^- K^+ K^-$ |
| 0.84 ± 0.02                            |      | <sup>3</sup> ANISOVICH | 02D | SPEC | Combined fit                                              |
| ~ 0.68                                 |      | OLLER                  | 99B | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                     |
| 0.67 ± 0.09                            |      | <sup>4</sup> LOVERRE   | 80  | HBC  | $4 \pi^- p \rightarrow n 2 K_S^0$                         |
| 0.81 <sup>+0.09</sup> <sub>-0.04</sub> |      | <sup>4</sup> CASON     | 78  | STRC | $7 \pi^- p \rightarrow n 2 K_S^0$                         |
| 0.78 ± 0.03                            |      | <sup>4</sup> WETZEL    | 76  | OSPK | $8.9 \pi^- p \rightarrow n 2 K_S^0$                       |

<sup>1</sup> Recalculated by us using  $\Gamma(K^+K^-) / \Gamma(\pi^+\pi^-) = 0.69 \pm 0.32$  from AUBERT 060 and isospin relations.

NODE=M003R1;LINKAGE=AU

<sup>2</sup> Using data from ABLIKIM 04G.

NODE=M003R1;LINKAGE=AB

<sup>3</sup> From a combined K-matrix analysis of Crystal Barrel ( $0^- p \bar{p} \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ ), GAMS ( $\pi p \rightarrow \pi^0 \pi^0 n, \eta \eta n, \eta \eta' n$ ), and BNL ( $\pi p \rightarrow K \bar{K} n$ ) data.

NODE=M003R;LINKAGE=CH

<sup>4</sup> Measure  $\pi\pi$  elasticity assuming two resonances coupled to the  $\pi\pi$  and  $K\bar{K}$  channels only.

NODE=M003R1;LINKAGE=B

**f<sub>0</sub>(980) REFERENCES**

NODE=M003

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|---------------|------|-----------------------------|------------------------------------------------|-----------------------------|----------------------|
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| BATLEY        | 10C  | EPJ C70 635                 | J.R. Batley <i>et al.</i>                      | (CERN NA48/2 Collab.)       | REFID=53567          |
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| BONVICINI     | 07   | PR D76 012001               | G. Bonvicini <i>et al.</i>                     | (CLEO Collab.)              | REFID=51721          |
| MORI          | 07   | PR D75 051101               | T. Mori <i>et al.</i>                          | (BELLE Collab.)             | REFID=51652          |
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| AKHMETSHIN    | 99B  | PL B462 371                 | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=47392          |
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| BARBERIS      | 99   | PL B453 305                 | D. Barberis <i>et al.</i>                      | (Omega Expt.)               | REFID=46921          |
| BARBERIS      | 99B  | PL B453 316                 | D. Barberis <i>et al.</i>                      | (Omega Expt.)               | REFID=46922          |
| BARBERIS      | 99C  | PL B453 325                 | D. Barberis <i>et al.</i>                      | (Omega Expt.)               | REFID=46923          |
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| ACHASOV       | 98I  | PL B440 442                 | M.N. Achasov <i>et al.</i>                     |                             | REFID=46600          |
| ACKERSTAFF    | 98Q  | EPJ C4 19                   | K. Ackerstaff <i>et al.</i>                    | (OPAL Collab.)              | REFID=46145          |
| ALDE          | 98   | EPJ A3 361                  | D. Alde <i>et al.</i>                          | (GAM4 Collab.)              | REFID=46605          |
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| ANISOVICH     | 98B  | Translated from YAF 62 446  | V.V. Anisovich <i>et al.</i>                   |                             | REFID=46331          |
| LOCHER        | 98   | SPI 41 419                  | M.P. Locher <i>et al.</i>                      | (PSI)                       | REFID=46372          |
| ALDE          | 97   | EPJ C4 317                  | D.M. Alde <i>et al.</i>                        | (GAMS Collab.)              | REFID=45392          |
| BERTIN        | 97C  | PL B408 476                 | A. Bertin <i>et al.</i>                        | (OBELIX Collab.)            | REFID=45701          |
| ISHIDA        | 96   | PTP 95 745                  | S. Ishida <i>et al.</i>                        | (TOKY, MIYA, KEK)           | REFID=45770          |
| TORNQVIST     | 96   | PRL 76 1575                 | N.A. Tornqvist, M. Roos                        | (HELS)                      | REFID=44507          |
| ALDE          | 95B  | ZPHY C66 375                | D.M. Alde <i>et al.</i>                        | (GAMS Collab.)              | REFID=44375          |
| AMSLER        | 95B  | PL B342 433                 | C. Amsler <i>et al.</i>                        | (Crystal Barrel Collab.)    | REFID=44377          |
| AMSLER        | 95D  | PL B355 425                 | C. Amsler <i>et al.</i>                        | (Crystal Barrel Collab.)    | REFID=44441          |
| ANISOVICH     | 95   | PL B355 363                 | V.V. Anisovich <i>et al.</i>                   | (PNPI, SERP)                | REFID=44442          |
| JANSEN        | 95   | PR D52 2690                 | G. Janssen <i>et al.</i>                       | (STON, ADL, JULI)           | REFID=44508          |
| AMSLER        | 94D  | PL B333 277                 | C. Amsler <i>et al.</i>                        | (Crystal Barrel Collab.)    | REFID=44093          |
| ANISOVICH     | 94   | PL B323 233                 | V.V. Anisovich <i>et al.</i>                   | (Crystal Barrel Collab.)    | REFID=43659          |
| BUGG          | 94   | PR D50 4412                 | D.V. Bugg <i>et al.</i>                        | (LOQM)                      | REFID=44078          |
| KAMINSKI      | 94   | PR D50 3145                 | R. Kaminski, L. Lesniak, J.P. Maillet          | (CRAC+)                     | REFID=45771          |
| ZOU           | 94B  | PR D50 591                  | B.S. Zou, D.V. Bugg                            | (LOQM)                      | REFID=44072          |
| MORGAN        | 93   | PR D48 1185                 | D. Morgan, M.R. Pennington                     | (RAL, DURH)                 | REFID=43614          |
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| AGUILAR-...   | 91   | ZPHY C50 405                | M. Aguilar-Benitez <i>et al.</i>               | (LEBC-EHS Collab.)          | REFID=41637          |
| ARMSTRONG     | 91   | ZPHY C51 351                | T.A. Armstrong <i>et al.</i>                   | (ATHU, BARI, BIRM+)         | REFID=41744          |
| BOYER         | 90   | PR D42 1350                 | J. Boyer <i>et al.</i>                         | (Mark II Collab.)           | REFID=41362          |
| BREAKSTONE    | 90   | ZPHY C48 569                | A.M. Breakstone <i>et al.</i>                  | (ISU, BGNA, CERN+)          | REFID=41376          |
| MARSISKE      | 90   | PR D41 3324                 | H. Marsiske <i>et al.</i>                      | (Crystal Ball Collab.)      | REFID=41351          |
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| OEST          | 90   | ZPHY C47 343                | T. Oest <i>et al.</i>                          | (JADE Collab.)              | REFID=41358          |
| ACHASOV       | 89   | NP B315 465                 | N.N. Achasov, V.N. Ivanchenko                  |                             | REFID=48021          |
| AUGUSTIN      | 89   | NP B320 1                   | J.E. Augustin, G. Cosme                        | (DM2 Collab.)               | REFID=41004          |
| VOROBYEV      | 88   | SJNP 48 273                 | P.V. Vorobiev <i>et al.</i>                    | (NOVO)                      | REFID=41023          |
| ABACHI        | 86B  | Translated from YAF 48 436  | S. Abachi <i>et al.</i>                        | (PURD, ANL, IND, MICH+)     | REFID=20394          |
| LONGACRE      | 86   | PRL 57 1990                 | R.S. Longacre <i>et al.</i>                    | (BNL, BRAN, CUNY+)          | REFID=20768          |
| BINON         | 84C  | NC 80A 363                  | F.G. Binon <i>et al.</i>                       | (BELG, LAPP, SERP+)         | REFID=21418          |
| BINON         | 83   | NC 78A 313                  | F.G. Binon <i>et al.</i>                       | (BELG, LAPP, SERP+)         | REFID=20750          |
| ETKIN         | 82B  | PR D25 1786                 | A. Etkin <i>et al.</i>                         | (BNL, CUNY, TUFTS, VAND)    | REFID=20390          |
| GIDAL         | 81   | PL 107B 153                 | G. Gidal <i>et al.</i>                         | (SLAC, LBL)                 | REFID=20386          |
| ACHASOV       | 80   | SJNP 32 566                 | N.N. Achasov, S.A. Devyanin, G.N. Shestakov    | (NOVM)                      | REFID=20458          |
| COHEN         | 80   | Translated from YAF 32 1098 | D. Cohen <i>et al.</i>                         | (ANL) IJP                   | REFID=20381          |
| LOVERRE       | 80   | ZPHY C6 187                 | P.F. Loverre <i>et al.</i>                     | (CERN, CDEF, MADR+ IJP)     | REFID=20382          |
| AGUILAR-...   | 78   | NP B140 73                  | M. Aguilar-Benitez <i>et al.</i>               | (MADR, BOMB+)               | REFID=20368          |
| CASON         | 78   | PRL 41 271                  | N.M. Cason <i>et al.</i>                       | (NDAM, ANL)                 | REFID=20370          |
| LEEPER        | 77   | PR D16 2054                 | R.J. Leeper <i>et al.</i>                      | (ISU)                       | REFID=20365          |
| ROSSELET      | 77   | PR D15 574                  | L. Rosselet <i>et al.</i>                      | (GEVA, SACL)                | REFID=11004          |
| FLATTE        | 76   | PL 63B 224                  | S.M. Flatte                                    | (CERN)                      | REFID=20446          |
| WETZEL        | 76   | NP B115 208                 | W. Wetzel <i>et al.</i>                        | (ETH, CERN, LOIC)           | REFID=20362          |
| HYAMS         | 75   | NP B100 205                 | B.D. Hyams <i>et al.</i>                       | (CERN, MPIM)                | REFID=20355          |
| SRINIVASAN    | 75   | PR D12 681                  | V. Srinivasan <i>et al.</i>                    | (NDAM, ANL)                 | REFID=21062          |
| ESTABROOKS    | 74   | NP B79 301                  | P.G. Estabrooks, A.D. Martin                   | (DURH)                      | REFID=20111          |
| GRAYR         | 74   | NP B75 189                  | G. Grayer <i>et al.</i>                        | (CERN, MPIM)                | REFID=20113          |
| BINNIE        | 73   | PRL 31 1534                 | D.M. Binnie <i>et al.</i>                      | (LOIC, SHMP)                | REFID=20343          |
| GRAYR         | 73   | Tallahassee                 | G. Grayer <i>et al.</i>                        | (CERN, MPIM)                | REFID=20347          |
| HYAMS         | 73   | NP B64 134                  | B.D. Hyams <i>et al.</i>                       | (CERN, MPIM)                | REFID=20107          |
| PROTOPOP...   | 73   | PR D7 1279                  | S.D. Protopopescu <i>et al.</i>                | (LBL)                       | REFID=20108          |

$a_0(980)$ 

$$I^G(J^{PC}) = 1^-(0^{++})$$

See the review on "Scalar Mesons below 2 GeV."

NODE=M036

NODE=M036

NODE=M036PP

NODE=M036PP

NODE=M036PP;LINKAGE=A

NODE=M036205

NODE=M036MX  
→ UNCHECKED ←

NODE=M036MX;LINKAGE=A

NODE=M036M1  
NODE=M036M1 **$a_0(980)$  T-MATRIX POLE  $\sqrt{s}$** 

| VALUE (MeV)                                                                                                | DOCUMENT ID         | TECN     | COMMENT                                              |
|------------------------------------------------------------------------------------------------------------|---------------------|----------|------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                              |                     |          |                                                      |
| $(1117^{+24}_{-320}) - i(12^{+43}_{-12})$                                                                  | <sup>1</sup> PELAEZ | 04A RVUE | $\pi\pi \rightarrow \pi\pi, \pi K \rightarrow \pi K$ |
| <sup>1</sup> Reanalysis of data from LINGLIN 73, ESTABROOKS 78, and ASTON 88 in the unitarized ChPT model. |                     |          |                                                      |

 **$a_0(980)$  MASS**

| VALUE (MeV)                                                                   | DOCUMENT ID                             | TECN    | COMMENT                                           |
|-------------------------------------------------------------------------------|-----------------------------------------|---------|---------------------------------------------------|
| <b>980 ±20 OUR ESTIMATE</b>                                                   | Mass determination very model dependent |         |                                                   |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                                         |         |                                                   |
| 1000.7 <sup>+12.9</sup> <sub>-0.7</sub>                                       | <sup>1</sup> LU                         | 20 RVUE | $\gamma\gamma \rightarrow \pi^0\eta, K_S^0 K_S^0$ |
| <sup>1</sup> T-matrix pole on sheet II.                                       |                                         |         |                                                   |

 **$\eta\pi$  FINAL STATE ONLY**

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID                | TECN | CHG    | COMMENT                                                                 |
|-------------------------------------------------------------------------------|-------|----------------------------|------|--------|-------------------------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |       |                            |      |        |                                                                         |
| $1004.1 \pm 1.5 \pm 6.5$                                                      |       | <sup>1</sup> ALBRECHT      | 20   | CBAR   | $0.9 \bar{p}p \rightarrow \pi^0\pi^0\eta, \pi^0\eta\eta, \pi^0 K^+ K^-$ |
| $982.5 \pm 1.6 \pm 1.1$                                                       | 16.9k | <sup>2</sup> AMBROSINO     | 09F  | KLOE   | $1.02 e^+ e^- \rightarrow \eta\pi^0\gamma$                              |
| $986 \pm 4$                                                                   |       | ANISOVICH                  | 09   | RVUE   | $0.0 \bar{p}p, \pi N$                                                   |
| $982.3^{+0.6}_{-0.7} {}^{+3.1}_{-4.7}$                                        |       | <sup>3</sup> UEHARA        | 09A  | BELL   | $\gamma\gamma \rightarrow \pi^0\eta$                                    |
| $987.4 \pm 1.0 \pm 3.0$                                                       |       | <sup>4,5</sup> BUGG        | 08A  | RVUE 0 | $\bar{p}p \rightarrow \pi^0\pi^0\eta$                                   |
| $989.1 \pm 1.0 \pm 3.0$                                                       |       | <sup>5,6</sup> BUGG        | 08A  | RVUE 0 | $\bar{p}p \rightarrow \pi^0\pi^0\eta$                                   |
| $985 \pm 4 \pm 6$                                                             | 318   | ACHARD                     | 02B  | L3     | $183-209 e^+ e^- \rightarrow e^+ e^- \eta\pi^+ \pi^-$                   |
| $995^{+52}_{-10}$                                                             | 36    | <sup>7</sup> ACHASOV       | 00F  | SND    | $e^+ e^- \rightarrow \eta\pi^0\gamma$                                   |
| $994^{+33}_{-8}$                                                              | 36    | <sup>8</sup> ACHASOV       | 00F  | SND    | $e^+ e^- \rightarrow \eta\pi^0\gamma$                                   |
| $975 \pm 7$                                                                   |       | BARBERIS                   | 00H  |        | $450 pp \rightarrow p_f \eta\pi^0 p_s$                                  |
| $988 \pm 8$                                                                   |       | BARBERIS                   | 00H  |        | $450 pp \rightarrow \Delta_f^{++} \eta\pi^- p_s$                        |
| ~ 1055                                                                        |       | <sup>9</sup> OLLER         | 99   | RVUE   | $\eta\pi, K\bar{K}$                                                     |
| ~ 1009.2                                                                      |       | <sup>9</sup> OLLER         | 99B  | RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                   |
| $993.1 \pm 2.1$                                                               |       | <sup>10</sup> TEIGE        | 99   | B852   | $18.3 \pi^- p \rightarrow \eta\pi^+ \pi^- n$                            |
| $988 \pm 6$                                                                   |       | <sup>9</sup> ANISOVICH     | 98B  | RVUE   | Compilation                                                             |
| 987                                                                           |       | TORNQVIST                  | 96   | RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$                    |
| 991                                                                           |       | JANSSEN                    | 95   | RVUE   | $\eta\pi \rightarrow \eta\pi, K\bar{K}, K\pi, \eta\pi$                  |
| $984.45 \pm 1.23 \pm 0.34$                                                    |       | AMSLER                     | 94C  | CBAR   | $0.0 \bar{p}p \rightarrow \omega\eta\pi^0$                              |
| $982 \pm 2$                                                                   |       | <sup>11</sup> AMSLER       | 92   | CBAR   | $0.0 \bar{p}p \rightarrow \eta\eta\pi^0$                                |
| $984 \pm 4$                                                                   | 1040  | <sup>11</sup> ARMSTRONG    | 91B  | OMEG ± | $300 pp \rightarrow p p \eta\pi^+ \pi^-$                                |
| $976 \pm 6$                                                                   |       | ATKINSON                   | 84E  | OMEG ± | $25-55 \gamma p \rightarrow \eta\pi n$                                  |
| $986 \pm 3$                                                                   | 500   | <sup>12</sup> EVANGELIS... | 81   | OMEG ± | $12 \pi^- p \rightarrow \eta\pi^+ \pi^- \pi^- p$                        |
| $990 \pm 7$                                                                   | 145   | <sup>12</sup> GURTU        | 79   | HBC ±  | $4.2 K^- p \rightarrow \Lambda\eta 2\pi$                                |
| $980 \pm 11$                                                                  | 47    | CONFORTO                   | 78   | OSPK - | $4.5 \pi^- p \rightarrow pX^-$                                          |
| $978 \pm 16$                                                                  | 50    | CORDEN                     | 78   | OMEG ± | $12-15 \pi^- p \rightarrow n\eta 2\pi$                                  |
| $977 \pm 7$                                                                   |       | GRASSLER                   | 77   | HBC -  | $16 \pi^\mp p \rightarrow p\eta 3\pi$                                   |
| $989 \pm 4$                                                                   | 70    | WELLS                      | 75   | HBC -  | $3.1-6 K^- p \rightarrow \Lambda\eta 2\pi$                              |
| $972 \pm 10$                                                                  | 150   | DEFOIX                     | 72   | HBC ±  | $0.7 \bar{p}p \rightarrow 7\pi$                                         |
| $970 \pm 15$                                                                  | 20    | BARNES                     | 69C  | HBC -  | $4-5 K^- p \rightarrow \Lambda\eta 2\pi$                                |
| $980 \pm 10$                                                                  |       | CAMPBELL                   | 69   | DBC ±  | $2.7 \pi^+ d$                                                           |
| $980 \pm 10$                                                                  | 15    | MILLER                     | 69B  | HBC -  | $4.5 K^- N \rightarrow \eta\pi\Lambda$                                  |
| $980 \pm 10$                                                                  | 30    | AMMAR                      | 68   | HBC ±  | $5.5 K^- p \rightarrow \Lambda\eta 2\pi$                                |

OCCUR=2

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- <sup>1</sup> T-matrix pole with 2 poles, 2 channels, pole mass on adjacent sheet  $1002.4 \pm 1.4 \pm 6.6$  MeV.
- <sup>2</sup> Using the model of ACHASOV 89 and ACHASOV 03B.
- <sup>3</sup> From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.
- <sup>4</sup> Parameterizes couplings to  $\bar{K}K$ ,  $\pi\eta$ , and  $\pi\eta'$ .
- <sup>5</sup> Using AMSLER 94D and ABELE 98.
- <sup>6</sup> From the T-matrix pole on sheet II.
- <sup>7</sup> Using the model of ACHASOV 89. Supersedes ACHASOV 98B.
- <sup>8</sup> Using the model of JAFFE 77. Supersedes ACHASOV 98B.
- <sup>9</sup> T-matrix pole.
- <sup>10</sup> Breit-Wigner fit, average between  $a_0^\pm$  and  $a_0^0$ . The fit favors a slightly heavier  $a_0^\pm$ .
- <sup>11</sup> From a single Breit-Wigner fit.
- <sup>12</sup> From  $f_1(1285)$  decay.

 **$K\bar{K}$  ONLY**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID              | TECN     | COMMENT                                        |
|-------------------------------------------------------------------------------|------|--------------------------|----------|------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                          |          |                                                |
| $947.7^{+5.5}_{-5.0} \pm 6.6$                                                 |      | <sup>1</sup> AAIJ        | 19H LHCb | $pp \rightarrow D^\pm X$                       |
| $925 \pm 5 \pm 8$                                                             | 190k | <sup>2</sup> AAIJ        | 16N LHCb | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$          |
| $\sim 1053$                                                                   |      | <sup>3</sup> OLLER       | 99C RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}$          |
| $982 \pm 3$                                                                   |      | <sup>4</sup> ABELE       | 98 CBAR  | $0.0 \bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$ |
| $975 \pm 15$                                                                  |      | BERTIN                   | 98B OBLX | $0.0 \bar{p}p \rightarrow K^\pm K_S \pi^\mp$   |
| $976 \pm 6$                                                                   | 316  | DEBILLY                  | 80 HBC   | $1.2-2 \bar{p}p \rightarrow f_1(1285)\omega$   |
| $1016 \pm 10$                                                                 | 100  | <sup>5</sup> ASTIER      | 67 HBC   | $0.0 \bar{p}p$                                 |
| $1003.3 \pm 7.0$                                                              | 143  | <sup>6,7</sup> ROSENFELD | 65 RVUE  |                                                |

- <sup>1</sup> From the  $D^\pm \rightarrow K^\pm K^+ K^-$  Dalitz plot fit with the Triple-M amplitude in the multi-meson model of AOUDE 18.
- <sup>2</sup> Using a two-channel resonance parametrization with couplings fixed to ABELE 98.
- <sup>3</sup> T-matrix pole.
- <sup>4</sup> T-matrix pole on sheet II, the pole on sheet III is at 1006-i49 MeV.
- <sup>5</sup> ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.
- <sup>6</sup> Note on  $J^P$ . Main argument for  $0^+$  is small  $Q$  value. Isotropy of decay distribution in  $\bar{p}p$  at rest proves nothing. See discussion by Rosenfeld (Oxford) and Butterworth (Heidelberg).
- <sup>7</sup> Plus systematic errors.

 **$a_0(980)$  WIDTH**

| VALUE (MeV)                                                                                                                                          | EVTS | DOCUMENT ID            | TECN           | CHG | COMMENT                                                                          |
|------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------|----------------|-----|----------------------------------------------------------------------------------|
| <b>50 to 100 OUR ESTIMATE</b> Width determination very model dependent. Peak width in $\eta\pi$ is about 60 MeV, but decay width can be much larger. |      |                        |                |     |                                                                                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                        |      |                        |                |     |                                                                                  |
| $97.2 \pm 1.9 \pm 5.7$                                                                                                                               |      | <sup>1</sup> ALBRECHT  | 20 CBAR        |     | $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta,$<br>$\pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| $73.2^{+25.4}_{-5.2}$                                                                                                                                |      | <sup>2</sup> LU        | 20 RVUE        |     | $\gamma\gamma \rightarrow \pi^0 \eta, K_S^0 K_S^0$                               |
| $75.6 \pm 1.6^{+17.4}_{-10.0}$                                                                                                                       |      | <sup>3</sup> UEHARA    | 09A BELL       |     | $\gamma\gamma \rightarrow \pi^0 \eta$                                            |
| $80.2 \pm 3.8 \pm 5.4$                                                                                                                               |      | <sup>4</sup> BUGG      | 08A RVUE 0     |     | $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$                                          |
| $50 \pm 13 \pm 4$                                                                                                                                    | 318  | ACHARD                 | 02B L3         |     | $183-209 e^+ e^- \rightarrow$<br>$e^+ e^- \eta \pi^+ \pi^-$                      |
| $72 \pm 16$                                                                                                                                          |      | BARBERIS               | 00H            |     | $450 pp \rightarrow p_f \eta \pi^0 p_s$                                          |
| $61 \pm 19$                                                                                                                                          |      | BARBERIS               | 00H            |     | $450 pp \rightarrow$<br>$\Delta_f^{++} \eta \pi^- p_s$                           |
| $\sim 42$                                                                                                                                            |      | <sup>5</sup> OLLER     | 99 RVUE        |     | $\eta\pi, K\bar{K}$                                                              |
| $\sim 112$                                                                                                                                           |      | <sup>5</sup> OLLER     | 99B RVUE       |     | $\pi\pi \rightarrow \eta\pi, K\bar{K}$                                           |
| $71 \pm 7$                                                                                                                                           |      | TEIGE                  | 99 B852        |     | $18.3 \pi^- p \rightarrow$<br>$\eta \pi^+ \pi^- n$                               |
| $92 \pm 20$                                                                                                                                          |      | <sup>5</sup> ANISOVICH | 98B RVUE       |     | Compilation                                                                      |
| $65 \pm 10$                                                                                                                                          |      | <sup>6</sup> BERTIN    | 98B OBLX $\pm$ |     | $0.0 \bar{p}p \rightarrow K^\pm K_S \pi^\mp$                                     |
| $\sim 100$                                                                                                                                           |      | TORNQVIST              | 96 RVUE        |     | $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi,$<br>$\eta\pi$                        |
| 202                                                                                                                                                  |      | JANSSEN                | 95 RVUE        |     | $\eta\pi \rightarrow \eta\pi, K\bar{K}, K\pi,$<br>$\eta\pi$                      |
| $54.12 \pm 0.34 \pm 0.12$                                                                                                                            |      | AMSLER                 | 94C CBAR       |     | $0.0 \bar{p}p \rightarrow \omega \eta \pi^0$                                     |

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NODE=M036210

NODE=M036W1  
→ UNCHECKED ←

OCCUR=2

|                                                             |      |                           |     |        |                                                |
|-------------------------------------------------------------|------|---------------------------|-----|--------|------------------------------------------------|
| 54 ±10                                                      |      | <sup>7</sup> AMSLER       | 92  | CBAR   | 0.0 $\bar{p}p \rightarrow \eta\eta\pi^0$       |
| 95 ±14                                                      | 1040 | <sup>7</sup> ARMSTRONG    | 91B | OMEG ± | 300 $pp \rightarrow p\rho\eta\pi^+\pi^-$       |
| 62 ±15                                                      | 500  | <sup>8</sup> EVANGELIS... | 81  | OMEG ± | 12 $\pi^- p \rightarrow \eta\pi^+\pi^-\pi^- p$ |
| 60 ±20                                                      | 145  | <sup>8</sup> GURTU        | 79  | HBC ±  | 4.2 $K^- p \rightarrow \Lambda\eta 2\pi$       |
| 60 $\begin{smallmatrix} +50 \\ -30 \end{smallmatrix}$       | 47   | CONFORTO                  | 78  | OSPK - | 4.5 $\pi^- p \rightarrow \rho X^-$             |
| 86.0 $\begin{smallmatrix} +60.0 \\ -50.0 \end{smallmatrix}$ | 50   | CORDEN                    | 78  | OMEG ± | 12-15 $\pi^- p \rightarrow n\eta 2\pi$         |
| 44 ±22                                                      |      | GRASSLER                  | 77  | HBC -  | 16 $\pi^\mp p \rightarrow p\eta 3\pi$          |
| 80 to 300                                                   |      | <sup>9</sup> FLATTE       | 76  | RVUE - | 4.2 $K^- p \rightarrow \Lambda\eta 2\pi$       |
| 16.0 $\begin{smallmatrix} +25.0 \\ -16.0 \end{smallmatrix}$ | 70   | <sup>10</sup> WELLS       | 75  | HBC -  | 3.1-6 $K^- p \rightarrow \Lambda\eta 2\pi$     |
| 30 ± 5                                                      | 150  | <sup>11</sup> DEFOIX      | 72  | HBC ±  | 0.7 $\bar{p}p \rightarrow 7\pi$                |
| 40 ±15                                                      |      | CAMPBELL                  | 69  | DBC ±  | 2.7 $\pi^+ d$                                  |
| 60 ±30                                                      | 15   | MILLER                    | 69B | HBC -  | 4.5 $K^- N \rightarrow \eta\pi\Lambda$         |
| 80 ±30                                                      | 30   | AMMAR                     | 68  | HBC ±  | 5.5 $K^- p \rightarrow \Lambda\eta 2\pi$       |

<sup>1</sup> T-matrix pole with 2 poles, 2 channels, pole width on adjacent sheet  $127.0 \pm 2.3 \pm 6.7$  MeV.

<sup>2</sup> T-matrix pole on sheet II.

<sup>3</sup> From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.

<sup>4</sup> From the T-matrix pole on sheet II, using AMSLER 94D and ABELE 98.

<sup>5</sup> T-matrix pole.

<sup>6</sup> The  $\eta\pi$  width.

<sup>7</sup> From a single Breit-Wigner fit.

<sup>8</sup> From  $f_1(1285)$  decay.

<sup>9</sup> Using a two-channel resonance parametrization of GAY 76B data.

<sup>10</sup> Weak evidence only for  $a_0(980)^+$  production.

<sup>11</sup> This number has very little meaning. Error is much too small. Vlada

### **$K\bar{K}$ ONLY**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | CHG    | COMMENT                                        |
|-------------------------------------------------------------------------------|------|------------------------|------|--------|------------------------------------------------|
| <b><math>92 \pm 8</math></b>                                                  |      | <sup>1</sup> ABELE     | 98   | CBAR   | 0.0 $\bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |      |        |                                                |
| ~ 24                                                                          |      | <sup>2</sup> OLLER     | 99C  | RVUE   | $\pi\pi \rightarrow \pi\pi, K\bar{K}$          |
| ~ 25                                                                          | 100  | <sup>3</sup> ASTIER    | 67   | HBC ±  |                                                |
| 57 ±13                                                                        | 143  | <sup>4</sup> ROSENFELD | 65   | RVUE ± |                                                |

<sup>1</sup> T-matrix pole on sheet II, the pole on sheet III is at 1006-i49 MeV.

<sup>2</sup> T-matrix pole.

<sup>3</sup> ASTIER 67 includes data of BARLOW 67, CONFORTO 67, ARMENTEROS 65.

<sup>4</sup> Plus systematic errors.

### **$a_0(980)$ DECAY MODES**

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $\eta\pi$      | seen                           |
| $\Gamma_2$ $K\bar{K}$     | seen                           |
| $\Gamma_3$ $\eta'\pi$     | seen                           |
| $\Gamma_4$ $\rho\pi$      | not seen                       |
| $\Gamma_5$ $\gamma\gamma$ | seen                           |
| $\Gamma_6$ $e^+e^-$       |                                |

### **$a_0(980)$ PARTIAL WIDTHS**

#### **$\Gamma(\gamma\gamma)$**

| VALUE (keV) | DOCUMENT ID         | TECN    |
|-------------|---------------------|---------|
| 0.30 ± 0.10 | <sup>1</sup> AMSLER | 98 RVUE |

<sup>1</sup> Using  $\Gamma_{\gamma\gamma} B(a_0(980) \rightarrow \eta\pi) = 0.24 \pm 0.08$  keV.

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NODE=M036W2;LINKAGE=S

NODE=M036215;NODE=M036

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DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=8

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=5;OUR EST;→ UNCHECKED ←

DESIG=6

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NODE=M036W4

NODE=M036W4

NODE=M036W4;LINKAGE=A

$a_0(980) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$ 

NODE=M036220

 $\Gamma(\eta\pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$  $\Gamma_1 \Gamma_5 / \Gamma$ 

| VALUE (keV)                                           | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------------------|------|-------------|------|---------|
| <b>0.21 <math>^{+0.08}_{-0.04}</math> OUR AVERAGE</b> |      |             |      |         |

NODE=M036G1  
NODE=M036G1

|                                        |    |                     |     |      |                                          |
|----------------------------------------|----|---------------------|-----|------|------------------------------------------|
| 0.128 $^{+0.003+0.502}_{-0.002-0.043}$ |    | <sup>1</sup> UEHARA | 09A | BELL | $\gamma\gamma \rightarrow \pi^0 \eta$    |
| 0.28 $\pm 0.04 \pm 0.10$               | 44 | OEST                | 90  | JADE | $e^+ e^- \rightarrow e^+ e^- \pi^0 \eta$ |
| 0.19 $\pm 0.07 \pm 0.10$<br>$-0.07$    |    | ANTREASYAN          | 86  | CBAL | $e^+ e^- \rightarrow e^+ e^- \pi^0 \eta$ |

<sup>1</sup> From a fit with the S-wave amplitude including two interfering Breit-Wigners plus a background term.

NODE=M036G1;LINKAGE=UE

 $\Gamma(\eta\pi) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_1 \Gamma_6 / \Gamma$ 

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT                          |
|------------|-----|-------------|------|----------------------------------|
| <1.5       | 90  | VOROBYEV 88 | ND   | $e^+ e^- \rightarrow \pi^0 \eta$ |

NODE=M036G2  
NODE=M036G2 $a_0(980)$  BRANCHING RATIOS

NODE=M036225

 $\Gamma(K\bar{K}) / \Gamma(\eta\pi)$  $\Gamma_2 / \Gamma_1$ 

| VALUE                                                                                | DOCUMENT ID                         | TECN | CHG  | COMMENT                                                                      |
|--------------------------------------------------------------------------------------|-------------------------------------|------|------|------------------------------------------------------------------------------|
| <b>0.183 <math>\pm 0.024</math> OUR AVERAGE</b>                                      | Error includes scale factor of 1.2. |      |      |                                                                              |
| 0.57 $\pm 0.16$                                                                      | <sup>1</sup> BARGIOTTI              | 03   | OBLX | $\bar{p} p$                                                                  |
| 0.23 $\pm 0.05$                                                                      | <sup>2</sup> ABELE                  | 98   | CBAR | $0.0 \bar{p} p \rightarrow K_L^0 K^\pm \pi^\mp$                              |
| 0.166 $\pm 0.01 \pm 0.02$                                                            | <sup>3</sup> BARBERIS               | 98C  | OMEG | $450 p p \rightarrow p_f f_1(1285) p_s$                                      |
| <b>• • • We do not use the following data for averages, fits, limits, etc. • • •</b> |                                     |      |      |                                                                              |
| 0.138 $\pm 0.001 \pm 0.035$                                                          | <sup>4</sup> ALBRECHT               | 20   | CBAR | $0.9 \bar{p} p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| 1.20 $\pm 0.15$                                                                      | <sup>5</sup> ANISOVICH              | 09   | RVUE | $0.0 \bar{p} p, \pi N$                                                       |
| 1.05 $\pm 0.07 \pm 0.05$                                                             | <sup>6</sup> BUGG                   | 08A  | RVUE | $0 \bar{p} p \rightarrow \pi^0 \pi^0 \eta$                                   |
| $\sim 0.60$                                                                          | OLLER                               | 99B  | RVUE | $\pi\pi \rightarrow \eta\pi, K\bar{K}$                                       |
| 0.7 $\pm 0.3$                                                                        | <sup>3</sup> CORDEN                 | 78   | OMEG | $12-15 \pi^- p \rightarrow n \eta 2\pi$                                      |
| 0.25 $\pm 0.08$                                                                      | <sup>3</sup> DEFOIX                 | 72   | HBC  | $\pm 0.7 \bar{p} \rightarrow 7\pi$                                           |

NODE=M036R2  
NODE=M036R2

<sup>1</sup> Coupled channel analysis of  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ , and  $K^\pm K_S^0 \pi^\mp$ .

<sup>2</sup> Using  $\pi^0 \pi^0 \eta$  from AMSLER 94D.

<sup>3</sup> From the decay of  $f_1(1285)$ .

<sup>4</sup> Residues from T-matrix pole with 2 poles, 2 channels. Solution on adjacent sheet  $0.149 \pm 0.001 \pm 0.039$ .

<sup>5</sup> This is a ratio of couplings.

<sup>6</sup> A ratio of couplings, using AMSLER 94D and ABELE 98. Supersedes BUGG 94.

NODE=M036R;LINKAGE=BG  
NODE=M036R2;LINKAGE=Q  
NODE=M036R2;LINKAGE=L  
NODE=M036R2;LINKAGE=ANODE=M036R2;LINKAGE=AN  
NODE=M036R2;LINKAGE=BU $\Gamma(\eta' \pi) / \Gamma_{\text{total}}$  $\Gamma_3 / \Gamma$ 

| VALUE | EVTS | DOCUMENT ID       | TECN | COMMENT                          |
|-------|------|-------------------|------|----------------------------------|
| seen  | 116k | <sup>1</sup> CHEN | 20A  | BELL                             |
|       |      |                   |      | $D^0 \rightarrow K^- \pi^+ \eta$ |

NODE=M036R00  
NODE=M036R00

<sup>1</sup> From an amplitude analysis of the  $D^0 \rightarrow K^- \pi^+ \eta$  decay in a three-channel Flatte model with a  $10.1 \sigma$  significance. Earlier observed by ABLIKIM 17K in the  $\chi_{c1} \rightarrow \eta \pi^+ \pi^-$  decay with a  $8.9 \sigma$  significance.

NODE=M036R00;LINKAGE=A

 $\Gamma(\rho\pi) / \Gamma(\eta\pi)$  $\Gamma_4 / \Gamma_1$ 

| VALUE                                                                                | CL% | DOCUMENT ID        | TECN | CHG | COMMENT                                            |
|--------------------------------------------------------------------------------------|-----|--------------------|------|-----|----------------------------------------------------|
| $\rho\pi$ forbidden.                                                                 |     |                    |      |     |                                                    |
| <b>• • • We do not use the following data for averages, fits, limits, etc. • • •</b> |     |                    |      |     |                                                    |
| <0.25                                                                                | 70  | <sup>1</sup> AMMAR | 70   | HBC | $\pm 4.1, 5.5 K^- p \rightarrow \Lambda \eta 2\pi$ |

NODE=M036R1  
NODE=M036R1  
NODE=M036R1

<sup>1</sup> Not clear if they really observed the  $a_0(980)$  3 standard deviations.

NODE=M036R1;LINKAGE=01

 $a_0(980)$  REFERENCES

NODE=M036

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| ALBRECHT  | 20  | EPJ C80 453    | M. Albrecht <i>et al.</i>      | (Crystal Barrel Collab.) |
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| LU        | 20  | EPJ C80 436    | J. Lu, B. Moussallam           |                          |
| AAIJ      | 19H | JHEP 1904 063  | R. Aaij <i>et al.</i>          | (LHCb Collab.)           |
| AOUDE     | 18  | PR D98 056021  | R.T. Aoude <i>et al.</i>       |                          |
| ABLIKIM   | 17K | PR D95 032002  | M. Ablikim <i>et al.</i>       | (BESIII Collab.)         |
| AAIJ      | 16N | PR D93 052018  | R. Aaij <i>et al.</i>          | (LHCb Collab.)           |
| AMBROSINO | 09F | PL B681 5      | F. Ambrosino <i>et al.</i>     | (KLOE Collab.)           |
| ANISOVICH | 09  | IJMP A24 2481  | V.V. Anisovich, A.V. Sarantsev |                          |
| UEHARA    | 09A | PR D80 032001  | S. Uehara <i>et al.</i>        | (BELLE Collab.)          |
| BUGG      | 08A | PR D78 074023  | D.V. Bugg                      | (LOQM)                   |
| PELAEZ    | 04A | MPL A19 2879   | J.R. Pelaez                    | (MADU)                   |
| ACHASOV   | 03B | PR D68 014006  | N.N. Achasov, A.V. Kiselev     |                          |
| BARGIOTTI | 03  | EPJ C26 371    | M. Bargiotti <i>et al.</i>     | (OBELIX Collab.)         |

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REFID=60436  
REFID=59670  
REFID=59987  
REFID=57953  
REFID=57273  
REFID=53105  
REFID=52719  
REFID=53002  
REFID=52578  
REFID=50347  
REFID=49476  
REFID=49217

|              |     |                                                             |                               |                           |             |
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| ACHARD       | 02B | PL B526 269                                                 | P. Achard <i>et al.</i>       | (L3 Collab.)              | REFID=48574 |
| ACHASOV      | 00F | PL B479 53                                                  | M.N. Achasov <i>et al.</i>    | (Novosibirsk SND Collab.) | REFID=47928 |
| BARBERIS     | 00H | PL B488 225                                                 | D. Barberis <i>et al.</i>     | (WA 102 Collab.)          | REFID=47964 |
| OLLER        | 99  | PR D60 099906 (erratum)                                     | J.A. Oller <i>et al.</i>      |                           | REFID=46899 |
| OLLER        | 99B | NP A652 407 (erratum)                                       | J.A. Oller, E. Oset           |                           | REFID=46924 |
| OLLER        | 99C | PR D60 074023                                               | J.A. Oller, E. Oset           |                           | REFID=47386 |
| TEIGE        | 99  | PR D59 012001                                               | S. Teige <i>et al.</i>        | (BNL E852 Collab.)        | REFID=46613 |
| ABELE        | 98  | PR D57 3860                                                 | A. Abele <i>et al.</i>        | (Crystal Barrel Collab.)  | REFID=45863 |
| ACHASOV      | 98B | PL B438 441                                                 | M.N. Achasov <i>et al.</i>    | (Novosibirsk SND Collab.) | REFID=46317 |
| AMSLER       | 98  | RMP 70 1293                                                 | C. Amsler                     |                           | REFID=46601 |
| ANISOVICH    | 98B | SPU 41 419                                                  | V.V. Anisovich <i>et al.</i>  |                           | REFID=46331 |
|              |     | Translated from UFN 168 481.                                |                               |                           |             |
| BARBERIS     | 98C | PL B440 225                                                 | D. Barberis <i>et al.</i>     | (WA 102 Collab.)          | REFID=46346 |
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| TORNQVIST    | 96  | PRL 76 1575                                                 | N.A. Tornqvist, M. Roos       | (HELS)                    | REFID=44507 |
| JANSSEN      | 95  | PR D52 2690                                                 | G. Janssen <i>et al.</i>      | (STON, ADLD, JULI)        | REFID=44508 |
| AMSLER       | 94C | PL B327 425                                                 | C. Amsler <i>et al.</i>       | (Crystal Barrel Collab.)  | REFID=44091 |
| AMSLER       | 94D | PL B333 277                                                 | C. Amsler <i>et al.</i>       | (Crystal Barrel Collab.)  | REFID=44093 |
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| ARMSTRONG    | 91B | ZPHY C52 389                                                | T.A. Armstrong <i>et al.</i>  | (ATHU, BARI, BIRM+)       | REFID=41862 |
| OEST         | 90  | ZPHY C47 343                                                | T. Oest <i>et al.</i>         | (JADE Collab.)            | REFID=41358 |
| ACHASOV      | 89  | NP B315 465                                                 | N.N. Achasov, V.N. Ivanchenko |                           | REFID=48021 |
| ASTON        | 88  | NP B296 493                                                 | D. Aston <i>et al.</i>        | (SLAC, NAGO, CINC, INUS)  | REFID=40262 |
| VOROBYEV     | 88  | SJNP 48 273                                                 | P.V. Vorobiev <i>et al.</i>   | (NOVO)                    | REFID=41023 |
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| ANTREASYAN   | 86  | PR D33 1847                                                 | D. Antreasyan <i>et al.</i>   | (Crystal Ball Collab.)    | REFID=20469 |
| ATKINSON     | 84E | PL 138B 459                                                 | M. Atkinson <i>et al.</i>     | (BONN, CERN, GLAS+)       | REFID=20624 |
| EVANGELIS... | 81  | NP B178 197                                                 | C. Evangelista <i>et al.</i>  | (BARI, BONN, CERN+)       | REFID=20462 |
| DEBILLY      | 80  | NP B176 1                                                   | L. de Billy <i>et al.</i>     | (CURIN, LAUS, NEUC+)      | REFID=20461 |
| GURTU        | 79  | NP B151 181                                                 | A. Gurtu <i>et al.</i>        | (CERN, ZEEM, NIJM, OXF)   | REFID=20456 |
| CONFORTO     | 78  | LNC 23 419                                                  | B. Conforto <i>et al.</i>     | (RHEL, TINTO, CHIC+)      | REFID=20451 |
| CORDEN       | 78  | NP B144 253                                                 | M.J. Corden <i>et al.</i>     | (BIRM, RHEL, TELA+)       | REFID=20452 |
| ESTABROOKS   | 78  | NP B133 490                                                 | P.G. Estabrooks <i>et al.</i> | (MCGI, CARL, DURH+)       | REFID=22443 |
| GRASSLER     | 77  | NP B121 189                                                 | H. Grassler <i>et al.</i>     | (AACH3, BERL, BONN+)      | REFID=20447 |
| JAFFE        | 77  | PR D15 267,281                                              | R. Jaffe                      | (MIT)                     | REFID=43673 |
| FLATTE       | 76  | PL 63B 224                                                  | S.M. Flatte                   | (CERN)                    | REFID=20446 |
| GAY          | 76B | PL 63B 220                                                  | J.B. Gay <i>et al.</i>        | (CERN, AMST, NIJM) JP     | REFID=20445 |
| WELLS        | 75  | NP B101 333                                                 | J. Wells <i>et al.</i>        | (OXF)                     | REFID=20444 |
| LINGLIN      | 73  | NP B55 408                                                  | D. Linglin                    | (CERN)                    | REFID=22428 |
| DEFOIX       | 72  | NP B44 125                                                  | C. Defoix <i>et al.</i>       | (CDEF, CERN)              | REFID=20435 |
| AMMAR        | 70  | PR D2 430                                                   | R. Ammar <i>et al.</i>        | (KANS, NWES, ANL, WISC)   | REFID=20428 |
| BARNES       | 69C | PRL 23 610                                                  | V.E. Barnes <i>et al.</i>     | (BNL, SYRA)               | REFID=20418 |
| CAMPBELL     | 69  | PRL 22 1204                                                 | J.H. Campbell <i>et al.</i>   | (PURD)                    | REFID=20419 |
| MILLER       | 69B | PL 29B 255                                                  | D.H. Miller <i>et al.</i>     | (PURD)                    | REFID=20424 |
| Also         |     | PR 188 2011                                                 | W.L. Yen <i>et al.</i>        | (PURD)                    | REFID=20425 |
| AMMAR        | 68  | PRL 21 1832                                                 | R. Ammar <i>et al.</i>        | (NWES, ANL)               | REFID=20412 |
| ASTIER       | 67  | PL 25B 294                                                  | A. Astier <i>et al.</i>       | (CDEF, CERN, IRAD)        | REFID=20405 |
|              |     | Includes data of BARLOW 67, CONFORTO 67, and ARMENTEROS 65. |                               |                           |             |
| BARLOW       | 67  | NC 50A 701                                                  | J. Barlow <i>et al.</i>       | (CERN, CDEF, IRAD, LIVP)  | REFID=20041 |
| CONFORTO     | 67  | NP B3 469                                                   | G. Conforto <i>et al.</i>     | (CERN, CDEF, IPNP+)       | REFID=20411 |
| ARMENTEROS   | 65  | PL 17 344                                                   | R. Armenteros <i>et al.</i>   | (CERN, CDEF)              | REFID=20396 |
| ROSENFELD    | 65  | Oxford Conf. 58                                             | A.H. Rosenfeld                | (LRL)                     | REFID=20399 |



$\phi(1020)$ 

$$J^{PC} = 0^{-}(1^{-})$$

NODE=M004

 $\phi(1020)$  MASS

NODE=M004M

NODE=M004M

| VALUE (MeV)                                                                   | EVTs  | DOCUMENT ID                 | TECN     | COMMENT                                               |
|-------------------------------------------------------------------------------|-------|-----------------------------|----------|-------------------------------------------------------|
| <b>1019.461±0.016 OUR AVERAGE</b>                                             |       |                             |          |                                                       |
| 1019.463±0.061                                                                | 2.3M  | <sup>1</sup> KOZYREV        | 18 CMD3  | $e^+e^- \rightarrow K^+K^-, K_S^0 K_L^0$              |
| 1019.462±0.042±0.056                                                          | 28k   | <sup>2</sup> LEES           | 14H BABR | $e^+e^- \rightarrow K_S^0 K_L^0 \gamma$               |
| 1019.51 ±0.02 ±0.05                                                           |       | <sup>3</sup> LEES           | 13Q BABR | $e^+e^- \rightarrow K^+K^-\gamma$                     |
| 1019.30 ±0.02 ±0.10                                                           | 105k  | AKHMETSHIN 06               | CMD2     | $0.98-1.06 e^+e^- \rightarrow \pi^+\pi^-\pi^0$        |
| 1019.52 ±0.05 ±0.05                                                           | 17.4k | AKHMETSHIN 05               | CMD2     | $0.60-1.38 e^+e^- \rightarrow \eta\gamma$             |
| 1019.483±0.011±0.025                                                          | 272k  | <sup>4</sup> AKHMETSHIN 04  | CMD2     | $e^+e^- \rightarrow K_L^0 K_S^0$                      |
| 1019.42 ±0.05                                                                 | 1900k | <sup>5</sup> ACHASOV        | 01E SND  | $e^+e^- \rightarrow K^+K^-, K_S K_L, \pi^+\pi^-\pi^0$ |
| 1019.40 ±0.04 ±0.05                                                           | 23k   | AKHMETSHIN 01B              | CMD2     | $e^+e^- \rightarrow \eta\gamma$                       |
| 1019.36 ±0.12                                                                 |       | <sup>6</sup> ACHASOV        | 00B SND  | $e^+e^- \rightarrow \eta\gamma$                       |
| 1019.38 ±0.07 ±0.08                                                           | 2200  | <sup>7</sup> AKHMETSHIN 99F | CMD2     | $e^+e^- \rightarrow \pi^+\pi^-\geq 2\gamma$           |
| 1019.51 ±0.07 ±0.10                                                           | 11169 | AKHMETSHIN 98               | CMD2     | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                  |
| 1019.5 ±0.4                                                                   |       | BARBERIS                    | 98 OMEG  | $450 pp \rightarrow pp2K^+2K^-$                       |
| 1019.42 ±0.06                                                                 | 55600 | AKHMETSHIN 95               | CMD2     | $e^+e^- \rightarrow \text{hadrons}$                   |
| 1019.7 ±0.3                                                                   | 2012  | DAVENPORT                   | 86 MPSF  | $400 pA \rightarrow 4KX$                              |
| 1019.7 ±0.1 ±0.1                                                              | 5079  | ALBRECHT                    | 85D ARG  | $10 e^+e^- \rightarrow K^+K^-X$                       |
| 1019.3 ±0.1                                                                   | 1500  | ARENTON                     | 82 AEMS  | $11.8 \text{ polar. } pp \rightarrow KK$              |
| 1019.67 ±0.17                                                                 | 25080 | <sup>8</sup> PELLINEN       | 82 RVUE  |                                                       |
| 1019.52 ±0.13                                                                 | 3681  | BUKIN                       | 78C OLYA | $e^+e^- \rightarrow \text{hadrons}$                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                             |          |                                                       |
| 1018.4 ±0.5 ±0.1                                                              |       | <sup>9</sup> ALBRECHT       | 20 CBAR  | $0.9 \bar{p}p \rightarrow K^+K^-\pi^0$                |
| 1019.21 ±0.04 ±0.03                                                           |       | <sup>10</sup> HOID          | 20 RVUE  | $e^+e^- \rightarrow \pi^0\gamma$                      |
| 1019.54 ±0.10 ±0.51                                                           |       | <sup>11</sup> AAIJ          | 19H LHCB | $pp \rightarrow D^\pm X$                              |
| 1019.20 ±0.02 ±0.01                                                           |       | <sup>12</sup> HOFERICH...   | 19 RVUE  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                  |
| 1019.469±0.061                                                                | 1.7M  | KOZYREV                     | 18 CMD3  | $e^+e^- \rightarrow K^+K^-$                           |
| 1019.457±0.061                                                                | 610k  | KOZYREV                     | 16 CMD3  | $e^+e^- \rightarrow K_S^0 K_L^0$                      |
| 1019.48 ±0.01                                                                 |       | LEES                        | 13F BABR | $D^+ \rightarrow K^+K^-\pi^+$                         |
| 1019.441±0.008±0.080                                                          | 542k  | <sup>13</sup> AKHMETSHIN 08 | CMD2     | $1.02 e^+e^- \rightarrow K^+K^-$                      |
| 1019.63 ±0.07                                                                 | 12540 | <sup>14</sup> AUBERT,B      | 05J BABR | $D^0 \rightarrow \bar{K}^0 K^+ K^-$                   |
| 1019.8 ±0.7                                                                   |       | ARMSTRONG                   | 86 OMEG  | $85 \pi^+/pp \rightarrow \pi^+/p4Kp$                  |
| 1020.1 ±0.11                                                                  | 5526  | <sup>14</sup> ATKINSON      | 86 OMEG  | $20-70 \gamma p$                                      |
| 1019.7 ±1.0                                                                   |       | BEBEK                       | 86 CLEO  | $e^+e^- \rightarrow \Upsilon(4S)$                     |
| 1019.411±0.008                                                                | 642k  | <sup>15</sup> DIJKSTRA      | 86 SPEC  | $100-200 \pi^\pm, \bar{p}, p, K^\pm, \text{ on Be}$   |
| 1020.9 ±0.2                                                                   |       | <sup>14</sup> FRAME         | 86 OMEG  | $13 K^+p \rightarrow \phi K^+p$                       |
| 1021.0 ±0.2                                                                   |       | <sup>14</sup> ARMSTRONG     | 83B OMEG | $18.5 K^-p \rightarrow K^-K^+\Lambda$                 |
| 1020.0 ±0.5                                                                   |       | <sup>14</sup> ARMSTRONG     | 83B OMEG | $18.5 K^-p \rightarrow K^-K^+\Lambda$                 |
| 1019.7 ±0.3                                                                   |       | <sup>14</sup> BARATE        | 83 GOLI  | $190 \pi^- \text{Be} \rightarrow 2\mu X$              |
| 1019.8 ±0.2 ±0.5                                                              | 766   | IVANOV                      | 81 OLYA  | $1-1.4 e^+e^- \rightarrow K^+K^-$                     |
| 1019.4 ±0.5                                                                   | 337   | COOPER                      | 78B HBC  | $0.7-0.8 \bar{p}p \rightarrow K_S^0 K_L^0 \pi^+\pi^-$ |
| 1020 ±1                                                                       | 383   | <sup>14</sup> BALDI         | 77 CNTR  | $10 \pi^-p \rightarrow \pi^- \phi p$                  |
| 1018.9 ±0.6                                                                   | 800   | COHEN                       | 77 ASPK  | $6 \pi^\pm N \rightarrow K^+K^-N$                     |
| 1019.7 ±0.5                                                                   | 454   | KALBFLEISCH                 | 76 HBC   | $2.18 K^-p \rightarrow \Lambda K \bar{K}$             |
| 1019.4 ±0.8                                                                   | 984   | BESCH                       | 74 CNTR  | $2 \gamma p \rightarrow pK^+K^-$                      |
| 1020.3 ±0.4                                                                   | 100   | BALLAM                      | 73 HBC   | $2.8-9.3 \gamma p$                                    |
| 1019.4 ±0.7                                                                   |       | BINNIE                      | 73B CNTR | $\pi^-p \rightarrow \phi n$                           |
| 1019.6 ±0.5                                                                   | 120   | <sup>16</sup> AGUILAR-...   | 72B HBC  | $3.9, 4.6 K^-p \rightarrow \Lambda K^+K^-$            |

OCCUR=2

OCCUR=2

OCCUR=2

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|             |     |                           |     |     |                                                    |
|-------------|-----|---------------------------|-----|-----|----------------------------------------------------|
| 1019.9 ±0.5 | 100 | <sup>16</sup> AGUILAR-... | 72B | HBC | 3.9,4.6 $K^- p \rightarrow K^- p K^+ K^-$          |
| 1020.4 ±0.5 | 131 | COLLEY                    | 72  | HBC | 10 $K^+ p \rightarrow K^+ p \phi$                  |
| 1019.9 ±0.3 | 410 | STOTTLE...                | 71  | HBC | 2.9 $K^- p \rightarrow \Sigma / \Lambda K \bar{K}$ |

OCCUR=2

- <sup>1</sup> Average of KOZYREV 16 and KOZYREV 18 values taking into account the correlated uncertainties. Supersedes individual KOZYREV 16 and KOZYREV 18 results.
- <sup>2</sup> Using a vector meson dominance model with contribution from  $\phi(1020)$  and higher mass excitations of  $\rho(770)$ ,  $\omega(782)$ , and  $\phi(1020)$ .
- <sup>3</sup> Using a phenomenological model based on KUHN 90 with a sum of Breit-Wigner resonances for  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$  and their higher mass excitations.
- <sup>4</sup> Update of AKHMETSHIN 99D
- <sup>5</sup> From the combined fit assuming that the total  $\phi(1020)$  production cross section is saturated by those of  $K^+ K^-$ ,  $K_S K_L$ ,  $\pi^+ \pi^- \pi^0$ , and  $\eta \gamma$  decays modes and using ACHASOV 00B for the  $\eta \gamma$  decay mode.
- <sup>6</sup> Using a total width of  $4.43 \pm 0.05$  MeV. Systematic uncertainty included.
- <sup>7</sup> Using a total width of  $4.43 \pm 0.05$  MeV.
- <sup>8</sup> PELLINEN 82 review includes AKERLOF 77, DAUM 81, BALDI 77, AYRES 74, DE-GROOT 74.
- <sup>9</sup> Width fixed at 4.2 MeV.
- <sup>10</sup> The values were extracted from a dispersively improved Breit-Wigner parameterization and do not include vacuum polarization. Inclusion of vacuum polarization gives  $1019.457 \pm 0.020$  MeV.
- <sup>11</sup> From the  $D^\pm \rightarrow K^\pm K^+ K^-$  Dalitz plot fit with the Triple-M amplitude in the multi-meson model of AOUDE 18.
- <sup>12</sup> The values were extracted from a dispersively improved Breit-Wigner parameterization and do not include vacuum polarization.
- <sup>13</sup> Strongly correlated with AKHMETSHIN 04.
- <sup>14</sup> Systematic errors not evaluated.
- <sup>15</sup> Weighted and scaled average of 12 measurements of DIJKSTRA 86.
- <sup>16</sup> Mass errors enlarged by us to  $\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

NODE=M004M;LINKAGE=G

NODE=M004M;LINKAGE=E

NODE=M004M;LINKAGE=C

NODE=M004M;LINKAGE=GS  
 NODE=M004M;LINKAGE=AE

NODE=M004M;LINKAGE=G2  
 NODE=M004M;LINKAGE=F2  
 NODE=M004M;LINKAGE=R

NODE=M004M;LINKAGE=J  
 NODE=M004M;LINKAGE=M

NODE=M004M;LINKAGE=I

NODE=M004M;LINKAGE=N

NODE=M004M;LINKAGE=AH  
 NODE=M004M;LINKAGE=A  
 NODE=M004M;LINKAGE=B  
 NODE=M004M;LINKAGE=D

 **$\phi(1020)$  WIDTH**

NODE=M004W

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID                         | TECN | COMMENT                                                                                           |
|-------------------------------------------------------------------------------|-------|-------------------------------------|------|---------------------------------------------------------------------------------------------------|
| <b>4.249±0.013 OUR AVERAGE</b>                                                |       | Error includes scale factor of 1.1. |      |                                                                                                   |
| 4.245±0.013                                                                   | 2.3M  | <sup>1</sup> KOZYREV                | 18   | CMD3 $e^+ e^- \rightarrow K^+ K^-$ , $K_S^0 K_L^0$                                                |
| 4.205±0.103±0.067                                                             | 28k   | <sup>2</sup> LEES                   | 14H  | BABR $e^+ e^- \rightarrow K_S^0 K_L^0 \gamma$                                                     |
| 4.29 ±0.04 ±0.07                                                              |       | <sup>3</sup> LEES                   | 13Q  | BABR $e^+ e^- \rightarrow K^+ K^- \gamma$                                                         |
| 4.30 ±0.06 ±0.17                                                              | 105k  | AKHMETSHIN 06                       | CMD2 | 0.98–1.06 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                                                 |
| 4.280±0.033±0.025                                                             | 272k  | <sup>4</sup> AKHMETSHIN 04          | CMD2 | $e^+ e^- \rightarrow K_L^0 K_S^0$                                                                 |
| 4.21 ±0.04                                                                    | 1900k | <sup>5</sup> ACHASOV                | 01E  | SND $e^+ e^- \rightarrow K^+ K^-$ , $K_S K_L$ , $\pi^+ \pi^- \pi^0$                               |
| 4.44 ±0.09                                                                    | 55600 | AKHMETSHIN 95                       | CMD2 | $e^+ e^- \rightarrow$ hadrons                                                                     |
| 4.5 ±0.7                                                                      | 1500  | ARENTON                             | 82   | AEMS 11.8 polar. $pp \rightarrow K K$                                                             |
| 4.2 ±0.6                                                                      | 766   | <sup>6</sup> IVANOV                 | 81   | OLYA 1–1.4 $e^+ e^- \rightarrow K^+ K^-$                                                          |
| 4.3 ±0.6                                                                      |       | <sup>6</sup> CORDIER                | 80   | DM1 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                                                       |
| 4.36 ±0.29                                                                    | 3681  | <sup>6</sup> BUKIN                  | 78C  | OLYA $e^+ e^- \rightarrow$ hadrons                                                                |
| 4.4 ±0.6                                                                      | 984   | <sup>6</sup> BESCH                  | 74   | CNTR $2 \gamma p \rightarrow p K^+ K^-$                                                           |
| 4.67 ±0.72                                                                    | 681   | <sup>6</sup> BALAKIN                | 71   | OSPK $e^+ e^- \rightarrow$ hadrons                                                                |
| 4.09 ±0.29                                                                    |       | BIZOT                               | 70   | OSPK $e^+ e^- \rightarrow$ hadrons                                                                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                                     |      |                                                                                                   |
| 4.07 ±0.13 ±0.01                                                              |       | <sup>7</sup> HOID                   | 20   | RVUE $e^+ e^- \rightarrow \pi^0 \gamma$                                                           |
| 4.23 ±0.04 ±0.02                                                              |       | <sup>8</sup> HOFERICH...            | 19   | RVUE $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                                                      |
| 4.249±0.015                                                                   | 1.7M  | KOZYREV                             | 18   | CMD3 $e^+ e^- \rightarrow K^+ K^-$                                                                |
| 4.240±0.017                                                                   | 610k  | KOZYREV                             | 16   | CMD3 $e^+ e^- \rightarrow K_S^0 K_L^0$                                                            |
| 4.37 ±0.02                                                                    |       | LEES                                | 13F  | BABR $D^+ \rightarrow K^+ K^- \pi^+$                                                              |
| 4.24 ±0.02 ±0.03                                                              | 542k  | <sup>9</sup> AKHMETSHIN 08          | CMD2 | 1.02 $e^+ e^- \rightarrow K^+ K^-$                                                                |
| 4.28 ±0.13                                                                    | 12540 | <sup>10</sup> AUBERT,B              | 05J  | BABR $D^0 \rightarrow \bar{K}^0 K^+ K^-$                                                          |
| 4.45 ±0.06                                                                    | 271k  | DIJKSTRA                            | 86   | SPEC 100 $\pi^-$ Be                                                                               |
| 3.6 ±0.8                                                                      | 337   | <sup>6</sup> COOPER                 | 78B  | HBC $0.7\text{--}0.8 \bar{p} p \rightarrow K_S^0 K_L^0 \pi^+ \pi^-$                               |
| 4.5 ±0.50                                                                     | 1300  | <sup>6,10</sup> AKERLOF             | 77   | SPEC 400 $p A \rightarrow K^+ K^- X$                                                              |
| 4.5 ±0.8                                                                      | 500   | <sup>6,10</sup> AYRES               | 74   | ASPK $3\text{--}6 \pi^- p \rightarrow K^+ K^- n$ , $K^- p \rightarrow K^+ K^- \Lambda / \Sigma^0$ |
| 3.81 ±0.37                                                                    |       | COSME                               | 74B  | OSPK $e^+ e^- \rightarrow K_L^0 K_S^0$                                                            |
| 3.8 ±0.7                                                                      | 454   | <sup>6</sup> BORENSTEIN             | 72   | HBC $2.18 K^- p \rightarrow K \bar{K} n$                                                          |

NODE=M004W

OCCUR=2

- <sup>1</sup> Average of KOZYREV 16 and KOZYREV 18 values taking into account the correlated uncertainties. Supersedes individual KOZYREV 16 and KOZYREV 18 results.
- <sup>2</sup> Using a vector meson dominance model with contribution from  $\phi(1020)$  and higher mass excitations of  $\rho(770)$ ,  $\omega(782)$ , and  $\phi(1020)$ .
- <sup>3</sup> Using a phenomenological model based on KUHN 90 with a sum of Breit-Wigner resonances for  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$  and their higher mass excitations.
- <sup>4</sup> Update of AKHMETSHIN 99D
- <sup>5</sup> From the combined fit assuming that the total  $\phi(1020)$  production cross section is saturated by those of  $K^+K^-$ ,  $K_S K_L$ ,  $\pi^+\pi^-\pi^0$ , and  $\eta\gamma$  decays modes and using ACHASOV 00B for the  $\eta\gamma$  decay mode.
- <sup>6</sup> Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.
- <sup>7</sup> The values were extracted from a dispersively improved Breit-Wigner parameterization.
- <sup>8</sup> The values were extracted from a dispersively improved Breit-Wigner parameterization and do not include vacuum polarization.
- <sup>9</sup> Strongly correlated with AKHMETSHIN 04.
- <sup>10</sup> Systematic errors not evaluated.

NODE=M004W;LINKAGE=G

NODE=M004W;LINKAGE=E

NODE=M004W;LINKAGE=C

NODE=M004W;LINKAGE=GS

NODE=M004W;LINKAGE=AE

NODE=M004W;LINKAGE=D

NODE=M004W;LINKAGE=I

NODE=M004W;LINKAGE=K

NODE=M004W;LINKAGE=AH

NODE=M004W;LINKAGE=A

NODE=M004215;NODE=M004

 **$\phi(1020)$  DECAY MODES**

|               | Mode                              | Fraction ( $\Gamma_i/\Gamma$ )               | Scale factor/<br>Confidence level |
|---------------|-----------------------------------|----------------------------------------------|-----------------------------------|
| $\Gamma_1$    | $K^+ K^-$                         | (49.2 $\pm$ 0.5 ) %                          | S=1.3                             |
| $\Gamma_2$    | $K_L^0 K_S^0$                     | (34.0 $\pm$ 0.4 ) %                          | S=1.3                             |
| $\Gamma_3$    | $\rho\pi + \pi^+\pi^-\pi^0$       | (15.24 $\pm$ 0.33 ) %                        | S=1.2                             |
| $\Gamma_4$    | $\rho\pi$                         |                                              |                                   |
| $\Gamma_5$    | $\pi^+\pi^-\pi^0$                 |                                              |                                   |
| $\Gamma_6$    | $\eta\gamma$                      | ( 1.303 $\pm$ 0.025 ) %                      | S=1.2                             |
| $\Gamma_7$    | $\pi^0\gamma$                     | ( 1.32 $\pm$ 0.06 ) $\times 10^{-3}$         |                                   |
| $\Gamma_8$    | $\ell^+\ell^-$                    | —                                            |                                   |
| $\Gamma_9$    | $e^+e^-$                          | ( 2.974 $\pm$ 0.034 ) $\times 10^{-4}$       | S=1.3                             |
| $\Gamma_{10}$ | $\mu^+\mu^-$                      | ( 2.86 $\pm$ 0.19 ) $\times 10^{-4}$         |                                   |
| $\Gamma_{11}$ | $\eta e^+e^-$                     | ( 1.08 $\pm$ 0.04 ) $\times 10^{-4}$         |                                   |
| $\Gamma_{12}$ | $\pi^+\pi^-$                      | ( 7.3 $\pm$ 1.3 ) $\times 10^{-5}$           |                                   |
| $\Gamma_{13}$ | $\omega\pi^0$                     | ( 4.7 $\pm$ 0.5 ) $\times 10^{-5}$           |                                   |
| $\Gamma_{14}$ | $\omega\gamma$                    | < 5 %                                        | CL=84%                            |
| $\Gamma_{15}$ | $\rho\gamma$                      | < 1.2 $\times 10^{-5}$                       | CL=90%                            |
| $\Gamma_{16}$ | $\pi^+\pi^-\gamma$                | ( 4.1 $\pm$ 1.3 ) $\times 10^{-5}$           |                                   |
| $\Gamma_{17}$ | $f_0(980)\gamma$                  | ( 3.22 $\pm$ 0.19 ) $\times 10^{-4}$         | S=1.1                             |
| $\Gamma_{18}$ | $\pi^0\pi^0\gamma$                | ( 1.12 $\pm$ 0.06 ) $\times 10^{-4}$         |                                   |
| $\Gamma_{19}$ | $\pi^+\pi^-\pi^+\pi^-$            | ( 3.9 $^{+2.8}_{-2.2}$ ) $\times 10^{-6}$    |                                   |
| $\Gamma_{20}$ | $\pi^+\pi^+\pi^-\pi^-\pi^0$       | < 4.6 $\times 10^{-6}$                       | CL=90%                            |
| $\Gamma_{21}$ | $\pi^0 e^+ e^-$                   | ( 1.33 $^{+0.07}_{-0.10}$ ) $\times 10^{-5}$ |                                   |
| $\Gamma_{22}$ | $\pi^0\eta\gamma$                 | ( 7.27 $\pm$ 0.30 ) $\times 10^{-5}$         | S=1.5                             |
| $\Gamma_{23}$ | $a_0(980)\gamma$                  | ( 7.6 $\pm$ 0.6 ) $\times 10^{-5}$           |                                   |
| $\Gamma_{24}$ | $K^0\bar{K}^0\gamma$              | < 1.9 $\times 10^{-8}$                       | CL=90%                            |
| $\Gamma_{25}$ | $\eta'(958)\gamma$                | ( 6.22 $\pm$ 0.21 ) $\times 10^{-5}$         |                                   |
| $\Gamma_{26}$ | $\eta\pi^0\pi^0\gamma$            | < 2 $\times 10^{-5}$                         | CL=90%                            |
| $\Gamma_{27}$ | $\mu^+\mu^-\gamma$                | ( 1.4 $\pm$ 0.5 ) $\times 10^{-5}$           |                                   |
| $\Gamma_{28}$ | $\rho\gamma\gamma$                | < 1.2 $\times 10^{-4}$                       | CL=90%                            |
| $\Gamma_{29}$ | $\eta\pi^+\pi^-$                  | < 1.8 $\times 10^{-5}$                       | CL=90%                            |
| $\Gamma_{30}$ | $\eta\mu^+\mu^-$                  | < 9.4 $\times 10^{-6}$                       | CL=90%                            |
| $\Gamma_{31}$ | $\eta U \rightarrow \eta e^+ e^-$ | < 1 $\times 10^{-6}$                         | CL=90%                            |
| $\Gamma_{32}$ | invisible                         | < 1.7 $\times 10^{-4}$                       | CL=90%                            |

DESIG=1

DESIG=2

DESIG=24

DESIG=16

DESIG=3

DESIG=4

DESIG=7

DESIG=256;OUR EVAL; $\rightarrow$  UNCHECKED  $\leftarrow$ 

DESIG=5

DESIG=6

DESIG=17

DESIG=8

DESIG=25

DESIG=10

DESIG=12

DESIG=9

DESIG=20

DESIG=19

DESIG=15

DESIG=14

DESIG=21

DESIG=22

DESIG=23

DESIG=257

DESIG=194

DESIG=195

DESIG=196

DESIG=250

DESIG=255

DESIG=26

DESIG=259

DESIG=260

**Lepton Family number (LF) violating modes**

|               |                |        |                  |        |
|---------------|----------------|--------|------------------|--------|
| $\Gamma_{33}$ | $e^\pm\mu^\mp$ | LF < 2 | $\times 10^{-6}$ | CL=90% |
|---------------|----------------|--------|------------------|--------|

NODE=M004;CLUMP=A

DESIG=258

## CONSTRAINED FIT INFORMATION

An overall fit to 30 branching ratios uses 81 measurements and one constraint to determine 14 parameters. The overall fit has a  $\chi^2 = 63.1$  for 68 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |          |          |          |       |       |       |          |          |          |          |
|----------|----------|----------|----------|-------|-------|-------|----------|----------|----------|----------|
| $x_2$    | -78      |          |          |       |       |       |          |          |          |          |
| $x_3$    | -59      | -4       |          |       |       |       |          |          |          |          |
| $x_6$    | -23      | 19       | 6        |       |       |       |          |          |          |          |
| $x_7$    | -13      | 12       | 4        | 9     |       |       |          |          |          |          |
| $x_9$    | 54       | -52      | -17      | -38   | -23   |       |          |          |          |          |
| $x_{10}$ | -7       | 7        | 2        | 5     | 3     | -13   |          |          |          |          |
| $x_{12}$ | -3       | 3        | 1        | 2     | 1     | -6    | 1        |          |          |          |
| $x_{13}$ | -5       | 4        | 1        | 3     | 2     | -8    | 1        | 1        |          |          |
| $x_{17}$ | 0        | 0        | 0        | 0     | 0     | 0     | 0        | 0        | 0        |          |
| $x_{18}$ | -11      | 10       | 3        | 19    | 5     | -20   | 2        | 1        | 2        | 0        |
| $x_{19}$ | -1       | 1        | 0        | 1     | 0     | -2    | 0        | 0        | 0        | 0        |
| $x_{23}$ | 0        | 0        | 0        | 0     | 0     | 0     | 0        | 0        | 0        | 0        |
| $x_{25}$ | -8       | 6        | 2        | 33    | 3     | -12   | 2        | 1        | 1        | 0        |
|          | $x_1$    | $x_2$    | $x_3$    | $x_6$ | $x_7$ | $x_9$ | $x_{10}$ | $x_{12}$ | $x_{13}$ | $x_{17}$ |
| $x_{19}$ | 0        |          |          |       |       |       |          |          |          |          |
| $x_{23}$ | 0        | 0        |          |       |       |       |          |          |          |          |
| $x_{25}$ | 6        | 0        | 0        |       |       |       |          |          |          |          |
|          | $x_{18}$ | $x_{19}$ | $x_{23}$ |       |       |       |          |          |          |          |

## $\phi(1020)$ PARTIAL WIDTHS

### $\Gamma(\eta\gamma)$

VALUE (keV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

$58.9 \pm 0.5 \pm 2.4$  ACHASOV 00 SND  $e^+e^- \rightarrow \eta\gamma$

$\Gamma_6$

NODE=M004218

NODE=M004W6  
NODE=M004W6

### $\Gamma(\pi^0\gamma)$

VALUE (keV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

$5.40 \pm 0.16^{+0.43}_{-0.40}$  ACHASOV 00 SND  $e^+e^- \rightarrow \pi^0\gamma$

$\Gamma_7$

NODE=M004W7  
NODE=M004W7

### $\Gamma(\ell^+\ell^-)$

VALUE (keV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.320 \pm 0.017 \pm 0.015$  <sup>1</sup> AMBROSINO 05 KLOE  $1.02 e^+e^- \rightarrow \mu^+\mu^-$   
<sup>1</sup> Weighted average of  $\Gamma_{ee}$  and  $\sqrt{\Gamma_{ee}\Gamma_{\mu\mu}}$  from AMBROSINO 05 assuming lepton universality.

$\Gamma_8$

NODE=M004W5  
NODE=M004W5

NODE=M004W5;LINKAGE=AM

### $\Gamma(e^+e^-)$

VALUE (keV) DOCUMENT ID TECN COMMENT

**1.27  $\pm 0.04$  OUR EVALUATION**

**1.251  $\pm 0.021$  OUR AVERAGE** Error includes scale factor of 1.1.

$1.235 \pm 0.006 \pm 0.022$  <sup>1</sup> AKHMETSHIN 11 CMD2  $1.02 e^+e^- \rightarrow \phi$   
 $1.32 \pm 0.05 \pm 0.03$  <sup>2</sup> AMBROSINO 05 KLOE  $1.02 e^+e^- \rightarrow e^+e^-$   
 $1.28 \pm 0.05$  AKHMETSHIN 95 CMD2  $1.02 e^+e^- \rightarrow \phi$

<sup>1</sup> Combined analysis of the CMD-2 data on  $\phi \rightarrow K^+K^-, K_S^0 K_L^0, \pi^+\pi^-\pi^0, \eta\gamma$  assuming that the sum of their branching fractions is  $0.99741 \pm 0.00007$ .

<sup>2</sup> From forward-backward asymmetry and using  $\Gamma_{\text{total}} = 4.26 \pm 0.05$  MeV from the 2004 edition of this Review.

$\Gamma_9$

NODE=M004W8  
NODE=M004W8

$\rightarrow$  UNCHECKED  $\leftarrow$

NODE=M004W8;LINKAGE=AK

NODE=M004W8;LINKAGE=AM

| $(\Gamma(e^+e^-) \times \Gamma(\mu^+\mu^-))^{\frac{1}{2}}$ |             |      |         | $(\Gamma_9\Gamma_{10})^{\frac{1}{2}}$ |
|------------------------------------------------------------|-------------|------|---------|---------------------------------------|
| VALUE (keV)                                                | DOCUMENT ID | TECN | COMMENT |                                       |
| <b>1.320 ± 0.018 ± 0.017</b>                               | AMBROSINO   | 05   | KLOE    | 1.02 $e^+e^- \rightarrow \mu^+\mu^-$  |

NODE=M004W9  
NODE=M004W9

### $\phi(1020) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$

NODE=M004223

| $\Gamma(K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |      |                   |      | $\Gamma_1\Gamma_9/\Gamma$              |
|--------------------------------------------------------------|------|-------------------|------|----------------------------------------|
| VALUE (keV)                                                  | EVTS | DOCUMENT ID       | TECN | COMMENT                                |
| <b>0.6340 ± 0.0070 ± 0.0039</b>                              |      | <sup>1</sup> LEES | 13Q  | BABR $e^+e^- \rightarrow K^+K^-\gamma$ |

NODE=M004G01  
NODE=M004G01

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.669 ± 0.001 ± 0.023 1.7M KOZYREV 18 CMD3  $e^+e^- \rightarrow K^+K^-$

<sup>1</sup> Using a phenomenological model based on KUHN 90 with a sum of Breit-Wigner resonances for  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$  and their higher mass excitations. The first error combines statistical and systematic uncertainties. The second one is due to the parametrization of the charged kaon form factor and mass calibration.

NODE=M004G01;LINKAGE=A

| $\Gamma(K_L^0 K_S^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |      |                   |      | $\Gamma_2\Gamma_9/\Gamma$                    |
|-------------------------------------------------------------------|------|-------------------|------|----------------------------------------------|
| VALUE (keV)                                                       | EVTS | DOCUMENT ID       | TECN | COMMENT                                      |
| <b>0.4200 ± 0.0033 ± 0.0123</b>                                   | 28k  | <sup>1</sup> LEES | 14H  | BABR $e^+e^- \rightarrow K_S^0 K_L^0 \gamma$ |

NODE=M004GXX  
NODE=M004GXX

<sup>1</sup> Using a vector meson dominance model with contribution from  $\phi(1020)$  and higher mass excitations of  $\rho(770)$ ,  $\omega(782)$ , and  $\phi(1020)$ .

NODE=M004GXX;LINKAGE=A

### $\phi(1020) \Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$

NODE=M004224

| $\Gamma(K^+K^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |      |             |      | $\Gamma_1/\Gamma \times \Gamma_9/\Gamma$                                                                 |
|------------------------------------------------------------------------------------|------|-------------|------|----------------------------------------------------------------------------------------------------------|
| VALUE (units $10^{-5}$ )                                                           | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                                  |
| <b>14.64 ± 0.29 OUR FIT</b>                                                        |      |             |      | Error includes scale factor of 1.5. $[(14.63 \pm 0.29) \times 10^{-5}]$ OUR 2020 FIT Scale factor = 1.5] |

NODE=M004G10  
NODE=M004G10

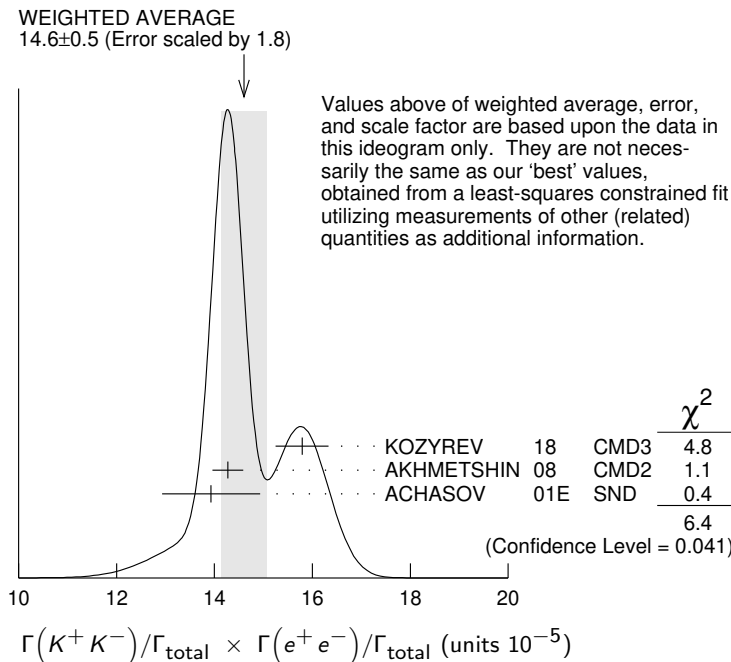
**14.6 ± 0.5 OUR AVERAGE** Error includes scale factor of 1.8. See the ideogram below.

NEW

|                     |       |                      |     |      |                                                           |
|---------------------|-------|----------------------|-----|------|-----------------------------------------------------------|
| 15.789 ± 0.541      | 1.7M  | KOZYREV              | 18  | CMD3 | $e^+e^- \rightarrow K^+K^-$                               |
| 14.27 ± 0.05 ± 0.31 | 542k  | AKHMETSHIN           | 08  | CMD2 | 1.02 $e^+e^- \rightarrow K^+K^-$                          |
| 13.93 ± 0.14 ± 0.99 | 1000k | <sup>1</sup> ACHASOV | 01E | SND  | $e^+e^- \rightarrow K^+K^-, K_S^0 K_L^0, \pi^+\pi^-\pi^0$ |

<sup>1</sup> From the combined fit assuming that the total  $\phi(1020)$  production cross section is saturated by those of  $K^+K^-$ ,  $K_S^0 K_L^0$ ,  $\pi^+\pi^-\pi^0$ , and  $\eta\gamma$  decays modes and using ACHASOV 00B for the  $\eta\gamma$  decay mode.

NODE=M004G10;LINKAGE=AE



$$\Gamma(K_L^0 K_S^0)/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$$

$$\Gamma_2/\Gamma \times \Gamma_9/\Gamma$$

| VALUE (units $10^{-5}$ )                                                       | EVTS | DOCUMENT ID                | TECN    | COMMENT                                                       |
|--------------------------------------------------------------------------------|------|----------------------------|---------|---------------------------------------------------------------|
| <b>10.10 <math>\pm 0.12</math> OUR FIT</b> Error includes scale factor of 1.1. |      |                            |         |                                                               |
| <b>10.07 <math>\pm 0.13</math> OUR AVERAGE</b>                                 |      |                            |         |                                                               |
| 10.078 $\pm 0.223$                                                             | 610k | <sup>1</sup> KOZYREV       | 16 CMD3 | $e^+ e^- \rightarrow K_S^0 K_L^0$                             |
| 10.01 $\pm 0.04 \pm 0.17$                                                      | 272k | <sup>2</sup> AKHMETSHIN 04 | CMD2    | $e^+ e^- \rightarrow K_L^0 K_S^0$                             |
| 10.27 $\pm 0.07 \pm 0.34$                                                      | 500k | <sup>3</sup> ACHASOV       | 01E SND | $e^+ e^- \rightarrow K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0$ |

<sup>1</sup> KOZYREV 16 also reports  $\Gamma(e^+ e^-) B(\phi \rightarrow K_S^0 K_L^0) = (0.428 \pm 0.001 \pm 0.009) \text{ keV}$ .

<sup>2</sup> Update of AKHMETSHIN 99D

<sup>3</sup> From the combined fit assuming that the total  $\phi(1020)$  production cross section is saturated by those of  $K^+ K^-$ ,  $K_S^0 K_L^0$ ,  $\pi^+ \pi^- \pi^0$ , and  $\eta\gamma$  decays modes and using ACHASOV 00B for the  $\eta\gamma$  decay mode.

NODE=M004G6  
NODE=M004G6

NODE=M004G6;LINKAGE=A  
NODE=M004G;LINKAGE=GS  
NODE=M004G6;LINKAGE=AE

$$[\Gamma(\rho\pi) + \Gamma(\pi^+ \pi^- \pi^0)]/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$$

$$\Gamma_3/\Gamma \times \Gamma_9/\Gamma$$

| VALUE (units $10^{-5}$ )                                                      | EVTS  | DOCUMENT ID                | TECN     | COMMENT                                                       |
|-------------------------------------------------------------------------------|-------|----------------------------|----------|---------------------------------------------------------------|
| <b>4.53 <math>\pm 0.10</math> OUR FIT</b> Error includes scale factor of 1.1. |       |                            |          |                                                               |
| <b>4.46 <math>\pm 0.12</math> OUR AVERAGE</b>                                 |       |                            |          |                                                               |
| 4.51 $\pm 0.16 \pm 0.11$                                                      | 105k  | AKHMETSHIN 06              | CMD2     | $0.98-1.06 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$             |
| 4.30 $\pm 0.08 \pm 0.21$                                                      |       | AUBERT,B                   | 04N BABR | $10.6 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \gamma$           |
| 4.665 $\pm 0.042 \pm 0.261$                                                   | 400k  | <sup>1</sup> ACHASOV       | 01E SND  | $e^+ e^- \rightarrow K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0$ |
| 4.35 $\pm 0.27 \pm 0.08$                                                      | 11169 | <sup>2</sup> AKHMETSHIN 98 | CMD2     | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                            |          |                                                               |
| 4.38 $\pm 0.12$                                                               |       | BENAYOUN                   | 10 RVUE  | $0.4-1.05 e^+ e^-$                                            |

<sup>1</sup> From the combined fit assuming that the total  $\phi(1020)$  production cross section is saturated by those of  $K^+ K^-$ ,  $K_S^0 K_L^0$ ,  $\pi^+ \pi^- \pi^0$ , and  $\eta\gamma$  decays modes and using ACHASOV 00B for the  $\eta\gamma$  decay mode.

<sup>2</sup> Recalculated by us from the cross section in the peak.

NODE=M004G7  
NODE=M004G7

NODE=M004G7;LINKAGE=AE

NODE=M004G;LINKAGE=B

$$\Gamma(\eta\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$$

$$\Gamma_6/\Gamma \times \Gamma_9/\Gamma$$

| VALUE (units $10^{-6}$ )                                                                                                                          | EVTS  | DOCUMENT ID                   | TECN    | COMMENT                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------|---------|--------------------------------------------|
| <b>3.88 <math>\pm 0.07</math> OUR FIT</b> Error includes scale factor of 1.2. $[(3.87 \pm 0.07) \times 10^{-6}]$ OUR 2020 FIT Scale factor = 1.2] |       |                               |         |                                            |
| <b>3.93 <math>\pm 0.09</math> OUR AVERAGE</b> Error includes scale factor of 1.3. See the ideogram below.                                         |       |                               |         |                                            |
| 4.050 $\pm 0.067 \pm 0.118$                                                                                                                       | 33k   | <sup>1</sup> ACHASOV          | 07B SND | $0.6-1.38 e^+ e^- \rightarrow \eta\gamma$  |
| 4.093 $^{+0.040}_{-0.043} \pm 0.247$                                                                                                              | 17.4k | <sup>2</sup> AKHMETSHIN 05    | CMD2    | $0.60-1.38 e^+ e^- \rightarrow \eta\gamma$ |
| 3.850 $\pm 0.041 \pm 0.159$                                                                                                                       | 23k   | <sup>3,4</sup> AKHMETSHIN 01B | CMD2    | $e^+ e^- \rightarrow \eta\gamma$           |
| 4.00 $\pm 0.04 \pm 0.11$                                                                                                                          |       | <sup>5</sup> ACHASOV          | 00 SND  | $e^+ e^- \rightarrow \eta\gamma$           |
| 3.53 $\pm 0.08 \pm 0.17$                                                                                                                          | 2200  | <sup>6,7</sup> AKHMETSHIN 99F | CMD2    | $e^+ e^- \rightarrow \eta\gamma$           |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                     |       |                               |         |                                            |
| 4.19 $\pm 0.06$                                                                                                                                   |       | <sup>8</sup> BENAYOUN         | 10 RVUE | $0.4-1.05 e^+ e^-$                         |

<sup>1</sup> From a combined fit of  $\sigma(e^+ e^- \rightarrow \eta\gamma)$  with  $\eta \rightarrow 3\pi^0$  and  $\eta \rightarrow \pi^+ \pi^- \pi^0$ , and fixing  $B(\eta \rightarrow 3\pi^0) / B(\eta \rightarrow \pi^+ \pi^- \pi^0) = 1.44 \pm 0.04$ . Recalculated by us from the cross section at the peak. Supersedes ACHASOV 00D and ACHASOV 06A.

<sup>2</sup> From the  $\eta \rightarrow 2\gamma$  decay and using  $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$ .

<sup>3</sup> From the  $\eta \rightarrow 3\pi^0$  decay and using  $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$ .

<sup>4</sup> The combined fit from 600 to 1380 MeV taking into account  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$ , and  $\rho(1450)$  (mass and width fixed at 1450 MeV and 310 MeV respectively).

<sup>5</sup> From the  $\eta \rightarrow 2\gamma$  decay and using  $B(\eta \rightarrow 2\gamma) = (39.21 \pm 0.34) \times 10^{-2}$ .

<sup>6</sup> Recalculated by the authors from the cross section in the peak.

<sup>7</sup> From the  $\eta \rightarrow \pi^+ \pi^- \pi^0$  decay and using  $B(\eta \rightarrow \pi^+ \pi^- \pi^0) = (23.1 \pm 0.5) \times 10^{-2}$ .

<sup>8</sup> A simultaneous fit of  $e^+ e^- \rightarrow \pi^+ \pi^-, \pi^+ \pi^- \pi^0, \pi^0 \gamma, \eta\gamma$  data.

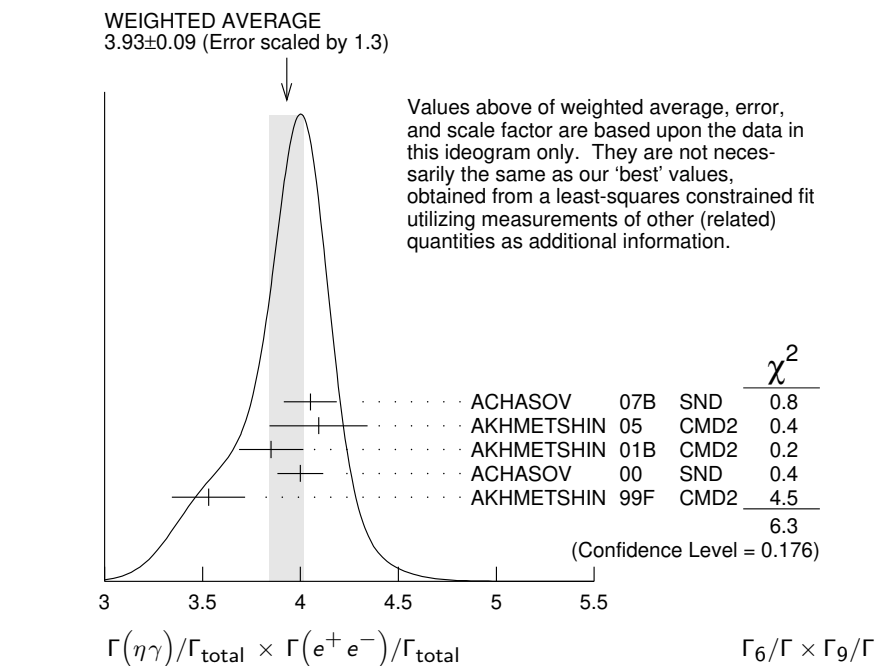
NODE=M004G2  
NODE=M004G2

NEW

NODE=M004G2;LINKAGE=AH

NODE=M004G2;LINKAGE=AK  
NODE=M004G;LINKAGE=AK  
NODE=M004G;LINKAGE=BQ

NODE=M004G2;LINKAGE=A  
NODE=M004G;LINKAGE=A  
NODE=M004G2;LINKAGE=C  
NODE=M004G7;LINKAGE=BE



$\Gamma(\pi^0\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$

$\Gamma_7/\Gamma \times \Gamma_9/\Gamma$

| VALUE (units $10^{-7}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**3.94±0.16 OUR FIT**

[(3.88 ± 0.14) × 10<sup>-7</sup> OUR 2020 FIT]

**3.95±0.17 OUR AVERAGE**

[(3.87 ± 0.15) × 10<sup>-7</sup> OUR 2020 AVERAGE]

4.04±0.09±0.19      <sup>1</sup> ACHASOV    16A    SND    0.60–1.38 e<sup>+</sup>e<sup>-</sup> → π<sup>0</sup>γ

3.75±0.11±0.29    18k    AKHMETSHIN 05    CMD2    0.60–1.38 e<sup>+</sup>e<sup>-</sup> → π<sup>0</sup>γ

• • • We do not use the following data for averages, fits, limits, etc. • • •

4.29±0.11      <sup>2</sup> BENAYOUN    10    RVUE    0.4–1.05 e<sup>+</sup>e<sup>-</sup>

3.67±0.10<sup>+0.27</sup><sub>-0.25</sub>      <sup>3</sup> ACHASOV    00    SND    e<sup>+</sup>e<sup>-</sup> → π<sup>0</sup>γ

<sup>1</sup> From the VMD model with the interfering ρ(770), ω(782), φ(1020) resonances, and an additional resonance describing the total contribution of the ρ(1450) and ω(1420) states. Supersedes ACHASOV 00.

<sup>2</sup> A simultaneous fit of e<sup>+</sup>e<sup>-</sup> → π<sup>+</sup>π<sup>-</sup>, π<sup>+</sup>π<sup>-</sup>π<sup>0</sup>, π<sup>0</sup>γ, ηγ data.

<sup>3</sup> From the π<sup>0</sup> → 2γ decay and using B(π<sup>0</sup> → 2γ) = (98.798 ± 0.032) × 10<sup>-2</sup>.

$\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$

$\Gamma_{10}/\Gamma \times \Gamma_9/\Gamma$

| VALUE (units $10^{-8}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**8.5 ±0.6 OUR FIT**

[(8.5<sup>+0.5</sup><sub>-0.6</sub>) × 10<sup>-8</sup> OUR 2020 FIT]

**8.8 ±0.9 OUR AVERAGE** Error includes scale factor of 1.5. See the ideogram below.

8.36±0.59±0.37      ACHASOV    01G    SND    e<sup>+</sup>e<sup>-</sup> → μ<sup>+</sup>μ<sup>-</sup>

9.9 ±1.4 ±0.9      <sup>1</sup> ACHASOV    99C    SND    e<sup>+</sup>e<sup>-</sup> → μ<sup>+</sup>μ<sup>-</sup>

14.4 ±3.0      <sup>2</sup> VASSERMAN 81    OLYA    e<sup>+</sup>e<sup>-</sup> → μ<sup>+</sup>μ<sup>-</sup>

8.6 ±5.9      <sup>2</sup> AUGUSTIN    73    OSPK    e<sup>+</sup>e<sup>-</sup> → μ<sup>+</sup>μ<sup>-</sup>

<sup>1</sup> Recalculated by the authors from the cross section in the peak.

<sup>2</sup> Recalculated by us from the cross section in the peak.

NODE=M004G3

NODE=M004G3

NEW

NEW

NODE=M004G3;LINKAGE=B

NODE=M004G3;LINKAGE=BE

NODE=M004G3;LINKAGE=A

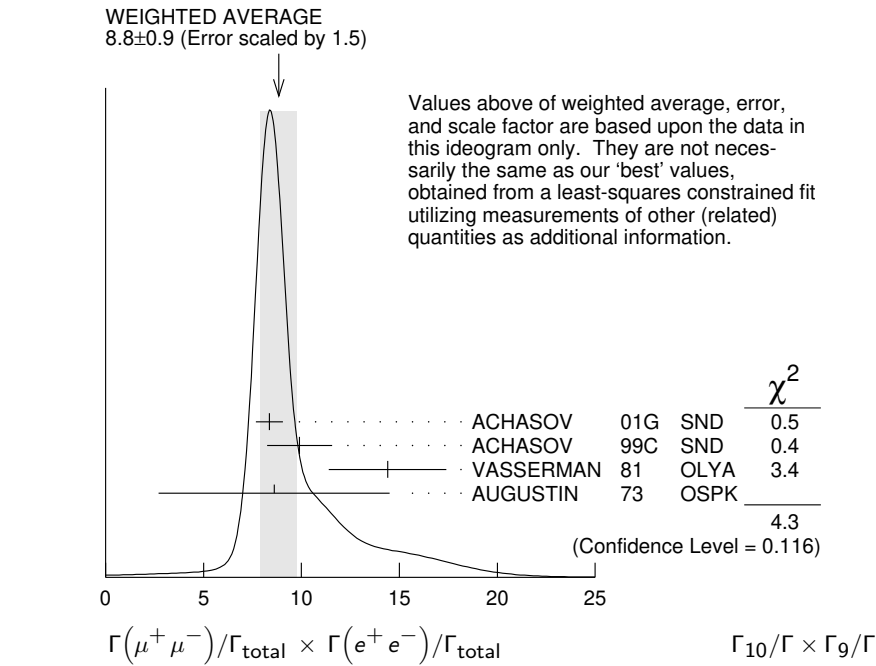
NODE=M004G5

NODE=M004G5

NEW

NODE=M004G5;LINKAGE=A

NODE=M004G5;LINKAGE=B



$$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{12}/\Gamma \times \Gamma_9/\Gamma$$

| VALUE (units 10 <sup>-8</sup> )                                                                                                                                            | DOCUMENT ID            | TECN    | COMMENT                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------|---------------------------------|
| <b>2.2 ±0.4 OUR FIT</b>                                                                                                                                                    |                        |         |                                 |
| <b>2.2 ±0.4 OUR AVERAGE</b>                                                                                                                                                |                        |         |                                 |
| 2.1 ±0.3 ±0.3                                                                                                                                                              | <sup>1</sup> ACHASOV   | 00c SND | $e^+e^- \rightarrow \pi^+\pi^-$ |
| 1.95 <sup>+1.15</sup> <sub>-0.87</sub>                                                                                                                                     | <sup>2</sup> GOLUBEV   | 86 ND   | $e^+e^- \rightarrow \pi^+\pi^-$ |
| 6.01 <sup>+3.19</sup> <sub>-2.51</sub>                                                                                                                                     | <sup>2</sup> VASSERMAN | 81 OLYA | $e^+e^- \rightarrow \pi^+\pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                              |                        |         |                                 |
| 3.31±0.99                                                                                                                                                                  | <sup>3</sup> BENAYOUN  | 13 RVUE | 0.4–1.05 $e^+e^-$               |
| <sup>1</sup> Recalculated by the authors from the cross section in the peak.                                                                                               |                        |         |                                 |
| <sup>2</sup> Recalculated by us from the cross section in the peak.                                                                                                        |                        |         |                                 |
| <sup>3</sup> A simultaneous fit to $e^+e^- \rightarrow \pi^+\pi^-, \pi^+\pi^-\pi^0, \pi^0\gamma, \eta\gamma, K\bar{K}$ , and $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ data. |                        |         |                                 |

NODE=M004G4  
NODE=M004G4

NODE=M004G4;LINKAGE=AC  
NODE=M004G4;LINKAGE=B  
NODE=M004G4;LINKAGE=A

$$\Gamma(\omega\pi^0)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{13}/\Gamma \times \Gamma_9/\Gamma$$

| VALUE (units 10 <sup>-8</sup> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | DOCUMENT ID              | TECN     | COMMENT                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|----------|-----------------------------------------------------|
| <b>1.40±0.15 OUR FIT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          |          |                                                     |
| <b>1.37±0.17±0.01</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <sup>1,2</sup> AMBROSINO | 08G KLOE | $e^+e^- \rightarrow \pi^+\pi^-2\pi^0, 2\pi^0\gamma$ |
| <sup>1</sup> Recalculated by the authors from the cross section at the peak.                                                                                                                                                                                                                                                                                                                                                                                                                                  |                          |          |                                                     |
| <sup>2</sup> AMBROSINO 08G reports $[\Gamma(\phi(1020) \rightarrow \omega\pi^0)/\Gamma_{\text{total}} \times \Gamma(\phi(1020) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow \pi^+\pi^-\pi^0)] = (1.22 \pm 0.13 \pm 0.08) \times 10^{-8}$ which we divide by our best value $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |                          |          |                                                     |

NODE=M004G11  
NODE=M004G11

NODE=M004G11;LINKAGE=AB  
NODE=M004G11;LINKAGE=AM

$$\Gamma(\pi^0\pi^0\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{18}/\Gamma \times \Gamma_9/\Gamma$$

| VALUE (units 10 <sup>-8</sup> )                                            | DOCUMENT ID            | TECN    | COMMENT                               |
|----------------------------------------------------------------------------|------------------------|---------|---------------------------------------|
| <b>3.34±0.17 OUR FIT</b>                                                   |                        |         |                                       |
| <b>3.33<sup>+0.04+0.19</sup><sub>-0.09-0.20</sub></b>                      | <sup>1</sup> AMBROSINO | 07 KLOE | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| <sup>1</sup> Calculated by the authors from the cross section at the peak. |                        |         |                                       |

NODE=M004G9  
NODE=M004G9

NODE=M004G9;LINKAGE=AM

$$\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{19}/\Gamma \times \Gamma_9/\Gamma$$

| VALUE (units 10 <sup>-9</sup> )                                              | EVTS | DOCUMENT ID             | TECN     | COMMENT                                   |
|------------------------------------------------------------------------------|------|-------------------------|----------|-------------------------------------------|
| <b>1.2<sup>+0.8</sup><sub>-0.7</sub> OUR FIT</b>                             |      |                         |          |                                           |
| <b>1.17±0.52±0.64</b>                                                        | 3285 | <sup>1</sup> AKHMETSHIN | 00E CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$ |
| <sup>1</sup> Recalculated by the authors from the cross section in the peak. |      |                         |          |                                           |

NODE=M004G8  
NODE=M004G8

NODE=M004G8;LINKAGE=A



$\phi(1020)$  BRANCHING RATIOS

NODE=M004220

 $\Gamma(K^+K^-)/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma$ 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.492±0.005 OUR FIT** Error includes scale factor of 1.3.**0.493±0.010 OUR AVERAGE**

|             |      |                |      |                                           |
|-------------|------|----------------|------|-------------------------------------------|
| 0.492±0.012 | 2913 | AKHMETSHIN 95  | CMD2 | $e^+e^- \rightarrow K^+K^-$               |
| 0.44 ±0.05  | 321  | KALBFLEISCH 76 | HBC  | $2.18 K^-p \rightarrow \Lambda K^+K^-$    |
| 0.49 ±0.06  | 270  | DEGROOT 74     | HBC  | $4.2 K^-p \rightarrow \Lambda\phi$        |
| 0.540±0.034 | 565  | BALAKIN 71     | OSPK | $e^+e^- \rightarrow K^+K^-$               |
| 0.48 ±0.04  | 252  | LINDSEY 66     | HBC  | $2.1-2.7 K^-p \rightarrow \Lambda K^+K^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |       |                            |      |                                                           |
|-------------------|-------|----------------------------|------|-----------------------------------------------------------|
| 0.493±0.003±0.007 |       | <sup>1</sup> AKHMETSHIN 11 | CMD2 | $1.02 e^+e^- \rightarrow K^+K^-$                          |
| 0.476±0.017       | 1000k | <sup>2</sup> ACHASOV 01E   | SND  | $e^+e^- \rightarrow K^+K^-, K_S^0 K_L^0, \pi^+\pi^-\pi^0$ |

<sup>1</sup> Combined analysis of the CMD-2 data on  $\phi \rightarrow K^+K^-, K_S^0 K_L^0, \pi^+\pi^-\pi^0, \eta\gamma$  assuming that the sum of their branching fractions is  $0.99741 \pm 0.00007$ .

<sup>2</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.93 \pm 0.14) \times 10^{-4}$ .

NODE=M004R1  
NODE=M004R1

NODE=M004R1;LINKAGE=AK

NODE=M004R1;LINKAGE=B2

 $\Gamma(K_L^0 K_S^0)/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$ 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.340±0.004 OUR FIT** Error includes scale factor of 1.3.**0.331±0.009 OUR AVERAGE**

|             |       |               |      |                                  |
|-------------|-------|---------------|------|----------------------------------|
| 0.335±0.010 | 40644 | AKHMETSHIN 95 | CMD2 | $e^+e^- \rightarrow K_L^0 K_S^0$ |
| 0.326±0.035 |       | DOLINSKY 91   | ND   | $e^+e^- \rightarrow K_L^0 K_S^0$ |
| 0.310±0.024 |       | DRUZHININ 84  | ND   | $e^+e^- \rightarrow K_L^0 K_S^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |      |                            |      |                                                           |
|-------------------|------|----------------------------|------|-----------------------------------------------------------|
| 0.336±0.002±0.006 |      | <sup>1</sup> AKHMETSHIN 11 | CMD2 | $1.02 e^+e^- \rightarrow K_S^0 K_L^0$                     |
| 0.351±0.013       | 500k | <sup>2</sup> ACHASOV 01E   | SND  | $e^+e^- \rightarrow K^+K^-, K_S^0 K_L^0, \pi^+\pi^-\pi^0$ |
| 0.27 ±0.03        | 133  | KALBFLEISCH 76             | HBC  | $2.18 K^-p \rightarrow \Lambda K_L^0 K_S^0$               |
| 0.257±0.030       | 95   | <sup>3</sup> BALAKIN 71    | OSPK | $e^+e^- \rightarrow K_L^0 K_S^0$                          |
| 0.40 ±0.04        | 167  | LINDSEY 66                 | HBC  | $2.1-2.7 K^-p \rightarrow \Lambda K_L^0 K_S^0$            |

<sup>1</sup> Combined analysis of the CMD-2 data on  $\phi \rightarrow K^+K^-, K_S^0 K_L^0, \pi^+\pi^-\pi^0, \eta\gamma$  assuming that the sum of their branching fractions is  $0.99741 \pm 0.00007$ .

<sup>2</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.93 \pm 0.14) \times 10^{-4}$ .

<sup>3</sup> Balakin error increased by Paul.

NODE=M004R2  
NODE=M004R2

NODE=M004R2;LINKAGE=AK

NODE=M004R2;LINKAGE=B2

NODE=M004R2;LINKAGE=01

 $\Gamma(K_L^0 K_S^0)/\Gamma(K^+K^-)$   $\Gamma_2/\Gamma_1$ 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.690±0.015 OUR FIT** Error includes scale factor of 1.3.**0.740±0.031 OUR AVERAGE**

|            |      |                 |      |                                             |
|------------|------|-----------------|------|---------------------------------------------|
| 0.70 ±0.06 | 2732 | BUKIN 78C       | OLYA | $e^+e^- \rightarrow K_L^0 K_S^0$            |
| 0.82 ±0.08 |      | LOSTY 78        | HBC  | $4.2 K^-p \rightarrow \phi \text{ hyperon}$ |
| 0.71 ±0.05 |      | LAVEN 77        | HBC  | $10 K^-p \rightarrow K^+K^-\Lambda$         |
| 0.71 ±0.08 |      | LYONS 77        | HBC  | $3-4 K^-p \rightarrow \Lambda\phi$          |
| 0.89 ±0.10 | 144  | AGUILAR-... 72B | HBC  | $3.9, 4.6 K^-p$                             |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |      |                            |      |                                          |
|-------------|------|----------------------------|------|------------------------------------------|
| 0.638±0.022 | 2.3M | <sup>1</sup> KOZYREV 18    | CMD3 | $e^+e^- \rightarrow K_L^0 K_S^0, K^+K^-$ |
| 0.68 ±0.03  |      | <sup>2</sup> AKHMETSHIN 95 | CMD2 | $e^+e^- \rightarrow K_L^0 K_S^0, K^+K^-$ |

<sup>1</sup> The prediction taking into account phase-space difference, radiative corrections, isospin breaking, and the Sommerfeld-Gamow-Sakharov factor gives 0.630.

<sup>2</sup> Theoretical analysis of BRAMON 00 taking into account phase-space difference, electromagnetic radiative corrections, as well as isospin breaking, predicts 0.62. FLOREZ-BAEZ 08 predicts 0.63 considering also structure-dependent radiative corrections. FIS-CHBACH 02 calculates additional corrections caused by the close threshold and predicts 0.68. See also BENAYOUN 01 and DUBYSKIY 07. BENAYOUN 12 obtains  $0.71 \pm 0.01$  in the HLS model.

NODE=M004R19  
NODE=M004R19

NODE=M004R19;LINKAGE=A

NODE=M004R19;LINKAGE=KH

$$\Gamma(K_L^0 K_S^0)/\Gamma(K\bar{K})$$

$$\Gamma_2/(\Gamma_1+\Gamma_2)$$

| VALUE                         | EVTS                                | DOCUMENT ID         | TECN    | COMMENT                                    |
|-------------------------------|-------------------------------------|---------------------|---------|--------------------------------------------|
| <b>0.408±0.005 OUR FIT</b>    | Error includes scale factor of 1.3. |                     |         |                                            |
| <b>0.45 ±0.04 OUR AVERAGE</b> |                                     |                     |         |                                            |
| 0.44 ±0.07                    |                                     | <sup>1</sup> LONDON | 66 HBC  | 2.24 $K^- p \rightarrow \Lambda K \bar{K}$ |
| 0.48 ±0.07                    | 52                                  | BADIER              | 65B HBC | 3 $K^- p$                                  |
| 0.40 ±0.10                    | 34                                  | SCHLEIN             | 63 HBC  | 1.95 $K^- p \rightarrow \Lambda K \bar{K}$ |

<sup>1</sup> This is probably not affected by their controversial background subtraction; the value is from their numbers of  $K_1 K_2$  vs  $K^+ K^-$  events.

NODE=M004R5  
NODE=M004R5

NODE=M004R5;LINKAGE=01

$$[\Gamma(\rho\pi) + \Gamma(\pi^+ \pi^- \pi^0)]/\Gamma_{\text{total}}$$

$$\Gamma_3/\Gamma$$

| VALUE                                                                         | EVTS                                | DOCUMENT ID                | TECN     | COMMENT                                                       |
|-------------------------------------------------------------------------------|-------------------------------------|----------------------------|----------|---------------------------------------------------------------|
| <b>0.1524±0.0033 OUR FIT</b>                                                  | Error includes scale factor of 1.2. |                            |          |                                                               |
| <b>0.151 ±0.009 OUR AVERAGE</b>                                               | Error includes scale factor of 1.7. |                            |          |                                                               |
| 0.161 ±0.008                                                                  | 11761                               | AKHMETSHIN 95              | CMD2     | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                       |
| 0.143 ±0.007                                                                  |                                     | DOLINSKY 91                | ND       | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |                            |          |                                                               |
| 0.155 ±0.002 ±0.005                                                           |                                     | <sup>1</sup> AKHMETSHIN 11 | CMD2     | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                  |
| 0.159 ±0.008                                                                  | 400k                                | <sup>2</sup> ACHASOV       | 01E SND  | $e^+ e^- \rightarrow K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0$ |
| 0.145 ±0.009 ±0.003                                                           | 11169                               | <sup>3</sup> AKHMETSHIN 98 | CMD2     | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$                       |
| 0.139 ±0.007                                                                  |                                     | <sup>4</sup> PARROUR       | 76B OSPK | $e^+ e^-$                                                     |

<sup>1</sup> Combined analysis of the CMD-2 data on  $\phi \rightarrow K^+ K^-, K_S^0 K_L^0, \pi^+ \pi^- \pi^0, \eta \gamma$  assuming that the sum of their branching fractions is  $0.99741 \pm 0.00007$ .

<sup>2</sup> Using  $B(\phi \rightarrow e^+ e^-) = (2.93 \pm 0.14) \times 10^{-4}$ .

<sup>3</sup> Using  $B(\phi \rightarrow e^+ e^-) = (2.99 \pm 0.08) \times 10^{-4}$ .

<sup>4</sup> Using  $\Gamma(\phi) = 4.1$  MeV. If interference between the  $\rho\pi$  and  $3\pi$  modes is neglected, the fraction of the  $\rho\pi$  is more than 80% at the 90% confidence level.

NODE=M004R3  
NODE=M004R3

NODE=M004R3;LINKAGE=AK

NODE=M004R3;LINKAGE=B2

NODE=M004R;LINKAGE=8D

NODE=M004R3;LINKAGE=E

$$[\Gamma(\rho\pi) + \Gamma(\pi^+ \pi^- \pi^0)]/\Gamma(K^+ K^-)$$

$$\Gamma_3/\Gamma_1$$

| VALUE                      | EVTS                                | DOCUMENT ID | TECN    | COMMENT         |
|----------------------------|-------------------------------------|-------------|---------|-----------------|
| <b>0.310±0.009 OUR FIT</b> | Error includes scale factor of 1.2. |             |         |                 |
| <b>0.28 ±0.09</b>          | 34                                  | AGUILAR-... | 72B HBC | 3.9,4.6 $K^- p$ |

NODE=M004R20  
NODE=M004R20

$$[\Gamma(\rho\pi) + \Gamma(\pi^+ \pi^- \pi^0)]/\Gamma(K\bar{K})$$

$$\Gamma_3/(\Gamma_1+\Gamma_2)$$

| VALUE                         | DOCUMENT ID                         | TECN    | COMMENT                                            |
|-------------------------------|-------------------------------------|---------|----------------------------------------------------|
| <b>0.183±0.005 OUR FIT</b>    | Error includes scale factor of 1.2. |         |                                                    |
| <b>0.24 ±0.04 OUR AVERAGE</b> |                                     |         |                                                    |
| 0.237±0.039                   | CERRADA                             | 77B HBC | 4.2 $K^- p \rightarrow \Lambda 3\pi$               |
| 0.30 ±0.15                    | LONDON                              | 66 HBC  | 2.24 $K^- p \rightarrow \Lambda \pi^+ \pi^- \pi^0$ |

NODE=M004R6  
NODE=M004R6

$$[\Gamma(\rho\pi) + \Gamma(\pi^+ \pi^- \pi^0)]/\Gamma(K_L^0 K_S^0)$$

$$\Gamma_3/\Gamma_2$$

| VALUE                         | EVTS                                | DOCUMENT ID | TECN     | COMMENT                                              |
|-------------------------------|-------------------------------------|-------------|----------|------------------------------------------------------|
| <b>0.448±0.011 OUR FIT</b>    | Error includes scale factor of 1.1. |             |          |                                                      |
| <b>0.51 ±0.05 OUR AVERAGE</b> |                                     |             |          |                                                      |
| 0.56 ±0.07                    | 3681                                | BUKIN       | 78C OLYA | $e^+ e^- \rightarrow K_L^0 K_S^0, \pi^+ \pi^- \pi^0$ |
| 0.47 ±0.06                    | 516                                 | COSME       | 74 OSPK  | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$              |

NODE=M004R7  
NODE=M004R7

$$\Gamma(\pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$$

$$\Gamma_5/\Gamma$$

| VALUE                                                                         | CL%   | EVTS                   | DOCUMENT ID | TECN                                         | COMMENT |
|-------------------------------------------------------------------------------|-------|------------------------|-------------|----------------------------------------------|---------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                        |             |                                              |         |
| ≈ 0.0087                                                                      | 1.98M | <sup>1,2</sup> ALOISIO | 03 KLOE     | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |         |
| <0.0006                                                                       | 90    | <sup>3</sup> ACHASOV   | 02 SND      | 1.02 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$ |         |
| <0.23                                                                         | 90    | <sup>3</sup> CORDIER   | 80 DM1      | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$      |         |
| <0.20                                                                         | 90    | <sup>3</sup> PARROUR   | 76B OSPK    | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$      |         |

<sup>1</sup> From a fit without limitations on charged and neutral  $\rho$  masses and widths.

<sup>2</sup> Adding the direct and  $\omega\pi$  contributions and considering the interference between the  $\rho\pi$  and  $\pi^+ \pi^- \pi^0$ .

<sup>3</sup> Neglecting the interference between the  $\rho\pi$  and  $\pi^+ \pi^- \pi^0$ .

NODE=M004R46  
NODE=M004R46

NODE=M004R;LINKAGE=L1

NODE=M004R;LINKAGE=L2

NODE=M004R;LINKAGE=46

$\Gamma(\eta\gamma)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

NODE=M004R11  
 NODE=M004R11

VALUE (units  $10^{-2}$ ) EVTS DOCUMENT ID TECN COMMENT

**1.303 $\pm$ 0.025 OUR FIT** Error includes scale factor of 1.2.

**1.26  $\pm$ 0.04 OUR AVERAGE**

|                                                                               |       |                            |     |      |                                           |
|-------------------------------------------------------------------------------|-------|----------------------------|-----|------|-------------------------------------------|
| 1.246 $\pm$ 0.025 $\pm$ 0.057                                                 | 10k   | <sup>1</sup> ACHASOV       | 98F | SND  | $e^+e^- \rightarrow 7\gamma$              |
| 1.18 $\pm$ 0.11                                                               | 279   | <sup>2</sup> AKHMETSHIN    | 95  | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-3\gamma$    |
| 1.30 $\pm$ 0.06                                                               |       | <sup>3</sup> DRUZHININ     | 84  | ND   | $e^+e^- \rightarrow 3\gamma$              |
| 1.4 $\pm$ 0.2                                                                 |       | <sup>4</sup> DRUZHININ     | 84  | ND   | $e^+e^- \rightarrow 6\gamma$              |
| 0.88 $\pm$ 0.20                                                               | 290   | KURDADZE                   | 83C | OLYA | $e^+e^- \rightarrow 3\gamma$              |
| 1.35 $\pm$ 0.29                                                               |       | ANDREWS                    | 77  | CNTR | 6.7-10 $\gamma$ Cu                        |
| 1.5 $\pm$ 0.4                                                                 | 54    | <sup>3</sup> COSME         | 76  | OSPK | $e^+e^-$                                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                            |     |      |                                           |
| 1.38 $\pm$ 0.02 $\pm$ 0.02                                                    |       | <sup>5</sup> AKHMETSHIN    | 11  | CMD2 | 1.02 $e^+e^- \rightarrow \eta\gamma$      |
| 1.36 $\pm$ 0.05 $\pm$ 0.02                                                    | 33k   | <sup>6</sup> ACHASOV       | 07B | SND  | 0.6-1.38 $e^+e^- \rightarrow \eta\gamma$  |
| 1.373 $\pm$ 0.014 $\pm$ 0.085                                                 | 17.4k | <sup>7,8</sup> AKHMETSHIN  | 05  | CMD2 | 0.60-1.38 $e^+e^- \rightarrow \eta\gamma$ |
| 1.287 $\pm$ 0.013 $\pm$ 0.063                                                 |       | <sup>9,10</sup> AKHMETSHIN | 01B | CMD2 | $e^+e^- \rightarrow \eta\gamma$           |
| 1.338 $\pm$ 0.012 $\pm$ 0.052                                                 |       | <sup>11</sup> ACHASOV      | 00  | SND  | $e^+e^- \rightarrow \eta\gamma$           |
| 1.18 $\pm$ 0.03 $\pm$ 0.06                                                    | 2200  | <sup>12</sup> AKHMETSHIN   | 99F | CMD2 | $e^+e^- \rightarrow \eta\gamma$           |
| 1.21 $\pm$ 0.07                                                               |       | <sup>13</sup> BENAYOUN     | 96  | RVUE | 0.54-1.04 $e^+e^- \rightarrow \eta\gamma$ |

OCCUR=2

<sup>1</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.99 \pm 0.08) \times 10^{-4}$  and  $B(\eta \rightarrow 3\pi^0) = (32.2 \pm 0.4) \times 10^{-2}$ .

<sup>2</sup> From  $\pi^+\pi^-\pi^0$  decay mode of  $\eta$ .

<sup>3</sup> From  $2\gamma$  decay mode of  $\eta$ .

<sup>4</sup> From  $3\pi^0$  decay mode of  $\eta$ .

<sup>5</sup> Combined analysis of the CMD-2 data on  $\phi \rightarrow K^+K^-, K_S^0 K_L^0, \pi^+\pi^-\pi^0, \eta\gamma$  assuming that the sum of their branching fractions is  $0.99741 \pm 0.00007$ .

<sup>6</sup> ACHASOV 07B reports  $[\Gamma(\phi(1020) \rightarrow \eta\gamma)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow e^+e^-)] = (4.050 \pm 0.067 \pm 0.118) \times 10^{-6}$  which we divide by our best value  $B(\phi(1020) \rightarrow e^+e^-) = (2.974 \pm 0.034) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. Supersedes ACHASOV 00D and ACHASOV 06A.

<sup>7</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.98 \pm 0.04) \times 10^{-4}$  and  $B(\eta \rightarrow \gamma\gamma) = 39.43 \pm 0.26\%$ .

<sup>8</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\eta\gamma)/\Gamma_{\text{total}}^2$ .

<sup>9</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.99 \pm 0.08) \times 10^{-4}$  and  $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$ .

<sup>10</sup> The combined fit from 600 to 1380 MeV taking into account  $\rho(770), \omega(782), \phi(1020)$ , and  $\rho(1450)$  (mass and width fixed at 1450 MeV and 310 MeV respectively).

<sup>11</sup> From the  $\eta \rightarrow 2\gamma$  decay and using  $B(\phi \rightarrow e^+e^-) = (2.99 \pm 0.08) \times 10^{-4}$ .

<sup>12</sup> From  $\pi^+\pi^-\pi^0$  decay mode of  $\eta$  and using  $B(\phi \rightarrow e^+e^-) = (2.99 \pm 0.08) \times 10^{-4}$ .

<sup>13</sup> Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution.

NODE=M004R11;LINKAGE=AC  
 NODE=M004R11;LINKAGE=Z3  
 NODE=M004R11;LINKAGE=A  
 NODE=M004R11;LINKAGE=C  
 NODE=M004R11;LINKAGE=AN

NODE=M004R11;LINKAGE=AO

NODE=M004R11;LINKAGE=AH  
 NODE=M004R11;LINKAGE=AK  
 NODE=M004R;LINKAGE=AK  
 NODE=M004R;LINKAGE=BQ

NODE=M004R;LINKAGE=GA  
 NODE=M004R;LINKAGE=FF  
 NODE=M004R;LINKAGE=TS

 $\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

NODE=M004R17  
 NODE=M004R17  
 NEW

VALUE (units  $10^{-3}$ ) EVTS DOCUMENT ID TECN COMMENT

**1.32  $\pm$ 0.06 OUR FIT**

**[(1.30  $\pm$ 0.05)  $\times 10^{-3}$  OUR 2020 FIT]**

**1.31  $\pm$ 0.13 OUR AVERAGE**

|                                                                               |     |                           |     |      |                                            |
|-------------------------------------------------------------------------------|-----|---------------------------|-----|------|--------------------------------------------|
| 1.30 $\pm$ 0.13                                                               |     | DRUZHININ                 | 84  | ND   | $e^+e^- \rightarrow 3\gamma$               |
| 1.4 $\pm$ 0.5                                                                 | 32  | COSME                     | 76  | OSPK | $e^+e^-$                                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                           |     |      |                                            |
| 1.367 $\pm$ 0.072                                                             |     | <sup>1</sup> ACHASOV      | 16A | SND  | 0.60-1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| 1.258 $\pm$ 0.037 $\pm$ 0.077                                                 | 18k | <sup>2,3</sup> AKHMETSHIN | 05  | CMD2 | 0.60-1.38 $e^+e^- \rightarrow \pi^0\gamma$ |
| 1.226 $\pm$ 0.036 $^{+0.096}_{-0.089}$                                        |     | <sup>4</sup> ACHASOV      | 00  | SND  | $e^+e^- \rightarrow \pi^0\gamma$           |
| 1.26 $\pm$ 0.17                                                               |     | <sup>5</sup> BENAYOUN     | 96  | RVUE | 0.54-1.04 $e^+e^- \rightarrow \pi^0\gamma$ |

<sup>1</sup> Using  $B(\phi \rightarrow e^+e^-)$  from PDG 15. Supersedes ACHASOV 00.

<sup>2</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.98 \pm 0.04) \times 10^{-4}$ .

<sup>3</sup> Not independent of the corresponding  $\Gamma(e^+e^-) \times \Gamma(\pi^0\gamma)/\Gamma_{\text{total}}^2$ .

<sup>4</sup> From the  $\pi^0 \rightarrow 2\gamma$  decay and using  $B(\phi \rightarrow e^+e^-) = (2.99 \pm 0.08) \times 10^{-4}$ .

<sup>5</sup> Reanalysis of DRUZHININ 84, DOLINSKY 89, and DOLINSKY 91 taking into account a triangle anomaly contribution.

OCCUR=3

NODE=M004R17;LINKAGE=D  
 NODE=M004R17;LINKAGE=AH  
 NODE=M004R17;LINKAGE=AK  
 NODE=M004R;LINKAGE=3G  
 NODE=M004R17;LINKAGE=TS

 $\Gamma(\eta\gamma)/\Gamma(\pi^0\gamma)$  $\Gamma_6/\Gamma_7$ 

NODE=M004R42  
 NODE=M004R42

VALUE DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                 |         |    |     |                                              |
|---------------------------------|---------|----|-----|----------------------------------------------|
| 10.9 $\pm$ 0.3 $^{+0.7}_{-0.8}$ | ACHASOV | 00 | SND | $e^+e^- \rightarrow \eta\gamma, \pi^0\gamma$ |
|---------------------------------|---------|----|-----|----------------------------------------------|

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**2.974 ± 0.034 OUR FIT** Error includes scale factor of 1.3.  $[(2.973 \pm 0.034) \times 10^{-4}]$  OUR 2020 FIT Scale factor = 1.3]

**2.98 ± 0.07 OUR AVERAGE** Error includes scale factor of 1.1.

|             |       |                      |     |      |                                                           |
|-------------|-------|----------------------|-----|------|-----------------------------------------------------------|
| 2.93 ± 0.14 | 1900k | <sup>1</sup> ACHASOV | 01E | SND  | $e^+e^- \rightarrow K^+K^-, K_S^0 K_L^0, \pi^+\pi^-\pi^0$ |
| 2.88 ± 0.09 | 55600 | AKHMETSHIN           | 95  | CMD2 | $e^+e^- \rightarrow \text{hadrons}$                       |
| 3.00 ± 0.21 | 3681  | BUKIN                | 78C | OLYA | $e^+e^- \rightarrow \text{hadrons}$                       |
| 3.10 ± 0.14 |       | <sup>2</sup> PARROUR | 76  | OSPK | $e^+e^-$                                                  |
| 3.3 ± 0.3   |       | COSME                | 74  | OSPK | $e^+e^- \rightarrow \text{hadrons}$                       |
| 2.81 ± 0.25 | 681   | BALAKIN              | 71  | OSPK | $e^+e^- \rightarrow \text{hadrons}$                       |
| 3.50 ± 0.27 |       | CHATELUS             | 71  | OSPK | $e^+e^-$                                                  |

<sup>1</sup> From the combined fit assuming that the total  $\phi(1020)$  production cross section is saturated by those of  $K^+K^-$ ,  $K_S^0 K_L^0$ ,  $\pi^+\pi^-\pi^0$ , and  $\eta\gamma$  decays modes and using ACHASOV 00B for the  $\eta\gamma$  decay mode.

<sup>2</sup> Using total width 4.2 MeV. They detect  $3\pi$  mode and observe significant interference with  $\omega$  tail. This is accounted for in the result quoted above.

NODE=M004R16  
NODE=M004R16

NEW

NODE=M004R16;LINKAGE=AE

NODE=M004R16;LINKAGE=E

 $\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**2.86 ± 0.19 OUR FIT****2.5 ± 0.4 OUR AVERAGE**

|                                                                               |  |                        |     |      |                                              |
|-------------------------------------------------------------------------------|--|------------------------|-----|------|----------------------------------------------|
| 2.69 ± 0.46                                                                   |  | <sup>1</sup> HAYES     | 71  | CNTR | $8.3, 9.8 \gamma C \rightarrow \mu^+\mu^- X$ |
| 2.17 ± 0.60                                                                   |  | <sup>1</sup> EARLES    | 70  | CNTR | $6.0 \gamma C \rightarrow \mu^+\mu^- X$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |                        |     |      |                                              |
| 2.87 ± 0.20 ± 0.14                                                            |  | <sup>2</sup> ACHASOV   | 01G | SND  | $e^+e^- \rightarrow \mu^+\mu^-$              |
| 3.30 ± 0.45 ± 0.32                                                            |  | <sup>3</sup> ACHASOV   | 99C | SND  | $e^+e^- \rightarrow \mu^+\mu^-$              |
| 4.83 ± 1.02                                                                   |  | <sup>4</sup> VASSERMAN | 81  | OLYA | $e^+e^- \rightarrow \mu^+\mu^-$              |
| 2.87 ± 1.98                                                                   |  | <sup>4</sup> AUGUSTIN  | 73  | OSPK | $e^+e^- \rightarrow \mu^+\mu^-$              |

<sup>1</sup> Neglecting interference between resonance and continuum.

<sup>2</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.91 \pm 0.07) \times 10^{-4}$ .

<sup>3</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.99 \pm 0.08) \times 10^{-4}$ .

<sup>4</sup> Recalculated by us using  $B(\phi \rightarrow e^+e^-) = (2.99 \pm 0.08) \times 10^{-4}$ .

NODE=M004R10  
NODE=M004R10

NODE=M004R10;LINKAGE=A  
NODE=M004R;LINKAGE=GZ  
NODE=M004R10;LINKAGE=8D  
NODE=M004R;LINKAGE=VA

 $\Gamma(\eta e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.08 ± 0.04 OUR AVERAGE**

|                                                                               |     |                         |     |      |                                       |
|-------------------------------------------------------------------------------|-----|-------------------------|-----|------|---------------------------------------|
| 1.075 ± 0.007 ± 0.038                                                         | 30k | <sup>1</sup> BABUSCI    | 15  | KLOE | $1.02 e^+e^- \rightarrow \eta e^+e^-$ |
| 1.19 ± 0.19 ± 0.12                                                            | 213 | <sup>2</sup> ACHASOV    | 01B | SND  | $e^+e^- \rightarrow \eta e^+e^-$      |
| 1.14 ± 0.10 ± 0.06                                                            | 355 | <sup>3</sup> AKHMETSHIN | 01  | CMD2 | $e^+e^- \rightarrow \eta e^+e^-$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                         |     |      |                                       |
| 1.13 ± 0.14 ± 0.07                                                            | 183 | <sup>4</sup> AKHMETSHIN | 01  | CMD2 | $e^+e^- \rightarrow \eta e^+e^-$      |
| 1.21 ± 0.14 ± 0.09                                                            | 130 | <sup>5</sup> AKHMETSHIN | 01  | CMD2 | $e^+e^- \rightarrow \eta e^+e^-$      |
| 1.04 ± 0.20 ± 0.08                                                            | 42  | <sup>6</sup> AKHMETSHIN | 01  | CMD2 | $e^+e^- \rightarrow \eta e^+e^-$      |
| 1.3 $\begin{smallmatrix} +0.8 \\ -0.6 \end{smallmatrix}$                      | 7   | GOLUBEV                 | 85  | ND   | $e^+e^- \rightarrow \eta e^+e^-$      |

<sup>1</sup> Using  $B(\eta \rightarrow 3\pi^0) = (32.57 \pm 0.23)\%$  from PDG 12.

<sup>2</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.25 \pm 0.32)\%$ ,  $B(\phi \rightarrow \eta\gamma) = (1.26 \pm 0.06)\%$ , and  $B(\phi \rightarrow e^+e^-) = (3.00 \pm 0.06) \times 10^{-4}$ .

<sup>3</sup> The average of the branching ratios separately obtained from the  $\eta \rightarrow \gamma\gamma$ ,  $3\pi^0$ ,  $\pi^+\pi^-\pi^0$  decays.

<sup>4</sup> From  $\eta \rightarrow \gamma\gamma$  decays and using  $B(\eta \rightarrow \gamma\gamma) = (39.33 \pm 0.25) \times 10^{-2}$ ,  $B(\eta \rightarrow \pi^+\pi^-\gamma) = (4.75 \pm 11) \times 10^{-2}$ , and  $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$ .

<sup>5</sup> From  $\eta \rightarrow 3\pi^0$  decays and using  $B(\pi^0 \rightarrow \gamma\gamma) = (98.798 \pm 0.033) \times 10^{-2}$ ,  $B(\eta \rightarrow 3\pi^0) = (32.24 \pm 0.29) \times 10^{-2}$ ,  $B(\eta \rightarrow \pi^+\pi^-\gamma) = (4.75 \pm 0.11) \times 10^{-2}$ , and  $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$ .

<sup>6</sup> From  $\eta \rightarrow \pi^+\pi^-\pi^0$  decays and using  $B(\pi^0 \rightarrow \gamma\gamma) = (98.798 \pm 0.033) \times 10^{-2}$ ,  $B(\pi^0 \rightarrow e^+e^-\gamma) = (1.198 \pm 0.032) \times 10^{-2}$ ,  $B(\eta \rightarrow \pi^+\pi^-\pi^0) = (23.0 \pm 0.4) \times 10^{-2}$ ,  $B(\phi \rightarrow \pi^+\pi^-\pi^0) = (15.5 \pm 0.6) \times 10^{-2}$ , and  $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$ .

NODE=M004R24  
NODE=M004R24

OCCUR=2  
OCCUR=3  
OCCUR=4

NODE=M004R24;LINKAGE=A  
NODE=M004R;LINKAGE=VM

NODE=M004R;LINKAGE=H1

NODE=M004R;LINKAGE=H2

NODE=M004R;LINKAGE=H3

NODE=M004R;LINKAGE=H4

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |    |                        |     |      |                                        |
|--------------------------|----|------------------------|-----|------|----------------------------------------|
| $0.71 \pm 0.11 \pm 0.09$ |    | <sup>1</sup> ACHASOV   | 00C | SND  | $e^+e^- \rightarrow \pi^+\pi^-$        |
| $0.65^{+0.38}_{-0.29}$   |    | <sup>1</sup> GOLUBEV   | 86  | ND   | $e^+e^- \rightarrow \pi^+\pi^-$        |
| $2.01^{+1.07}_{-0.84}$   |    | <sup>1</sup> VASSERMAN | 81  | OLYA | $e^+e^- \rightarrow \pi^+\pi^-$        |
| <6.6                     | 95 | BUKIN                  | 78B | OLYA | $e^+e^- \rightarrow \pi^+\pi^-$        |
| <2.7                     | 95 | ALVENSLEB...           | 72  | CNTR | $6.7 \gamma C \rightarrow C\pi^+\pi^-$ |

<sup>1</sup> Using  $B(\phi \rightarrow e^+e^-) = (2.99 \pm 0.08) \times 10^{-4}$ .

NODE=M004R18  
NODE=M004R18

NODE=M004R18;LINKAGE=8D

 $\Gamma(\omega\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**4.7±0.5 OUR FIT**

**5.2±1.3  
-1.1**

<sup>1,2</sup> AULCHENKO 00A SND  $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                             |  |                          |     |      |                                                    |
|-----------------------------|--|--------------------------|-----|------|----------------------------------------------------|
| $4.4 \pm 0.6$               |  | <sup>3</sup> AMBROSINO   | 08G | KLOE | $e^+e^- \rightarrow \pi^+\pi^-\pi^0, 2\pi^0\gamma$ |
| $\sim 5.4$                  |  | <sup>4</sup> ACHASOV     | 00E | SND  | $e^+e^- \rightarrow \pi^0\pi^0\gamma$              |
| $5.5^{+1.6}_{-1.4} \pm 0.3$ |  | <sup>2,5</sup> AULCHENKO | 00A | SND  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$          |
| $4.8^{+1.9}_{-1.7} \pm 0.8$ |  | <sup>4</sup> ACHASOV     | 99  | SND  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0$          |

<sup>1</sup> Using the 1996 and 1998 data.

<sup>2</sup>  $(2.3 \pm 0.3)\%$  correction for other decay modes of the  $\omega(782)$  applied.

<sup>3</sup> Not independent of the corresponding  $\Gamma(\omega\pi^0) \times \Gamma(e^+e^-) / \Gamma^2(\text{total})$ .

<sup>4</sup> Using the 1996 data.

<sup>5</sup> Using the 1998 data.

NODE=M004R28  
NODE=M004R28

OCCUR=2

NODE=M004R28;LINKAGE=K2  
NODE=M004R28;LINKAGE=K3  
NODE=M004R28;LINKAGE=AM  
NODE=M004R28;LINKAGE=VS  
NODE=M004R28;LINKAGE=K1

 $\Gamma(\omega\gamma)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

**<0.05** 84 LINDSEY 66 HBC  $2.1-2.7 K^-p \rightarrow \Lambda\pi^+\pi^-$  neutrals

NODE=M004R14  
NODE=M004R14

 $\Gamma(\rho\gamma)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

**< 0.12** 90 <sup>1</sup> AKHMETSHIN 99B CMD2  $e^+e^- \rightarrow \pi^+\pi^-\gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                |      |                                                       |
|------|----|----------------|------|-------------------------------------------------------|
| < 7  | 90 | AKHMETSHIN 97C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$                 |
| <200 | 84 | LINDSEY 66     | HBC  | $2.1-2.7 K^-p \rightarrow \Lambda\pi^+\pi^-$ neutrals |

<sup>1</sup> Supersedes AKHMETSHIN 97C.

NODE=M004R15  
NODE=M004R15

NODE=M004R;LINKAGE=1N

 $\Gamma(\pi^+\pi^-\gamma)/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**0.41±0.12±0.04** 30175 <sup>1</sup> AKHMETSHIN 99B CMD2  $e^+e^- \rightarrow \pi^+\pi^-\gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                             |      |                                                       |
|-------|----|-----------------------------|------|-------------------------------------------------------|
| < 0.3 | 90 | <sup>2</sup> AKHMETSHIN 97C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$                 |
| <600  | 90 | KALBFLEISCH 75              | HBC  | $2.18 K^-p \rightarrow \Lambda\pi^+\pi^-\gamma$       |
| < 70  | 90 | COSME 74                    | OSPK | $e^+e^- \rightarrow \pi^+\pi^-\gamma$                 |
| <400  | 90 | LINDSEY 65                  | HBC  | $2.1-2.7 K^-p \rightarrow \Lambda\pi^+\pi^-$ neutrals |

<sup>1</sup> For  $E_\gamma > 20$  MeV and assuming that  $B(\phi(1020) \rightarrow f_0(980)\gamma)$  is negligible. Supersedes AKHMETSHIN 97C.

<sup>2</sup> For  $E_\gamma > 20$  MeV and assuming that  $B(\phi(1020) \rightarrow f_0(980)\gamma)$  is negligible.

NODE=M004R12  
NODE=M004R12

NODE=M004R;LINKAGE=2N

NODE=M004R12;LINKAGE=Z3

 $\Gamma(f_0(980)\gamma)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**3.22±0.19 OUR FIT** Error includes scale factor of 1.1.

**3.21±0.19 OUR AVERAGE**

|                                 |  |                             |      |                                                         |
|---------------------------------|--|-----------------------------|------|---------------------------------------------------------|
| $3.21^{+0.03}_{-0.09} \pm 0.18$ |  | <sup>1</sup> AMBROSINO 07   | KLOE | $e^+e^- \rightarrow \pi^0\pi^0\gamma$                   |
| $2.90 \pm 0.21 \pm 1.54$        |  | <sup>2</sup> AKHMETSHIN 99C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma, \pi^0\pi^0\gamma$ |

NODE=M004R30  
NODE=M004R30

OCCUR=3

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                                  |       |                          |     |      |                                       |
|------------------------------------------------------------------|-------|--------------------------|-----|------|---------------------------------------|
| $4.47 \pm 0.21$                                                  | 2438  | <sup>3</sup> ALOISIO     | 02D | KLOE | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| $3.5 \pm 0.3 \begin{smallmatrix} +1.3 \\ -0.5 \end{smallmatrix}$ | 419   | <sup>4,5</sup> ACHASOV   | 00H | SND  | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| $1.93 \pm 0.46 \pm 0.50$                                         | 27188 | <sup>6</sup> AKHMETSHIN  | 99B | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| $3.05 \pm 0.25 \pm 0.72$                                         | 268   | <sup>7</sup> AKHMETSHIN  | 99C | CMD2 | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| $1.5 \pm 0.5$                                                    | 268   | <sup>8</sup> AKHMETSHIN  | 99C | CMD2 | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| $3.42 \pm 0.30 \pm 0.36$                                         | 164   | <sup>4</sup> ACHASOV     | 98I | SND  | $e^+e^- \rightarrow 5\gamma$          |
| $< 1$                                                            | 90    | <sup>9</sup> AKHMETSHIN  | 97C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| $< 7$                                                            | 90    | <sup>10</sup> AKHMETSHIN | 97C | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$ |
| $< 20$                                                           | 90    | DRUZHININ                | 87  | ND   | $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |

OCCUR=2

OCCUR=2

<sup>1</sup> Obtained by the authors taking into account the  $\pi^+\pi^-$  decay mode. Includes a component due to  $\pi\pi$  production via the  $f_0(500)$  meson. Supersedes ALOISIO 02D.

<sup>2</sup> From the combined fit of the photon spectra in the reactions  $e^+e^- \rightarrow \pi^+\pi^-\gamma$ ,  $\pi^0\pi^0\gamma$ .

<sup>3</sup> From the negative interference with the  $f_0(500)$  meson of AITALA 01B using the ACHASOV 89 parameterization for the  $f_0(980)$ , a Breit-Wigner for the  $f_0(500)$ , and ACHASOV 01F for the  $\rho\pi$  contribution. Superseded by AMBROSINO 07.

<sup>4</sup> Assuming that the  $\pi^0\pi^0\gamma$  final state is completely determined by the  $f_0\gamma$  mechanism, neglecting the decay  $B(\phi \rightarrow K\bar{K}\gamma)$  and using  $B(f_0 \rightarrow \pi^+\pi^-) = 2B(f_0 \rightarrow \pi^0\pi^0)$ .

<sup>5</sup> Using the value  $B(\phi \rightarrow \eta\gamma) = (1.338 \pm 0.053) \times 10^{-2}$ .

<sup>6</sup> For  $E_\gamma > 20$  MeV. Supersedes AKHMETSHIN 97C.

<sup>7</sup> Neglecting other intermediate mechanisms ( $\rho\pi$ ,  $\sigma\gamma$ ).

<sup>8</sup> A narrow pole fit taking into account  $f_0(980)$  and  $f_0(1200)$  intermediate mechanisms.

<sup>9</sup> For destructive interference with the Bremsstrahlung process

<sup>10</sup> For constructive interference with the Bremsstrahlung process

NODE=M004R30;LINKAGE=MB

NODE=M004R;LINKAGE=SL

NODE=M004R;LINKAGE=KD

NODE=M004R;LINKAGE=AI

NODE=M004R;LINKAGE=U8

NODE=M004R;LINKAGE=3N

NODE=M004R;LINKAGE=SM

NODE=M004R;LINKAGE=ST

NODE=M004R30;LINKAGE=A

NODE=M004R30;LINKAGE=B

### $\Gamma(f_0(980)\gamma)/\Gamma(\eta\gamma)$

 $\Gamma_{17}/\Gamma_6$ 

VALUE (units  $10^{-2}$ ) EVTS DOCUMENT ID TECN COMMENT

**$2.47^{+0.15}_{-0.16}$  OUR FIT** Error includes scale factor of 1.1.

**$2.6 \pm 0.2 \begin{smallmatrix} +0.8 \\ -0.3 \end{smallmatrix}$**  419 <sup>1</sup> ACHASOV 00H SND  $e^+e^- \rightarrow \pi^0\pi^0\gamma$

<sup>1</sup> Assuming that the  $\pi^0\pi^0\gamma$  final state is completely determined by the  $f_0\gamma$  mechanism, neglecting the decay  $B(\phi \rightarrow K\bar{K}\gamma)$  and using  $B(f_0 \rightarrow \pi^+\pi^-) = 2B(f_0 \rightarrow \pi^0\pi^0)$ .

NODE=M004R44  
NODE=M004R44

NODE=M004R44;LINKAGE=AI

### $\Gamma(\pi^0\pi^0\gamma)/\Gamma_{\text{total}}$

 $\Gamma_{18}/\Gamma$ 

VALUE (units  $10^{-4}$ ) CL% EVTS DOCUMENT ID TECN COMMENT

**$1.07 \pm 0.06$  OUR AVERAGE**

$1.07 \begin{smallmatrix} +0.01 & +0.06 \\ -0.03 & -0.06 \end{smallmatrix}$  <sup>1</sup> AMBROSINO 07 KLOE  $e^+e^- \rightarrow \pi^0\pi^0\gamma$

$1.08 \pm 0.17 \pm 0.09$  268 AKHMETSHIN 99C CMD2  $e^+e^- \rightarrow \pi^0\pi^0\gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.09 \pm 0.03 \pm 0.05$  2438 ALOISIO 02D KLOE  $e^+e^- \rightarrow \pi^0\pi^0\gamma$

$1.158 \pm 0.093 \pm 0.052$  419 <sup>2,3</sup> ACHASOV 00H SND  $e^+e^- \rightarrow \pi^0\pi^0\gamma$

$< 10$  90 DRUZHININ 87 ND  $e^+e^- \rightarrow 5\gamma$

<sup>1</sup> Supersedes ALOISIO 02D.

<sup>2</sup> Using the value  $B(\phi \rightarrow \eta\gamma) = (1.338 \pm 0.053) \times 10^{-2}$ .

<sup>3</sup> Supersedes ACHASOV 98I. Excluding  $\omega\pi^0$ .

NODE=M004R26  
NODE=M004R26

NODE=M004R26;LINKAGE=MB

NODE=M004R26;LINKAGE=U8

NODE=M004R26;LINKAGE=V8

### $\Gamma(\pi^0\pi^0\gamma)/\Gamma(\eta\gamma)$

 $\Gamma_{18}/\Gamma_6$ 

VALUE (units  $10^{-2}$ ) EVTS DOCUMENT ID TECN COMMENT

**$0.86 \pm 0.04$  OUR FIT**

**$0.865 \pm 0.070 \pm 0.017$**  419 <sup>1</sup> ACHASOV 00H SND  $e^+e^- \rightarrow \pi^0\pi^0\gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.90 \pm 0.08 \pm 0.07$  164 ACHASOV 98I SND  $e^+e^- \rightarrow 5\gamma$

<sup>1</sup> Supersedes ACHASOV 98I. Excluding  $\omega\pi^0$ .

NODE=M004R39  
NODE=M004R39

NODE=M004R39;LINKAGE=V8

### $\Gamma(\pi^+\pi^-\pi^+\pi^-)/\Gamma_{\text{total}}$

 $\Gamma_{19}/\Gamma$ 

VALUE (units  $10^{-6}$ ) CL% EVTS DOCUMENT ID TECN COMMENT

**$6.5 \pm 2.7 \pm 1.6$**  6.8k <sup>1</sup> AKHMETSHIN 17 CMD3  $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$3.93 \pm 1.74 \pm 2.14$  3.3k AKHMETSHIN 00E CMD2  $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$

$< 870$  90 CORDIER 79 WIRE  $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$

<sup>1</sup> Using the cross section at the  $\phi$  meson peak  $\sigma(\phi) = 4172 \pm 42$  nb, the nonresonant cross section  $\sigma(0) = 1.263 \pm 0.027$  nb and  $\text{Re}(Z) = 0.146 \pm 0.030$ ,  $\text{Im}(Z) = -0.002 \pm 0.024$  for the complex amplitude of the  $\phi \rightarrow \pi^+\pi^-\pi^+\pi^-$  transition.

NODE=M004R22  
NODE=M004R22

NODE=M004R22;LINKAGE=A

$$\Gamma(\pi^+\pi^+\pi^-\pi^-\pi^0)/\Gamma_{\text{total}}$$

$$\Gamma_{20}/\Gamma$$

| VALUE (units $10^{-6}$ )                                                      | CL% | DOCUMENT ID    | TECN | COMMENT                                            |
|-------------------------------------------------------------------------------|-----|----------------|------|----------------------------------------------------|
| < 4.6                                                                         | 90  | AKHMETSHIN 00E | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0$     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                |      |                                                    |
| <150                                                                          | 95  | BARKOV         | 88   | CMD $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0$ |

NODE=M004R27  
NODE=M004R27

$$\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{21}/\Gamma$$

| VALUE (units $10^{-5}$ )                                                      | CL%  | EVTS | DOCUMENT ID | TECN | COMMENT                                 |
|-------------------------------------------------------------------------------|------|------|-------------|------|-----------------------------------------|
| <b>1.33<sup>+0.07</sup><sub>-0.10</sub> OUR AVERAGE</b>                       |      |      |             |      |                                         |
| 1.35 ± 0.05 <sup>+0.05</sup> <sub>-0.10</sub>                                 | 9.5k | 1    | ANASTASI    | 16B  | KLOE $e^+e^- \rightarrow \pi^0 e^+ e^-$ |
| 1.01 ± 0.28 ± 0.29                                                            | 52   | 2    | ACHASOV     | 02D  | SND $e^+e^- \rightarrow \pi^0 e^+ e^-$  |
| 1.22 ± 0.34 ± 0.21                                                            | 46   | 3    | AKHMETSHIN  | 01C  | CMD2 $e^+e^- \rightarrow \pi^0 e^+ e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |      |             |      |                                         |
| <12                                                                           | 90   |      | DOLINSKY    | 88   | ND $e^+e^- \rightarrow \pi^0 e^+ e^-$   |

NODE=M004R31  
NODE=M004R31

<sup>1</sup> Using  $B(\pi^0 \rightarrow \gamma\gamma)$  from the 2014 Edition of this Review (PDG 14).

<sup>2</sup> Using various branching ratios from the 2000 Edition of this Review (PDG 00).

<sup>3</sup> Using  $B(\pi^0 \rightarrow \gamma\gamma) = 0.98798 \pm 0.00032$ ,  $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033) \times 10^{-2}$ , and  $B(\eta \rightarrow \pi^+\pi^-\gamma) = (4.75 \pm 0.11) \times 10^{-2}$ .

NODE=M004R31;LINKAGE=A  
NODE=M004R;LINKAGE=DS  
NODE=M004R;LINKAGE=5H

$$\Gamma(\pi^0 \eta\gamma)/\Gamma_{\text{total}}$$

$$\Gamma_{22}/\Gamma$$

| VALUE (units $10^{-5}$ )                                                                   | CL%   | EVTS | DOCUMENT ID | TECN | COMMENT                                        |
|--------------------------------------------------------------------------------------------|-------|------|-------------|------|------------------------------------------------|
| <b>7.27 ± 0.30 OUR AVERAGE</b> Error includes scale factor of 1.5. See the ideogram below. |       |      |             |      |                                                |
| 7.06 ± 0.22                                                                                | 16.9k | 1    | AMBROSINO   | 09F  | KLOE 1.02 $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 8.51 ± 0.51 ± 0.57                                                                         | 607   | 2    | ALOISIO     | 02C  | KLOE $e^+e^- \rightarrow \eta\pi^0\gamma$      |
| 7.96 ± 0.60 ± 0.40                                                                         | 197   | 3    | ALOISIO     | 02C  | KLOE $e^+e^- \rightarrow \eta\pi^0\gamma$      |
| 8.8 ± 1.4 ± 0.9                                                                            | 36    | 4    | ACHASOV     | 00F  | SND $e^+e^- \rightarrow \eta\pi^0\gamma$       |
| 9.0 ± 2.4 ± 1.0                                                                            | 80    |      | AKHMETSHIN  | 99C  | CMD2 $e^+e^- \rightarrow \eta\pi^0\gamma$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • •              |       |      |             |      |                                                |
| 7.01 ± 0.10 ± 0.20                                                                         | 13.3k | 2,5  | AMBROSINO   | 09F  | KLOE 1.02 $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 7.12 ± 0.13 ± 0.22                                                                         | 3.6k  | 3,6  | AMBROSINO   | 09F  | KLOE 1.02 $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| 8.3 ± 2.3 ± 1.2                                                                            | 20    |      | ACHASOV     | 98B  | SND $e^+e^- \rightarrow 5\gamma$               |
| <250                                                                                       | 90    |      | DOLINSKY    | 91   | ND $e^+e^- \rightarrow \pi^0\eta\gamma$        |

NODE=M004R32  
NODE=M004R32

OCCUR=2

OCCUR=2

OCCUR=3

<sup>1</sup> Combined results of  $\eta \rightarrow \gamma\gamma$  and  $\eta \rightarrow \pi^+\pi^-\pi^0$  decay modes measurements.

<sup>2</sup> From the decay mode  $\eta \rightarrow \gamma\gamma$ .

<sup>3</sup> From the decay mode  $\eta \rightarrow \pi^+\pi^-\pi^0$ .

<sup>4</sup> Supersedes ACHASOV 98B.

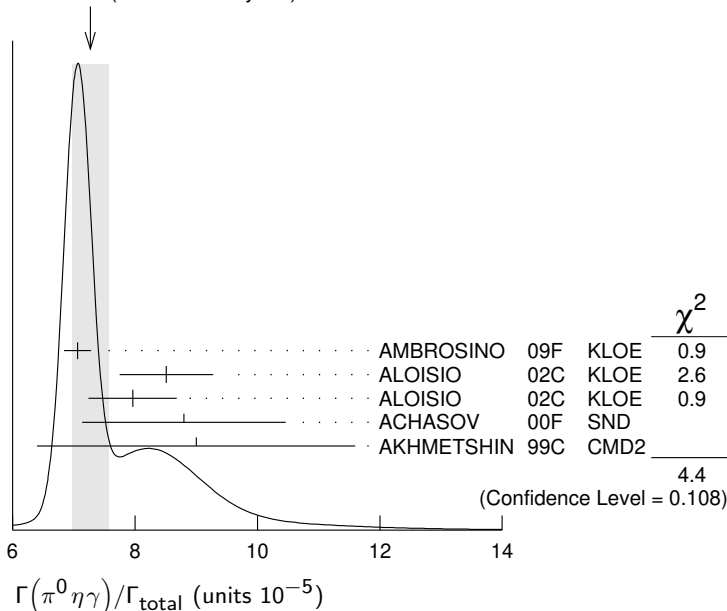
<sup>5</sup> Using  $B(\phi \rightarrow \eta\gamma) = (1.304 \pm 0.025)\%$ ,  $B(\eta \rightarrow 3\pi^0) = (32.56 \pm 0.23)\%$ , and  $B(\eta \rightarrow \gamma\gamma) = (39.31 \pm 0.20)\%$ .

<sup>6</sup> Using  $B(\phi \rightarrow \eta\gamma) = (1.304 \pm 0.025)\%$ ,  $B(\eta \rightarrow 3\pi^0) = (32.56 \pm 0.23)\%$ , and  $B(\eta \rightarrow \pi^+\pi^-\pi^0) = (22.73 \pm 0.28)\%$ .

NODE=M004R32;LINKAGE=AM  
NODE=M004R;LINKAGE=C1  
NODE=M004R;LINKAGE=C2  
NODE=M004R32;LINKAGE=AF  
NODE=M004R32;LINKAGE=AB

NODE=M004R32;LINKAGE=AR

WEIGHTED AVERAGE  
7.27 ± 0.30 (Error scaled by 1.5)



$\Gamma(a_0(980)\gamma)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                              |
|-------------------------------------------------------------------------------|-----|------|----------------------|----------|--------------------------------------|
| <b><math>7.6 \pm 0.6</math> OUR FIT</b>                                       |     |      |                      |          |                                      |
| <b><math>7.6 \pm 0.6</math> OUR AVERAGE</b>                                   |     |      |                      |          |                                      |
| $7.4 \pm 0.7$                                                                 |     |      | <sup>1</sup> ALOISIO | 02C KLOE | $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| $8.8 \pm 1.7$                                                                 | 36  |      | <sup>2</sup> ACHASOV | 00F SND  | $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                      |          |                                      |
| $11 \pm 2$                                                                    |     |      | <sup>3</sup> GOKALP  | 02 RVUE  | $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| <500                                                                          | 90  |      | DOLINSKY             | 91 ND    | $e^+e^- \rightarrow \pi^0\eta\gamma$ |

<sup>1</sup> Using  $M_{a_0(980)}=984.8$  MeV and assuming  $a_0(980)\gamma$  dominance.

<sup>2</sup> Assuming  $a_0(980)\gamma$  dominance in the  $\eta\pi^0\gamma$  final state.

<sup>3</sup> Using data of ACHASOV 00F.

NODE=M004R33  
NODE=M004R33

NODE=M004R;LINKAGE=C3  
NODE=M004R33;LINKAGE=AF  
NODE=M004R;LINKAGE=GK

 $\Gamma(f_0(980)\gamma)/\Gamma(a_0(980)\gamma)$ 

| VALUE                                                                                                                                | DOCUMENT ID          | TECN     | COMMENT                              |
|--------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|--------------------------------------|
| <b><math>6.1 \pm 0.6</math></b>                                                                                                      | <sup>1</sup> ALOISIO | 02C KLOE | $e^+e^- \rightarrow \eta\pi^0\gamma$ |
| <sup>1</sup> Using results of ALOISIO 02D and assuming that $f_0(980)$ decays into $\pi\pi$ only and $a_0(980)$ into $\eta\pi$ only. |                      |          |                                      |

NODE=M004R47  
NODE=M004R47

NODE=M004R;LINKAGE=C4

 $\Gamma(K^0\bar{K}^0\gamma)/\Gamma_{\text{total}}$ 

| VALUE                                      | CL% | DOCUMENT ID | TECN     | COMMENT                                 |
|--------------------------------------------|-----|-------------|----------|-----------------------------------------|
| <b><math>&lt;1.9 \times 10^{-8}</math></b> | 90  | AMBROSINO   | 09C KLOE | $e^+e^- \rightarrow K_S^0 K_S^0 \gamma$ |

NODE=M004R48  
NODE=M004R48

 $\Gamma(\eta'(958)\gamma)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )                                                      | CL%  | EVTS | DOCUMENT ID             | TECN     | COMMENT                                                |
|-------------------------------------------------------------------------------|------|------|-------------------------|----------|--------------------------------------------------------|
| <b><math>6.22 \pm 0.21</math> OUR FIT</b>                                     |      |      |                         |          |                                                        |
| <b><math>6.22 \pm 0.30</math> OUR AVERAGE</b>                                 |      |      |                         |          |                                                        |
| $6.22 \pm 0.27 \pm 0.12$                                                      | 3407 |      | <sup>1</sup> AMBROSINO  | 07A KLOE | $1.02 e^+e^- \rightarrow \pi^+\pi^-\gamma$             |
| $6.7^{+2.8}_{-2.4} \pm 0.8$                                                   | 12   |      | <sup>2</sup> AULCHENKO  | 03B SND  | $e^+e^- \rightarrow \eta'\gamma$                       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |      |                         |          |                                                        |
| $6.7^{+5.0}_{-4.2} \pm 1.5$                                                   | 7    |      | AULCHENKO               | 03B SND  | $e^+e^- \rightarrow 7\gamma$                           |
| $6.10 \pm 0.61 \pm 0.43$                                                      | 120  |      | <sup>3</sup> ALOISIO    | 02E KLOE | $1.02 e^+e^- \rightarrow \pi^+\pi^-\gamma$             |
| $8.2^{+2.1}_{-1.9} \pm 1.1$                                                   | 21   |      | <sup>4</sup> AKHMETSHIN | 00B CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$                  |
| $4.9^{+2.2}_{-1.8} \pm 0.6$                                                   | 9    |      | <sup>5</sup> AKHMETSHIN | 00F CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^- \geq 2\gamma$ |
| $6.4 \pm 1.6$                                                                 | 30   |      | <sup>6</sup> AKHMETSHIN | 00F CMD2 | $e^+e^- \rightarrow \eta'(958)\gamma$                  |
| $6.7^{+3.4}_{-2.9} \pm 1.0$                                                   | 5    |      | <sup>7</sup> AULCHENKO  | 99 SND   | $e^+e^- \rightarrow \pi^+\pi^-\gamma$                  |
| <11                                                                           | 90   |      | AULCHENKO               | 98 SND   | $e^+e^- \rightarrow 7\gamma$                           |
| $12^{+7}_{-5} \pm 2$                                                          | 6    |      | <sup>4</sup> AKHMETSHIN | 97B CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma$                  |
| <41                                                                           | 90   |      | DRUZHININ               | 87 ND    | $e^+e^- \rightarrow \gamma\eta\pi^+\pi^-$              |

NODE=M004R25  
NODE=M004R25

OCCUR=2

OCCUR=2

<sup>1</sup> AMBROSINO 07A reports  $[\Gamma(\phi(1020) \rightarrow \eta'(958)\gamma)/\Gamma_{\text{total}}] / [B(\phi(1020) \rightarrow \eta\gamma)] = (4.77 \pm 0.09 \pm 0.19) \times 10^{-3}$  which we multiply by our best value  $B(\phi(1020) \rightarrow \eta\gamma) = (1.303 \pm 0.025) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Averaging AULCHENKO 03B with AULCHENKO 99.

<sup>3</sup> Using  $B(\phi \rightarrow \eta\gamma) = (1.297 \pm 0.033)\%$ .

<sup>4</sup> Using the value  $B(\phi \rightarrow \eta\gamma) = (1.26 \pm 0.06) \times 10^{-2}$ .

<sup>5</sup> Using  $B(\phi \rightarrow K_L^0 K_S^0) = (33.8 \pm 0.6)\%$ .

<sup>6</sup> Averaging AKHMETSHIN 00B with AKHMETSHIN 00F.

<sup>7</sup> Using the value  $B(\eta' \rightarrow \eta\pi^+\pi^-) = (43.7 \pm 1.5) \times 10^{-2}$  and  $B(\eta \rightarrow \gamma\gamma) = (39.25 \pm 0.31) \times 10^{-2}$ .

NODE=M004R25;LINKAGE=AM

NODE=M004R25;LINKAGE=BK  
NODE=M004R;LINKAGE=E2  
NODE=M004R25;LINKAGE=Q  
NODE=M004R;LINKAGE=T2  
NODE=M004R;LINKAGE=T3  
NODE=M004R25;LINKAGE=AU

 $\Gamma(\eta'(958)\gamma)/\Gamma(K_L^0 K_S^0)$ 

| VALUE (units $10^{-4}$ )                          | EVTS | DOCUMENT ID             | TECN     | COMMENT                                                |
|---------------------------------------------------|------|-------------------------|----------|--------------------------------------------------------|
| <b><math>1.83 \pm 0.06</math> OUR FIT</b>         |      |                         |          |                                                        |
| <b><math>1.46^{+0.64}_{-0.54} \pm 0.18</math></b> | 9    | <sup>1</sup> AKHMETSHIN | 00F CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^- \geq 2\gamma$ |

<sup>1</sup> Using various branching ratios of  $K_S^0$ ,  $K_L^0$ ,  $\eta$ ,  $\eta'$  from the 2000 edition (The European Physical Journal **C15** 1 (2000)) of this Review.

NODE=M004R43  
NODE=M004R43

NODE=M004R;LINKAGE=T1



$\Gamma(\eta'(958)\gamma)/\Gamma(\eta\gamma)$  $\Gamma_{25}/\Gamma_6$ VALUE (units  $10^{-3}$ ) EVTS

DOCUMENT ID TECN COMMENT

**4.77±0.15 OUR FIT****4.78±0.20 OUR AVERAGE**4.77±0.09±0.19 3407 AMBROSINO 07A KLOE 1.02  $e^+e^- \rightarrow \pi^+\pi^-7\gamma$ 4.70±0.47±0.31 120 <sup>1</sup> ALOISIO 02E KLOE 1.02  $e^+e^- \rightarrow \pi^+\pi^-3\gamma$ 6.5  $^{+1.7}_{-1.5}$  ±0.8 21 AKHMETSHIN 00B CMD2  $e^+e^- \rightarrow \pi^+\pi^-3\gamma$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

9.5  $^{+5.2}_{-4.0}$  ±1.4 6 <sup>2</sup> AKHMETSHIN 97B CMD2  $e^+e^- \rightarrow \pi^+\pi^-3\gamma$ <sup>1</sup> From the decay mode  $\eta' \rightarrow \eta\pi^+\pi^-$ ,  $\eta \rightarrow \gamma\gamma$ .<sup>2</sup> Superseded by AKHMETSHIN 00B.NODE=M004R34  
NODE=M004R34NODE=M004R;LINKAGE=E1  
NODE=M004R;LINKAGE=KS $\Gamma(\eta\pi^0\pi^0\gamma)/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ VALUE (units  $10^{-5}$ ) CL%

DOCUMENT ID TECN COMMENT

<2 90 AULCHENKO 98 SND  $e^+e^- \rightarrow 7\gamma$ NODE=M004R36  
NODE=M004R36 $\Gamma(\mu^+\mu^-\gamma)/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ VALUE (units  $10^{-5}$ ) EVTS

DOCUMENT ID TECN COMMENT

**1.43±0.45±0.14** 27188 <sup>1</sup> AKHMETSHIN 99B CMD2  $e^+e^- \rightarrow \mu^+\mu^-\gamma$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.3 ±1.0 824 ± 33 <sup>2</sup> AKHMETSHIN 97C CMD2  $e^+e^- \rightarrow \mu^+\mu^-\gamma$ <sup>1</sup> For  $E_\gamma > 20$  MeV. Supersedes AKHMETSHIN 97C.<sup>2</sup> For  $E_\gamma > 20$  MeV.NODE=M004R35  
NODE=M004R35NODE=M004R35;LINKAGE=3N  
NODE=M004R35;LINKAGE=A $\Gamma(\rho\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{28}/\Gamma$ VALUE (units  $10^{-4}$ ) CL%

DOCUMENT ID TECN COMMENT

<1.2 90 AULCHENKO 08 CMD2  $\phi \rightarrow \pi^+\pi^-\gamma\gamma$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

<5 90 AKHMETSHIN 98 CMD2  $e^+e^- \rightarrow \pi^+\pi^-\gamma\gamma$ NODE=M004R37  
NODE=M004R37 $\Gamma(\eta\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ VALUE (units  $10^{-5}$ ) CL%

DOCUMENT ID TECN COMMENT

< 1.8 90 AKHMETSHIN 00E CMD2  $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 6.1 90 AULCHENKO 08 CMD2  $\phi \rightarrow \eta\pi^+\pi^-$ <30 90 AKHMETSHIN 98 CMD2  $e^+e^- \rightarrow \pi^+\pi^-\gamma\gamma$ NODE=M004R38  
NODE=M004R38 $\Gamma(\eta\mu^+\mu^-)/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ VALUE (units  $10^{-6}$ ) CL%

DOCUMENT ID TECN COMMENT

<9.4 90 AKHMETSHIN 01 CMD2  $e^+e^- \rightarrow \eta e^+e^-$ NODE=M004R45  
NODE=M004R45 $\Gamma(\eta U \rightarrow \eta e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ 

VALUE CL%

DOCUMENT ID TECN COMMENT

<1 × 10<sup>-6</sup> 90 <sup>1</sup> BABUSCI 13B KLOE 1.02  $e^+e^- \rightarrow \eta e^+e^-$ <sup>1</sup> For a narrow vector  $U$  with mass between 5 and 470 MeV, from the combined analysis of  $\eta \rightarrow \pi^+\pi^-\pi^0$  and  $\eta \rightarrow \pi^0\pi^0\pi^0$  from ARCHILLI 12. Measured 90% CL limits as a function of  $m_U$  range from  $2.2 \times 10^{-8}$  to  $10^{-6}$ .NODE=M004R01  
NODE=M004R01

NODE=M004R01;LINKAGE=A

 $\Gamma(\text{invisible})/\Gamma(K^+K^-)$  $\Gamma_{32}/\Gamma_1$ 

VALUE CL%

DOCUMENT ID TECN COMMENT

<3.4 × 10<sup>-4</sup> 90 ABLIKIM 18S BES3  $J/\psi \rightarrow \phi\eta \rightarrow \phi\pi^+\pi^-\pi^0$ NODE=M004R02  
NODE=M004R02

## ———— Lepton Family number (LF) violating modes ————

NODE=M00422A

 $\Gamma(e^\pm\mu^\mp)/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

VALUE CL%

DOCUMENT ID TECN COMMENT

<2 × 10<sup>-6</sup> 90 ACHASOV 10A SND  $e^+e^- \rightarrow e^\pm\mu^\mp$ NODE=M004R29  
NODE=M004R29 $\pi^+\pi^-\pi^0 / \rho\pi$  AMPLITUDE RATIO  $a_1$  IN DECAY OF  $\phi \rightarrow \pi^+\pi^-\pi^0$ 

NODE=M004D1

NIECKNIG 12 describes final-state interactions between the three pions in a dispersive framework using data on the  $\pi\pi$   $P$ -wave scattering phase shift.

NODE=M004D1

| VALUE (units $10^{-2}$ )                                                                                         | CL%   | EVTs | DOCUMENT ID                  | TECN | COMMENT                                          |
|------------------------------------------------------------------------------------------------------------------|-------|------|------------------------------|------|--------------------------------------------------|
| <b>9.1±1.2 OUR AVERAGE</b>                                                                                       |       |      |                              |      |                                                  |
| 10.1±4.4±1.7                                                                                                     | 80k   |      | <sup>1</sup> AKHMETSHIN 06   | CMD2 | 1.017–1.021 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
| 9.0±1.1±0.6                                                                                                      | 1.98M |      | <sup>2,3</sup> ALOISIO 03    | KLOE | 1.02 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                    |       |      |                              |      |                                                  |
| −6 < $a_1$ < 6                                                                                                   | 500k  |      | <sup>3</sup> ACHASOV 02      | SND  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$             |
| −16 < $a_1$ < 11                                                                                                 | 90    | 9.8k | <sup>1,4</sup> AKHMETSHIN 98 | CMD2 | $e^+e^- \rightarrow \pi^+\pi^-\gamma\gamma$      |
| <sup>1</sup> Dalitz plot analysis taking into account interference between the contact and $\rho\pi$ amplitudes. |       |      |                              |      |                                                  |
| <sup>2</sup> From a fit without limitations on charged and neutral $\rho$ masses and widths.                     |       |      |                              |      |                                                  |
| <sup>3</sup> Recalculated by us to match the notations of AKHMETSHIN 98.                                         |       |      |                              |      |                                                  |
| <sup>4</sup> Assuming zero phase for the contact term.                                                           |       |      |                              |      |                                                  |

NODE=M004D1

NODE=M004D1;LINKAGE=AK

NODE=M004D;LINKAGE=L1

NODE=M004D;LINKAGE=L3

NODE=M004D1;LINKAGE=KL

## PARAMETER $\beta$ IN $\phi \rightarrow Pe^+e^-$ DECAYS

In the one-pole approximation the electromagnetic transition form factor for  $\phi \rightarrow Pe^+e^-$  ( $P = \pi, \eta$ ) is given as a function of the  $e^+e^-$  invariant mass squared,  $q^2$ , by the expression:

$$|F(q^2)|^2 = (1 - q^2/\Lambda^2)^{-2},$$

where vector meson dominance predicts parameter  $\Lambda \approx 0.770$  GeV ( $\Lambda^{-2} \approx 1.687$  GeV $^{-2}$ ). The slope of this form factor,  $\beta = dF/dq^2(q^2=0)$ , equals  $\Lambda^{-2}$  in this approximation.

The measurements below obtain  $\beta$  in the one-pole approximation.

NODE=M004230

NODE=M004230

## PARAMETER $\beta$ IN $\phi \rightarrow \pi^0 e^+e^-$ DECAY

| VALUE (GeV $^{-2}$ )                                                      | EVTs | DOCUMENT ID               | TECN | COMMENT                                |
|---------------------------------------------------------------------------|------|---------------------------|------|----------------------------------------|
| <b>2.02±0.11</b>                                                          | 9.5k | <sup>1</sup> ANASTASI 16B | KLOE | 1.02 $e^+e^- \rightarrow \pi^0 e^+e^-$ |
| <sup>1</sup> The error combines statistical and systematic uncertainties. |      |                           |      |                                        |

NODE=M004A00  
NODE=M004A00

NODE=M004A00;LINKAGE=A

## PARAMETER $\beta$ IN $\phi \rightarrow \eta e^+e^-$ DECAY

| VALUE (GeV $^{-2}$ )                                                                               | EVTs | DOCUMENT ID              | TECN | COMMENT                               |
|----------------------------------------------------------------------------------------------------|------|--------------------------|------|---------------------------------------|
| <b>1.29±0.13 OUR AVERAGE</b>                                                                       |      |                          |      |                                       |
| 1.28±0.10 <sup>+0.09</sup> <sub>−0.08</sub>                                                        | 30k  | BABUSCI 15               | KLOE | 1.02 $e^+e^- \rightarrow \eta e^+e^-$ |
| 3.8 ±1.8                                                                                           | 213  | <sup>1</sup> ACHASOV 01B | SND  | 1.02 $e^+e^- \rightarrow \eta e^+e^-$ |
| <sup>1</sup> The uncertainty is statistical only. The systematic one is negligible, in comparison. |      |                          |      |                                       |

NODE=M004BFP  
NODE=M004BFP

NODE=M004BFP;LINKAGE=A

## $\phi(1020)$ REFERENCES

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| HOID 20        | EPJ C80 988             | B.-L. Hoid, M. Hoferichter, B. Kubis  | (BONN, BERN)              | REFID=61048         |
| AAIJ 19H       | JHEP 1904 063           | R. Aaij <i>et al.</i>                 | (LHCb Collab.)            | REFID=59670         |
| HOERICHT... 19 | JHEP 1908 137           | M. Hoferichter, B.-L. Hoid, B. Kubis  | (WASH, BONN)              | REFID=60974         |
| ABLIKIM 18S    | PR D98 032001           | M. Ablikim <i>et al.</i>              | (BESIII Collab.)          | REFID=58971         |
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| KOZYREV 18     | PL B779 64              | E.A. Kozyrev <i>et al.</i>            | (CMD-3 Collab.)           | REFID=58794         |
| AKHMETSHIN 17  | PL B768 345             | R.R. Akhmetshin <i>et al.</i>         | (CMD-3 Collab.)           | REFID=57893         |
| ACHASOV 16A    | PR D93 092001           | M.N. Achasov <i>et al.</i>            | (SND Collab.)             | REFID=57513         |
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| LEES 14H       | PR D89 092002           | J.P. Lees <i>et al.</i>               | (BABAR Collab.)           | REFID=55940         |
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| ARCHILLI 12    | PL B706 251             | F. Archilli <i>et al.</i>             | (KLOE-2 Collab.)          | REFID=53951         |
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| AKHMETSHIN 11  | PL B695 412             | R.R. Akhmetshin <i>et al.</i>         | (CMD-2 Collab.)           | REFID=53645         |
| ACHASOV 10A    | PR D81 057102           | M.N. Achasov <i>et al.</i>            | (Novosibirsk SND Collab.) | REFID=53352         |
| BENAYOUN 10    | EPJ C65 211             | M. Benayoun <i>et al.</i>             |                           | REFID=53212         |
| AMBROSINO 09C  | PL B679 10              | F. Ambrosino <i>et al.</i>            | (KLOE Collab.)            | REFID=52969         |
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Translated from ZETFP 88 93.

NODE=M004

|             |     |                                |                                                |                             |             |
|-------------|-----|--------------------------------|------------------------------------------------|-----------------------------|-------------|
| FLOREZ-BAEZ | 08  | PR D78 077301                  | F.V. Florez-Baez, G. Lopez Castro              |                             | REFID=52584 |
| ACHASOV     | 07B | PR D76 077101                  | M.N. Achasov <i>et al.</i>                     | (SND Collab.)               | REFID=51942 |
| AMBROSINO   | 07  | EPJ C49 473                    | F. Ambrosino <i>et al.</i>                     | (KLOE Collab.)              | REFID=51616 |
| AMBROSINO   | 07A | PL B648 267                    | F. Ambrosino <i>et al.</i>                     | (KLOE Collab.)              | REFID=51646 |
| DUBYNISKIY  | 07  | PR D75 113001                  | S. Dubynskiy <i>et al.</i>                     |                             | REFID=51719 |
| ACHASOV     | 06A | PR D74 014016                  | M.N. Achasov <i>et al.</i>                     | (SND Collab.)               | REFID=51133 |
| AKHMETSHIN  | 06  | PL B642 203                    | R.R. Akhmetshin <i>et al.</i>                  | (CMD-2 Collab.)             | REFID=51465 |
| AKHMETSHIN  | 05  | PL B605 26                     | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=50330 |
| AMBROSINO   | 05  | PL B608 199                    | F. Ambrosino <i>et al.</i>                     | (KLOE Collab.)              | REFID=50453 |
| AUBERT,B    | 05J | PR D72 052008                  | B. Aubert <i>et al.</i>                        | (BABAR Collab.)             | REFID=50824 |
| AKHMETSHIN  | 04  | PL B578 285                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=49609 |
| AUBERT,B    | 04N | PR D70 072004                  | B. Aubert <i>et al.</i>                        | (BABAR Collab.)             | REFID=50184 |
| ALOISIO     | 03  | PL B561 55                     | A. Aloisio <i>et al.</i>                       | (KLOE Collab.)              | REFID=49404 |
| AULCHENKO   | 03B | JETP 97 24                     | V.M. Aulchenko <i>et al.</i>                   | (Novosibirsk SND Collab.)   | REFID=49613 |
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| ACHASOV     | 02  | PR D65 032002                  | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=48549 |
| ACHASOV     | 02D | JETPL 75 449                   | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=48814 |
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| ALOISIO     | 02C | PL B536 209                    | A. Aloisio <i>et al.</i>                       | (KLOE Collab.)              | REFID=48823 |
| ALOISIO     | 02D | PL B537 21                     | A. Aloisio <i>et al.</i>                       | (KLOE Collab.)              | REFID=48824 |
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| FISCHBACH   | 02  | PL B526 355                    | E. Fischbach, A.W. Overhauser, B. Woodahl      |                             | REFID=48575 |
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| ACHASOV     | 01B | PL B504 275                    | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=48111 |
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| AKHMETSHIN  | 01  | PL B501 191                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=48110 |
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| BRAMON      | 00  | PL B486 406                    | A. Bramon <i>et al.</i>                        |                             | REFID=47969 |
| PDG         | 00  | EPJ C15 1                      | D.E. Groom <i>et al.</i>                       | (PDG Collab.)               | REFID=47469 |
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| AKHMETSHIN  | 99F | PL B460 242                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=47473 |
| AULCHENKO   | 99  | JETPL 69 97                    | V.M. Aulchenko <i>et al.</i>                   |                             | REFID=46920 |
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| ACHASOV     | 98B | PL B438 441                    | M.N. Achasov <i>et al.</i>                     | (Novosibirsk SND Collab.)   | REFID=46317 |
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| AKHMETSHIN  | 98  | PL B434 426                    | R.R. Akhmetshin <i>et al.</i>                  | (CMD-2 Collab.)             | REFID=46325 |
| AULCHENKO   | 98  | PL B436 199                    | V.M. Aulchenko <i>et al.</i>                   | (Novosibirsk SND Collab.)   | REFID=46336 |
| BARBERIS    | 98  | PL B432 436                    | D. Barberis <i>et al.</i>                      | (Omega Expt.)               | REFID=46344 |
| AKHMETSHIN  | 97B | PL B415 445                    | R.R. Akhmetshin <i>et al.</i>                  | (NOVO, BOST, PITT+)         | REFID=45801 |
| AKHMETSHIN  | 97C | PL B415 452                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=45802 |
| BENAYOUN    | 96  | ZPHY C72 221                   | M. Benayoun <i>et al.</i>                      | (IPNP, NOVO)                | REFID=45753 |
| AKHMETSHIN  | 95  | PL B364 199                    | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.) | REFID=44617 |
| DOLINSKY    | 91  | PRPL 202 99                    | S.I. Dolinsky <i>et al.</i>                    | (NOVO)                      | REFID=41369 |
| KUHN        | 90  | ZPHY C48 445                   | J.H. Kuhn <i>et al.</i>                        | (MPIM)                      | REFID=45862 |
| ACHASOV     | 89  | NP B315 465                    | N.N. Achasov, V.N. Ivanchenko                  |                             | REFID=48021 |
| DOLINSKY    | 89  | ZPHY C42 511                   | S.I. Dolinsky <i>et al.</i>                    | (NOVO)                      | REFID=41003 |
| BARKOV      | 88  | SJNP 47 248                    | L.M. Barkov <i>et al.</i>                      | (NOVO)                      | REFID=41024 |
|             |     | Translated from YAF 47 393.    |                                                |                             |             |
| DOLINSKY    | 88  | SJNP 48 277                    | S.I. Dolinsky <i>et al.</i>                    | (NOVO)                      | REFID=41022 |
|             |     | Translated from YAF 48 442.    |                                                |                             |             |
| DRUZHININ   | 87  | ZPHY C37 1                     | V.P. Druzhinin <i>et al.</i>                   | (NOVO)                      | REFID=40448 |
| ARMSTRONG   | 86  | PL 166B 245                    | T.A. Armstrong <i>et al.</i>                   | (ATHU, BARI, BIRM+)         | REFID=20563 |
| ATKINSON    | 86  | ZPHY C30 521                   | M. Atkinson <i>et al.</i>                      | (BONN, CERN, GLAS+)         | REFID=20564 |
| BEBEK       | 86  | PRL 56 1893                    | C. Bebek <i>et al.</i>                         | (CLEO Collab.)              | REFID=11540 |
| DAVENPORT   | 86  | PR D33 2519                    | T.F. Davenport (TUFTS, ARIZ, FNAL, FSU, NDAM+) |                             | REFID=20567 |
| DIJKSTRA    | 86  | ZPHY C31 375                   | H. Dijkstra <i>et al.</i>                      | (ANIK, BRIS, CERN+)         | REFID=20568 |
| FRAME       | 86  | NP B276 667                    | D. Frame <i>et al.</i>                         | (GLAS)                      | REFID=20569 |
| GOLUBEV     | 86  | SJNP 44 409                    | V.B. Golubev <i>et al.</i>                     | (NOVO)                      | REFID=40449 |
|             |     | Translated from YAF 44 633.    |                                                |                             |             |
| ALBRECHT    | 85D | PL 153B 343                    | H. Albrecht <i>et al.</i>                      | (ARGUS Collab.)             | REFID=20562 |
| GOLUBEV     | 85  | SJNP 41 756                    | V.B. Golubev <i>et al.</i>                     | (NOVO)                      | REFID=40450 |
|             |     | Translated from YAF 41 1183.   |                                                |                             |             |
| DRUZHININ   | 84  | PL 144B 136                    | V.P. Druzhinin <i>et al.</i>                   | (NOVO)                      | REFID=20561 |
| ARMSTRONG   | 83B | NP B224 193                    | T.A. Armstrong <i>et al.</i>                   | (BARI, BIRM, CERN+)         | REFID=20558 |
| BARATE      | 83  | PL 121B 449                    | R. Barate <i>et al.</i>                        | (SACL, LOIC, SHMP, IND)     | REFID=12177 |
| KURDADZE    | 83C | JETPL 38 366                   | L.M. Kurdadze <i>et al.</i>                    | (NOVO)                      | REFID=20560 |
|             |     | Translated from ZETFP 38 306.  |                                                |                             |             |
| ARENTON     | 82  | PR D25 2241                    | M.W. Arenton <i>et al.</i>                     | (ANL, ILL)                  | REFID=20556 |
| PELLINEN    | 82  | PS 25 599                      | A. Pellinen, M. Roos                           | (HELs)                      | REFID=20557 |
| DAUM        | 81  | PL 100B 439                    | C. Daum <i>et al.</i>                          | (AMST, BRIS, CERN, CRAC+)   | REFID=20552 |
| IVANOV      | 81  | PL 107B 297                    | P.M. Ivanov <i>et al.</i>                      | (NOVO)                      | REFID=20553 |
| Also        |     | Private Comm.                  | S.I. Eidelman                                  | (NOVO)                      | REFID=20554 |
| VASSERMAN   | 81  | PL 99B 62                      | I.B. Vasserman <i>et al.</i>                   | (NOVO)                      | REFID=20555 |
| Also        |     | SJNP 35 240                    | L.M. Kurdadze <i>et al.</i>                    |                             | REFID=47475 |
|             |     | Translated from YAF 35 352.    |                                                |                             |             |

|                                         |     |                            |                                             |                            |             |
|-----------------------------------------|-----|----------------------------|---------------------------------------------|----------------------------|-------------|
| CORDIER                                 | 80  | NP B172 13                 | A. Cordier <i>et al.</i>                    | (LALO)                     | REFID=20240 |
| CORDIER                                 | 79  | PL 81B 389                 | A. Cordier <i>et al.</i>                    | (LALO)                     | REFID=20549 |
| BUKIN                                   | 78B | SJNP 27 521                | A.D. Bukin <i>et al.</i>                    | (NOVO)                     | REFID=20545 |
| BUKIN                                   | 78C | Translated from YAF 27 985 | A.D. Bukin <i>et al.</i>                    | (NOVO)                     | REFID=20544 |
| COOPER                                  | 78B | NP B146 1                  | A.M. Cooper <i>et al.</i>                   | (TATA, CERN, CDEF+)        | REFID=20235 |
| LOSTY                                   | 78  | NP B133 38                 | M.J. Losty <i>et al.</i>                    | (CERN, AMST, NIJM+)        | REFID=20547 |
| AKERLOF                                 | 77  | PRL 39 861                 | C.W. Akerlof <i>et al.</i>                  | (FNAL, MICH, PURD)         | REFID=20534 |
| ANDREWS                                 | 77  | PRL 38 198                 | D.E. Andrews <i>et al.</i>                  | (ROCH)                     | REFID=20120 |
| BALDI                                   | 77  | PL 68B 381                 | R. Baldi <i>et al.</i>                      | (GEVA)                     | REFID=20536 |
| CERRADA                                 | 77B | NP B126 241                | M. Cerrada <i>et al.</i>                    | (AMST, CERN, NIJM+)        | REFID=20537 |
| COHEN                                   | 77  | PRL 38 269                 | D. Cohen <i>et al.</i>                      | (ANL)                      | REFID=20538 |
| LAVEN                                   | 77  | NP B127 43                 | H. Laven <i>et al.</i>                      | (AACH3, BERL, CERN, LOIC+) | REFID=20541 |
| LYONS                                   | 77  | NP B125 207                | L. Lyons, A.M. Cooper, A.G. Clark           | (OXF)                      | REFID=20232 |
| COSME                                   | 76  | PL 63B 352                 | G. Cosme <i>et al.</i>                      | (ORSAY)                    | REFID=20529 |
| KALBFLEISCH                             | 76  | PR D13 22                  | G.R. Kalbfleisch, R.C. Strand, J.W. Chapman | (BNL+)                     | REFID=20531 |
| PARROUR                                 | 76  | PL 63B 357                 | G. Parrou <i>et al.</i>                     | (ORSAY)                    | REFID=20532 |
| PARROUR                                 | 76B | PL 63B 362                 | G. Parrou <i>et al.</i>                     | (ORSAY)                    | REFID=20533 |
| KALBFLEISCH                             | 75  | PR D11 987                 | G.R. Kalbfleisch, R.C. Strand, J.W. Chapman | (BNL+)                     | REFID=20223 |
| AYRES                                   | 74  | PRL 32 1463                | D.S. Ayres <i>et al.</i>                    | (ANL)                      | REFID=20522 |
| BESCH                                   | 74  | NP B70 257                 | H.J. Besch <i>et al.</i>                    | (BONN)                     | REFID=20523 |
| COSME                                   | 74  | PL 48B 155                 | G. Cosme <i>et al.</i>                      | (ORSAY)                    | REFID=20525 |
| COSME                                   | 74B | PL 48B 159                 | G. Cosme <i>et al.</i>                      | (ORSAY)                    | REFID=20526 |
| DEGROOT                                 | 74  | NP B74 77                  | A.J. de Groot <i>et al.</i>                 | (AMST, NIJM)               | REFID=20527 |
| AUGUSTIN                                | 73  | PRL 30 462                 | J.E. Augustin <i>et al.</i>                 | (ORSAY)                    | REFID=47515 |
| BALLAM                                  | 73  | PR D7 3150                 | J. Ballam <i>et al.</i>                     | (SLAC, LBL)                | REFID=20520 |
| BINNIE                                  | 73B | PR D8 2789                 | D.M. Binnie <i>et al.</i>                   | (LOIC, SHMP)               | REFID=20216 |
| AGUILAR-...                             | 72B | PR D6 29                   | M. Aguilar-Benitez <i>et al.</i>            | (BNL)                      | REFID=20205 |
| ALVENSLEB...                            | 72  | PRL 28 66                  | H. Alvensleben <i>et al.</i>                | (MIT, DESY)                | REFID=20514 |
| BORENSTEIN                              | 72  | PR D5 1559                 | S.R. Borenstein <i>et al.</i>               | (BNL, MICH)                | REFID=20215 |
| COLLEY                                  | 72  | NP B50 1                   | D.C. Colley <i>et al.</i>                   | (BIRM, GLAS)               | REFID=20519 |
| BALAKIN                                 | 71  | PL 34B 328                 | V.E. Balakin <i>et al.</i>                  | (NOVO)                     | REFID=20507 |
| CHATELUS                                | 71  | Thesis LAL 1247            | Y. Chatelus                                 | (STRB)                     | REFID=20508 |
| Also                                    |     | PL 32B 416                 | J.C. Bizot <i>et al.</i>                    | (ORSAY)                    | REFID=20501 |
| HAYES                                   | 71  | PR D4 899                  | S. Hayes <i>et al.</i>                      | (CORN)                     | REFID=20511 |
| STOTTLE...                              | 71  | Thesis ORO 2504 170        | A.R. Stottlemyer                            | (UMD)                      | REFID=20512 |
| BIZOT                                   | 70  | PL 32B 416                 | J.C. Bizot <i>et al.</i>                    | (ORSAY)                    | REFID=20501 |
| Also                                    |     | Liverpool Sym. 69          | J.P. Perez-y-Jorba                          |                            | REFID=20502 |
| EARLES                                  | 70  | PRL 25 1312                | D.R. Earles <i>et al.</i>                   | (NEAS)                     | REFID=20504 |
| LINDSEY                                 | 66  | PR 147 913                 | J.S. Lindsey, G. Smith                      | (LRL)                      | REFID=20481 |
| LONDON                                  | 66  | PR 143 1034                | G.W. London <i>et al.</i>                   | (BNL, SYRA)                | REFID=11774 |
| BADIER                                  | 65B | PL 17 337                  | J. Badier <i>et al.</i>                     | (EPOL, SACL, AMST)         | REFID=20253 |
| LINDSEY                                 | 65  | PRL 15 221                 | J.S. Lindsey, G.A. Smith                    | (LRL)                      | REFID=20478 |
| LINDSEY 65 data included in LINDSEY 66. |     |                            |                                             |                            |             |
| SCHLEIN                                 | 63  | PRL 10 368                 | P.E. Schlein <i>et al.</i>                  | (UCLA) IGJP                | REFID=20474 |

# h<sub>1</sub>(1170)

$$I^G(J^{PC}) = 0^-(1^{+-})$$

## h<sub>1</sub>(1170) MASS

| VALUE (MeV)         | DOCUMENT ID       | TECN | CHG  | COMMENT                                     |
|---------------------|-------------------|------|------|---------------------------------------------|
| <b>1166 ± 5 ± 3</b> | <sup>1</sup> ANDO | 92   | SPEC | 8 $\pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |                         |    |      |                                             |
|-----------|-------------------------|----|------|---------------------------------------------|
| 1168 ± 4  | ANDO                    | 92 | SPEC | 8 $\pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$ |
| 1190 ± 60 | <sup>2</sup> DANKOWY... | 81 | SPEC | 0 8 $\pi p \rightarrow 3\pi n$              |

<sup>1</sup> Average and spread of values using 2 variants of the model of BOWLER 75.

<sup>2</sup> Uses the model of BOWLER 75.

## h<sub>1</sub>(1170) WIDTH

| VALUE (MeV)         | DOCUMENT ID       | TECN | CHG  | COMMENT                                     |
|---------------------|-------------------|------|------|---------------------------------------------|
| <b>375 ± 6 ± 34</b> | <sup>3</sup> ANDO | 92   | SPEC | 8 $\pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |                         |    |      |                                             |
|----------|-------------------------|----|------|---------------------------------------------|
| 345 ± 6  | ANDO                    | 92 | SPEC | 8 $\pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$ |
| 320 ± 50 | <sup>4</sup> DANKOWY... | 81 | SPEC | 0 8 $\pi p \rightarrow 3\pi n$              |

<sup>3</sup> Average and spread of values using 2 variants of the model of BOWLER 75.

<sup>4</sup> Uses the model of BOWLER 75.

## h<sub>1</sub>(1170) DECAY MODES

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1 \quad \rho\pi$ | seen                           |

REFID=20240  
REFID=20549  
REFID=20545  
REFID=20544  
REFID=20235  
REFID=20547  
REFID=20534  
REFID=20120  
REFID=20536  
REFID=20537  
REFID=20538  
REFID=20541  
REFID=20232  
REFID=20529  
REFID=20531  
REFID=20532  
REFID=20533  
REFID=20223  
REFID=20522  
REFID=20523  
REFID=20525  
REFID=20526  
REFID=20527  
REFID=47515  
REFID=20520  
REFID=20216  
REFID=20205  
REFID=20514  
REFID=20215  
REFID=20519  
REFID=20507  
REFID=20508  
REFID=20501  
REFID=20511  
REFID=20512  
REFID=20501  
REFID=20502  
REFID=20504  
REFID=20481  
REFID=11774  
REFID=20253  
REFID=20478  
REFID=20474

NODE=M030

NODE=M030M

NODE=M030M

OCCUR=2

NODE=M030M;LINKAGE=B

NODE=M030M;LINKAGE=C

NODE=M030W

NODE=M030W

OCCUR=2

NODE=M030W;LINKAGE=B

NODE=M030W;LINKAGE=C

NODE=M030215;NODE=M030

DESIG=1;OUR EST;→ UNCHECKED ←

**$h_1(1170)$  BRANCHING RATIOS**

NODE=M030220

 $\Gamma(\rho\pi)/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                               |
|-------------------------------------------------------------------------------|-------------|------|-------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                                       |
| seen                                                                          | ANDO        | 92   | SPEC $8 \pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$      |
| seen                                                                          | ATKINSON    | 84   | OMEG $20-70 \gamma p \rightarrow \pi^+ \pi^- \pi^0 p$ |
| seen                                                                          | DANKOWY...  | 81   | SPEC $8 \pi p \rightarrow 3 \pi n$                    |

NODE=M030R1  
NODE=M030R1 **$h_1(1170)$  REFERENCES**

|            |    |             |                              |                          |
|------------|----|-------------|------------------------------|--------------------------|
| ANDO       | 92 | PL B291 496 | A. Ando <i>et al.</i>        | (KEK, KYOT, NIRS, SAGA+) |
| ATKINSON   | 84 | NP B231 15  | M. Atkinson <i>et al.</i>    | (BONN, CERN, GLAS+)      |
| DANKOWY... | 81 | PRL 46 580  | J.A. Dankowycz <i>et al.</i> | (TNT0, BNL, CARL+)       |
| BOWLER     | 75 | NP B97 227  | M.G. Bowler <i>et al.</i>    | (OXFTP, DARE)            |

NODE=M030

REFID=43171  
REFID=20574  
REFID=20572  
REFID=20571 **$b_1(1235)$** 

$$I^G(J^{PC}) = 1^+(1^{+-})$$

NODE=M011

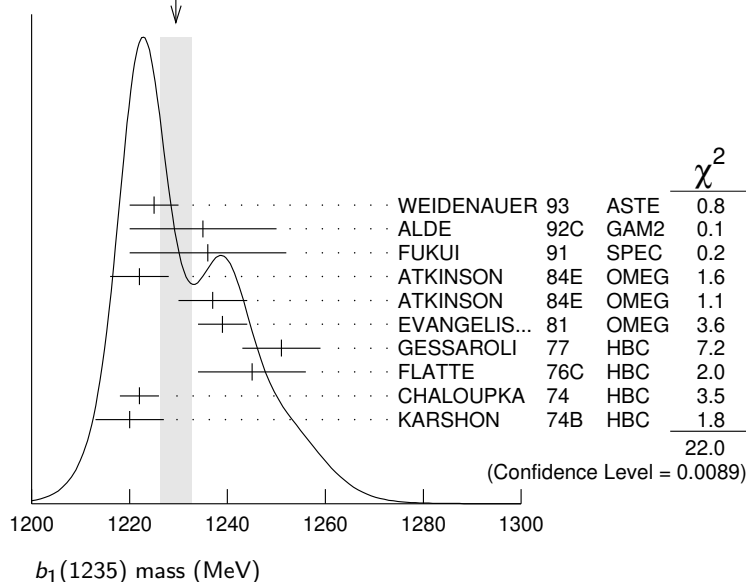
 **$b_1(1235)$  MASS**

NODE=M011M

| VALUE (MeV)                                                                                 | EVTS | DOCUMENT ID   | TECN | CHG    | COMMENT                                       |
|---------------------------------------------------------------------------------------------|------|---------------|------|--------|-----------------------------------------------|
| <b>1229.5 ± 3.2 OUR AVERAGE</b> Error includes scale factor of 1.6. See the ideogram below. |      |               |      |        |                                               |
| 1225 ± 5                                                                                    |      | WEIDENAUER 93 | ASTE |        | $\bar{p} p \rightarrow 2\pi^+ 2\pi^- \pi^0$   |
| 1235 ± 15                                                                                   |      | ALDE          | 92C  | GAM2   | $38,100 \pi^- p \rightarrow \omega \pi^0 n$   |
| 1236 ± 16                                                                                   |      | FUKUI         | 91   | SPEC   | $8.95 \pi^- p \rightarrow \omega \pi^0 n$     |
| 1222 ± 6                                                                                    |      | ATKINSON      | 84E  | OMEG ± | $25-55 \gamma p \rightarrow \omega \pi X$     |
| 1237 ± 7                                                                                    |      | ATKINSON      | 84E  | OMEG 0 | $25-55 \gamma p \rightarrow \omega \pi X$     |
| 1239 ± 5                                                                                    |      | EVANGELIS...  | 81   | OMEG - | $12 \pi^- p \rightarrow \omega \pi p$         |
| 1251 ± 8                                                                                    | 450  | GESSAROLI     | 77   | HBC -  | $11 \pi^- p \rightarrow \pi^- \omega p$       |
| 1245 ± 11                                                                                   | 890  | FLATTE        | 76C  | HBC -  | $4.2 K^- p \rightarrow \pi^- \omega \Sigma^+$ |
| 1222 ± 4                                                                                    | 1400 | CHALOUPKA     | 74   | HBC -  | $3.9 \pi^- p$                                 |
| 1220 ± 7                                                                                    | 600  | KARSHON       | 74B  | HBC +  | $4.9 \pi^+ p$                                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • •               |      |               |      |        |                                               |
| 1190 ± 10                                                                                   |      | AUGUSTIN      | 89   | DM2 ±  | $e^+ e^- \rightarrow 5\pi$                    |
| 1213 ± 5                                                                                    |      | ATKINSON      | 84C  | OMEG 0 | $20-70 \gamma p$                              |
| 1271 ± 11                                                                                   |      | COLLICK       | 84   | SPEC + | $200 \pi^+ Z \rightarrow Z \pi \omega$        |

NODE=M011M

OCCUR=2

WEIGHTED AVERAGE  
1229.5±3.2 (Error scaled by 1.6) **$b_1(1235)$  WIDTH**

NODE=M011W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                         | TECN | CHG  | COMMENT                                       |
|-------------------------------------------------------------------------------|------|-------------------------------------|------|------|-----------------------------------------------|
| <b>142 ± 9 OUR AVERAGE</b>                                                    |      | Error includes scale factor of 1.2. |      |      |                                               |
| 113 ± 12                                                                      |      | WEIDENAUER 93                       | ASTE |      | $\bar{p}p \rightarrow 2\pi^+ 2\pi^- \pi^0$    |
| 160 ± 30                                                                      |      | ALDE                                | 92C  | GAM2 | $38,100 \pi^- p \rightarrow \omega \pi^0 n$   |
| 151 ± 31                                                                      |      | FUKUI                               | 91   | SPEC | $8.95 \pi^- p \rightarrow \omega \pi^0 n$     |
| 170 ± 15                                                                      |      | EVANGELIS...                        | 81   | OMEG | $12 \pi^- p \rightarrow \omega \pi p$         |
| 170 ± 50                                                                      | 225  | BALTAY                              | 78B  | HBC  | $15 \pi^+ p \rightarrow p 4\pi$               |
| 155 ± 32                                                                      | 450  | GESSAROLI                           | 77   | HBC  | $11 \pi^- p \rightarrow \pi^- \omega p$       |
| 182 ± 45                                                                      | 890  | FLATTE                              | 76C  | HBC  | $4.2 K^- p \rightarrow \pi^- \omega \Sigma^+$ |
| 135 ± 20                                                                      | 1400 | CHALOUPKA                           | 74   | HBC  | $3.9 \pi^- p$                                 |
| 156 ± 22                                                                      | 600  | KARSHON                             | 74B  | HBC  | $4.9 \pi^+ p$                                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                     |      |      |                                               |
| 210 ± 19                                                                      |      | AUGUSTIN                            | 89   | DM2  | $e^+ e^- \rightarrow 5\pi$                    |
| 231 ± 14                                                                      |      | ATKINSON                            | 84C  | OMEG | $20-70 \gamma p$                              |
| 232 ± 29                                                                      |      | COLLICK                             | 84   | SPEC | $200 \pi^+ Z \rightarrow Z \pi \omega$        |

NODE=M011W

 **$b_1(1235)$  DECAY MODES**

NODE=M011215;NODE=M011

| Mode                                                                     | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|--------------------------------------------------------------------------|--------------------------------|------------------|
| $\Gamma_1$ $\omega \pi$<br>[ $D/S$ amplitude ratio = $0.277 \pm 0.027$ ] | seen                           |                  |
| $\Gamma_2$ $\pi^\pm \gamma$                                              | $(1.6 \pm 0.4) \times 10^{-3}$ |                  |
| $\Gamma_3$ $\eta \rho$                                                   | seen                           |                  |
| $\Gamma_4$ $\pi^+ \pi^+ \pi^- \pi^0$                                     | < 50 %                         | 84%              |
| $\Gamma_5$ $K^*(892)^\pm K^\mp$                                          | seen                           |                  |
| $\Gamma_6$ $(KK)^\pm \pi^0$                                              | < 8 %                          | 90%              |
| $\Gamma_7$ $K_S^0 K_L^0 \pi^\pm$                                         | < 6 %                          | 90%              |
| $\Gamma_8$ $K_S^0 K_S^0 \pi^\pm$                                         | < 2 %                          | 90%              |
| $\Gamma_9$ $\phi \pi$                                                    | < 1.5 %                        | 84%              |

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=9

DESIG=8;OUR EST;→ UNCHECKED ←

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=74

DESIG=71;OUR EST;→ UNCHECKED ←

DESIG=73;OUR EST;→ UNCHECKED ←

DESIG=72;OUR EST;→ UNCHECKED ←

DESIG=5;OUR EST;→ UNCHECKED ←

 **$b_1(1235)$  PARTIAL WIDTHS**

NODE=M011220

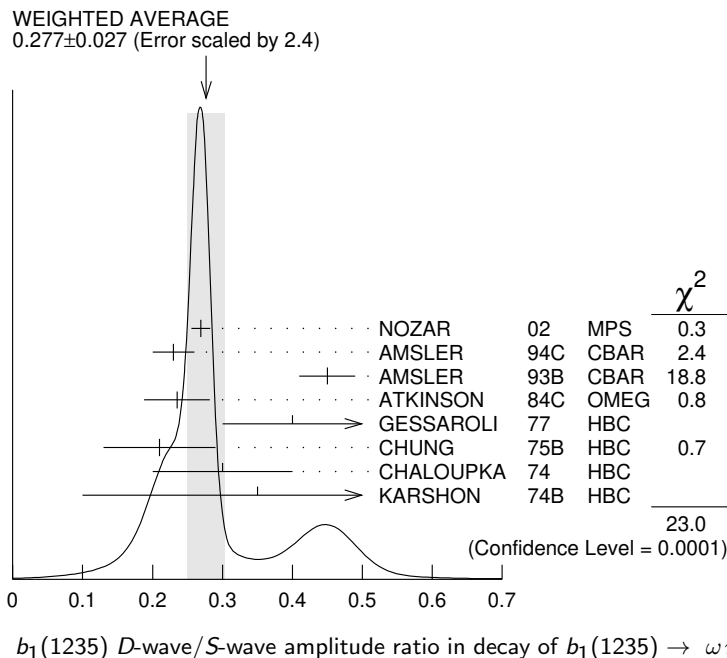
| $\Gamma(\pi^\pm \gamma)$ | DOCUMENT ID | TECN | CHG  | COMMENT                                | $\Gamma_2$ |
|--------------------------|-------------|------|------|----------------------------------------|------------|
| VALUE (keV)              |             |      |      |                                        |            |
| <b>230 ± 60</b>          | COLLICK     | 84   | SPEC | $200 \pi^+ Z \rightarrow Z \pi \omega$ |            |

NODE=M011W3  
NODE=M011W3 **$b_1(1235)$  D-wave/S-wave AMPLITUDE RATIO  
IN DECAY OF  $b_1(1235) \rightarrow \omega \pi$** 

NODE=M011DS

| VALUE                            | EVTS | DOCUMENT ID                                                 | TECN | CHG  | COMMENT                                        |
|----------------------------------|------|-------------------------------------------------------------|------|------|------------------------------------------------|
| <b>0.277 ± 0.027 OUR AVERAGE</b> |      | Error includes scale factor of 2.4. See the ideogram below. |      |      |                                                |
| 0.269 ± 0.009 ± 0.010            |      | NOZAR                                                       | 02   | MPS  | $18 \pi^- p \rightarrow \omega \pi^- p$        |
| 0.23 ± 0.03                      |      | AMSLER                                                      | 94C  | CBAR | $0.0 \bar{p} p \rightarrow \omega \eta \pi^0$  |
| 0.45 ± 0.04                      |      | AMSLER                                                      | 93B  | CBAR | $0.0 \bar{p} p \rightarrow \omega \pi^0 \pi^0$ |
| 0.235 ± 0.047                    |      | ATKINSON                                                    | 84C  | OMEG | $20-70 \gamma p$                               |
| 0.4 $^{+0.1}_{-0.1}$             |      | GESSAROLI                                                   | 77   | HBC  | $11 \pi^- p \rightarrow \pi^- \omega p$        |
| 0.21 ± 0.08                      |      | CHUNG                                                       | 75B  | HBC  | $7.1 \pi^+ p$                                  |
| 0.3 ± 0.1                        |      | CHALOUPKA                                                   | 74   | HBC  | $3.9-7.5 \pi^- p$                              |
| 0.35 ± 0.25                      | 600  | KARSHON                                                     | 74B  | HBC  | $4.9 \pi^+ p$                                  |

NODE=M011DS



### $b_1(1235)$ D-wave/S-wave AMPLITUDE PHASE DIFFERENCE IN DECAY OF $b_1(1235) \rightarrow \omega\pi$

NODE=M011PH

| VALUE (°)    | DOCUMENT ID | TECN | CHG | COMMENT                                  |
|--------------|-------------|------|-----|------------------------------------------|
| 10.5±2.4±3.9 | NOZAR       | 02   | MPS | — 18 $\pi^- p \rightarrow \omega\pi^- p$ |

NODE=M011PH

### $b_1(1235)$ BRANCHING RATIOS

NODE=M011230

#### $\Gamma(\eta\rho)/\Gamma(\omega\pi)$

| VALUE | DOCUMENT ID | TECN | CHG  | COMMENT          | $\Gamma_3/\Gamma_1$ |
|-------|-------------|------|------|------------------|---------------------|
| <0.10 | ATKINSON    | 84D  | OMEG | 20–70 $\gamma p$ |                     |

NODE=M011R9  
NODE=M011R9

#### $\Gamma(\pi^+\pi^+\pi^-\pi^0)/\Gamma(\omega\pi)$

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT         | $\Gamma_4/\Gamma_1$ |
|-------|-------------|------|-----|-----------------|---------------------|
| <0.5  | ABOLINS     | 63   | HBC | + 3.5 $\pi^+ p$ |                     |

NODE=M011R1  
NODE=M011R1

#### $\Gamma(K^*(892)^\pm K^\mp)/\Gamma_{\text{total}}$

| VALUE | DOCUMENT ID          | TECN | CHG  | COMMENT                                        | $\Gamma_5/\Gamma$ |
|-------|----------------------|------|------|------------------------------------------------|-------------------|
| seen  | <sup>1</sup> ABLIKIM | 10E  | BES2 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp \pi^0$ |                   |

NODE=M011R10  
NODE=M011R10

<sup>1</sup> From a fit including ten additional resonances and energy-independent Breit-Wigner width.

NODE=M011R10;LINKAGE=AB

#### $\Gamma((K\bar{K})^\pm \pi^0)/\Gamma(\omega\pi)$

| VALUE | CL% | DOCUMENT ID | TECN | CHG | COMMENT          | $\Gamma_6/\Gamma_1$ |
|-------|-----|-------------|------|-----|------------------|---------------------|
| <0.08 | 90  | BALTAY      | 67   | HBC | ± 0.0 $\bar{p}p$ |                     |

NODE=M011R6  
NODE=M011R6

#### $\Gamma(K_S^0 K_L^0 \pi^\pm)/\Gamma(\omega\pi)$

| VALUE | CL% | DOCUMENT ID | TECN | CHG | COMMENT          | $\Gamma_7/\Gamma_1$ |
|-------|-----|-------------|------|-----|------------------|---------------------|
| <0.06 | 90  | BALTAY      | 67   | HBC | ± 0.0 $\bar{p}p$ |                     |

NODE=M011R8  
NODE=M011R8

#### $\Gamma(K_S^0 K_S^0 \pi^\pm)/\Gamma(\omega\pi)$

| VALUE | CL% | DOCUMENT ID | TECN | CHG | COMMENT          | $\Gamma_8/\Gamma_1$ |
|-------|-----|-------------|------|-----|------------------|---------------------|
| <0.02 | 90  | BALTAY      | 67   | HBC | ± 0.0 $\bar{p}p$ |                     |

NODE=M011R7  
NODE=M011R7

#### $\Gamma(\phi\pi)/\Gamma(\omega\pi)$

| VALUE  | CL% | DOCUMENT ID | TECN | CHG  | COMMENT                                      | $\Gamma_9/\Gamma_1$ |
|--------|-----|-------------|------|------|----------------------------------------------|---------------------|
| <0.004 | 95  | VIKTOROV    | 96   | SPEC | 0 32.5 $\pi^- p \rightarrow K^+ K^- \pi^0 n$ |                     |

NODE=M011R4  
NODE=M011R4

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |          |    |     |                   |
|--------|----|----------|----|-----|-------------------|
| <0.04  | 95 | BIZZARRI | 69 | HBC | ± 0.0 $\bar{p}p$  |
| <0.015 |    | DAHL     | 67 | HBC | 1.6–4.2 $\pi^- p$ |

**$b_1(1235)$  REFERENCES**

|              |     |                              |                              |                          |
|--------------|-----|------------------------------|------------------------------|--------------------------|
| ABLIKIM      | 10E | PL B693 88                   | M. Ablikim <i>et al.</i>     | (BES II Collab.)         |
| NOZAR        | 02  | PL B541 35                   | M. Nozar <i>et al.</i>       |                          |
| VIKTOROV     | 96  | PAN 59 1184                  | V.A. Viktorov <i>et al.</i>  | (SERP)                   |
|              |     | Translated from YAF 59 1239. |                              |                          |
| AMSLER       | 94C | PL B327 425                  | C. Amsler <i>et al.</i>      | (Crystal Barrel Collab.) |
| AMSLER       | 93B | PL B311 362                  | C. Amsler <i>et al.</i>      | (Crystal Barrel Collab.) |
| WEIDENAUER   | 93  | ZPHY C59 387                 | P. Weidenauer <i>et al.</i>  | (ASTERIX Collab.)        |
| ALDE         | 92C | ZPHY C54 553                 | D.M. Alde <i>et al.</i>      | (BELG, SERP, KEK, LANL+) |
| FUKUI        | 91  | PL B257 241                  | S. Fukui <i>et al.</i>       | (SUGI, NAGO, KEK, KYOT+) |
| AUGUSTIN     | 89  | NP B320 1                    | J.E. Augustin, G. Cosme      | (DM2 Collab.)            |
| ATKINSON     | 84C | NP B243 1                    | M. Atkinson <i>et al.</i>    | (BONN, CERN, GLAS+) JP   |
| ATKINSON     | 84D | NP B242 269                  | M. Atkinson <i>et al.</i>    | (BONN, CERN, GLAS+)      |
| ATKINSON     | 84E | PL 138B 459                  | M. Atkinson <i>et al.</i>    | (BONN, CERN, GLAS+)      |
| COLLICK      | 84  | PRL 53 2374                  | B. Collick <i>et al.</i>     | (MINN, ROCH, FNAL)       |
| EVANGELIS... | 81  | NP B178 197                  | C. Evangelista <i>et al.</i> | (BARI, BONN, CERN+)      |
| BALTAY       | 78B | PR D17 62                    | C. Baltay <i>et al.</i>      | (COLU, BING)             |
| GESSAROLI    | 77  | NP B126 382                  | R. Gessaroli <i>et al.</i>   | (BGNA, FIRZ, GENO+) JP   |
| FLATTE       | 76C | PL 64B 225                   | S.M. Flatte <i>et al.</i>    | (CERN, AMST, NIJ+) JP    |
| CHUNG        | 75B | PR D11 2426                  | S.U. Chung <i>et al.</i>     | (BNL, LBL, UCSC) JP      |
| CHALOUPKA    | 74  | PL 51B 407                   | V. Chaloupka <i>et al.</i>   | (CERN) JP                |
| KARSHON      | 74B | PR D10 3608                  | U. Karshon <i>et al.</i>     | (REHO) JP                |
| BIZZARRI     | 69  | NP B14 169                   | R. Bizzarri <i>et al.</i>    | (CERN, CDEF)             |
| BALTAY       | 67  | PRL 18 93                    | C. Baltay <i>et al.</i>      | (COLU)                   |
| DAHL         | 67  | PR 163 1377                  | O.I. Dahl <i>et al.</i>      | (LRL)                    |
| ABOLINS      | 63  | PRL 11 381                   | M.A. Abolins <i>et al.</i>   | (UCSD)                   |

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 **$a_1(1260)$** 

$$I^G(J^{PC}) = 1^-(1^{++})$$

See also our review under the  $a_1(1260)$  in PDG 06, Journal of Physics **G33** 1 (2006).

NODE=M010

NODE=M010

 **$a_1(1260)$  MASS**

| VALUE (MeV)                                                                   | EVTs                | DOCUMENT ID                 | TECN | COMMENT                                                                                         |
|-------------------------------------------------------------------------------|---------------------|-----------------------------|------|-------------------------------------------------------------------------------------------------|
| <b>1230 ± 40</b>                                                              | <b>OUR ESTIMATE</b> |                             |      |                                                                                                 |
| <b>1299 +12 -28</b>                                                           | 46M                 | <sup>1</sup> AGHASYAN       | 18B  | COMP 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$                                              |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                     |                             |      |                                                                                                 |
| 1195.05 ± 1.05 ± 6.33                                                         | 894k                | AAIJ                        | 18A  | LHCB $D^0 \rightarrow K^\mp \pi^\pm \pi^\pm \pi^\mp$                                            |
| 1209 ± 4 +12 -9                                                               |                     | <sup>2</sup> MIKHASENKO     | 18   | RVUE $\tau^- \rightarrow \pi^- \pi^+ \pi^- \nu_\tau$                                            |
| 1225 ± 9 ± 20                                                                 | 7k                  | <sup>3</sup> DARGENT        | 17   | RVUE $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$                                                  |
| 1255 ± 6 +7 -17                                                               | 420k                | <sup>4</sup> ALEKSEEV       | 10   | COMP 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$                                           |
| 1243 ± 12 ± 20                                                                |                     | <sup>5</sup> AUBERT         | 07AU | BABR 10.6 $e^+ e^- \rightarrow \rho^0 \pi^\pm \pi^\mp \gamma$                                   |
| 1230–1270                                                                     | 6360                | <sup>6</sup> LINK           | 07A  | FOCS $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$                                                  |
| 1203 ± 3                                                                      |                     | <sup>7</sup> GOMEZ-DUM.     | 04   | RVUE $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu_\tau$                                            |
| 1330 ± 24                                                                     | 90k                 | SALVINI                     | 04   | OBLX $\bar{p} p \rightarrow 2\pi^+ 2\pi^-$                                                      |
| 1331 ± 10 ± 3                                                                 | 37k                 | <sup>8</sup> ASNER          | 00   | CLE2 10.6 $e^+ e^- \rightarrow \tau^+ \tau^-$ , $\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |
| 1255 ± 7 ± 6                                                                  | 5904                | <sup>9</sup> ABREU          | 98G  | DLPH $e^+ e^-$                                                                                  |
| 1207 ± 5 ± 8                                                                  | 5904                | <sup>10</sup> ABREU         | 98G  | DLPH $e^+ e^-$                                                                                  |
| 1196 ± 4 ± 5                                                                  | 5904                | <sup>11,12</sup> ABREU      | 98G  | DLPH $e^+ e^-$                                                                                  |
| 1240 ± 10                                                                     |                     | BARBERIS                    | 98B  | 450 $pp \rightarrow p_f \pi^+ \pi^- \pi^0 p_s$                                                  |
| 1262 ± 9 ± 7                                                                  |                     | <sup>9,13</sup> ACKERSTAFF  | 97R  | OPAL $E_{cm}^{ee} = 88-94, \tau \rightarrow 3\pi \nu$                                           |
| 1210 ± 7 ± 2                                                                  |                     | <sup>10,13</sup> ACKERSTAFF | 97R  | OPAL $E_{cm}^{ee} = 88-94, \tau \rightarrow 3\pi \nu$                                           |
| 1211 ± 7 +50 -0                                                               |                     | <sup>10</sup> ALBRECHT      | 93C  | ARG $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                  |
| 1121 ± 8                                                                      |                     | <sup>14</sup> ANDO          | 92   | SPEC 8 $\pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$                                                |
| 1242 ± 37                                                                     |                     | <sup>15</sup> IVANOV        | 91   | RVUE $\tau \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                   |
| 1260 ± 14                                                                     |                     | <sup>16</sup> IVANOV        | 91   | RVUE $\tau \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                   |
| 1250 ± 9                                                                      |                     | <sup>17</sup> IVANOV        | 91   | RVUE $\tau \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                   |
| 1208 ± 15                                                                     |                     | ARMSTRONG                   | 90   | OMEG 300.0 $pp \rightarrow p p \pi^+ \pi^- \pi^0$                                               |
| 1220 ± 15                                                                     |                     | <sup>18</sup> ISGUR         | 89   | RVUE $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                 |
| 1260 ± 25                                                                     |                     | <sup>19</sup> BOWLER        | 88   | RVUE                                                                                            |
| 1166 ± 18 ± 11                                                                |                     | BAND                        | 87   | MAC $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                                                  |

NODE=M010M

NODE=M010M

→ UNCHECKED ←

OCCUR=2

OCCUR=3

OCCUR=2

OCCUR=2

OCCUR=3



|      |          |          |                          |     |      |                                              |
|------|----------|----------|--------------------------|-----|------|----------------------------------------------|
| 1164 | $\pm 41$ | $\pm 23$ | BAND                     | 87  | MAC  | $\tau^+ \rightarrow \pi^+ \pi^0 \pi^0 \nu$   |
| 1250 | $\pm 40$ |          | <sup>18</sup> TORNQVIST  | 87  | RVUE |                                              |
| 1046 | $\pm 11$ |          | ALBRECHT                 | 86B | ARG  | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$   |
| 1056 | $\pm 20$ | $\pm 15$ | RUCKSTUHL                | 86  | DLCO | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$   |
| 1194 | $\pm 14$ | $\pm 10$ | SCHMIDKE                 | 86  | MRK2 | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$   |
| 1255 | $\pm 23$ |          | BELLINI                  | 85  | SPEC | $40 \pi^- A \rightarrow \pi^- \pi^+ \pi^- A$ |
| 1240 | $\pm 80$ |          | <sup>20</sup> DANKOWY... | 81  | SPEC | $8.45 \pi^- p \rightarrow n 3\pi$            |
| 1280 | $\pm 30$ |          | <sup>20</sup> DAUM       | 81B | CNTR | $63.94 \pi^- p \rightarrow p 3\pi$           |
| 1041 | $\pm 13$ |          | <sup>21</sup> GAVILLET   | 77  | HBC  | $4.2 K^- p \rightarrow \Sigma 3\pi$          |

OCCUR=2

<sup>1</sup> Statistical error negligible.<sup>2</sup> From the pole position. Using an amplitude analysis based on approximate three-body unitary of  $\tau$  data from SCHAEEL 05C.<sup>3</sup> Reanalysis of CLEO data using Breit-Wigner parameterization.<sup>4</sup> Superseded by AGHASYAN 2018B.<sup>5</sup> The  $\rho^\pm \pi^\mp$  state can be also due to the  $\pi(1300)$ .<sup>6</sup> Using the Breit-Wigner parameterization; strong correlation between mass and width.<sup>7</sup> Using the data of BARATE 98R.<sup>8</sup> From a fit to the  $3\pi$  mass spectrum including the  $K\bar{K}^*(892)$  threshold.<sup>9</sup> Uses the model of KUHN 90.<sup>10</sup> Uses the model of ISGUR 89.<sup>11</sup> Includes the effect of a possible  $a_1'$  state.<sup>12</sup> Uses the model of FEINDT 90.<sup>13</sup> Supersedes AKERS 95P.<sup>14</sup> Average and spread of values using 2 variants of the model of BOWLER 75.<sup>15</sup> Reanalysis of RUCKSTUHL 86.<sup>16</sup> Reanalysis of SCHMIDKE 86.<sup>17</sup> Reanalysis of ALBRECHT 86B.<sup>18</sup> From a combined reanalysis of ALBRECHT 86B, SCHMIDKE 86, and RUCKSTUHL 86.<sup>19</sup> From a combined reanalysis of ALBRECHT 86B and DAUM 81B.<sup>20</sup> Uses the model of BOWLER 75.<sup>21</sup> Produced in  $K^-$  backward scattering.

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 **$a_1(1260)$  WIDTH**

NODE=M010W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                 | TECN | COMMENT                                                                                      |
|-------------------------------------------------------------------------------|------|-----------------------------|------|----------------------------------------------------------------------------------------------|
| <b>250 to 600 OUR ESTIMATE</b>                                                |      |                             |      |                                                                                              |
| <b>420 <math>\pm 35</math> OUR AVERAGE</b>                                    |      |                             |      |                                                                                              |
| 380 $\pm 80$                                                                  | 46M  | <sup>1</sup> AGHASYAN       | 18B  | COMP $190 \pi^- p \rightarrow \pi^- \pi^+ \pi^- p$                                           |
| 430 $\pm 24 \pm 31$                                                           |      | DARGENT                     | 17   | RVUE $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$                                               |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                             |      |                                                                                              |
| 422.01 $\pm 2.10 \pm 12.72$                                                   | 894k | AAIJ                        | 18AI | LHCB $D^0 \rightarrow K^\mp \pi^\pm \pi^\pm \pi^\mp$                                         |
| 576 $\pm 11 \pm 89$                                                           |      | <sup>2</sup> MIKHASENKO     | 18   | RVUE $\tau^- \rightarrow \pi^- \pi^+ \pi^- \nu_\tau$                                         |
| 367 $\pm 9 \pm 28$                                                            | 420k | <sup>3</sup> ALEKSEEV       | 10   | COMP $190 \pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$                                        |
| 410 $\pm 31 \pm 30$                                                           |      | <sup>4</sup> AUBERT         | 07AU | BABR $10.6 e^+ e^- \rightarrow \rho^0 \rho^\pm \pi^\mp \gamma$                               |
| 520–680                                                                       | 6360 | <sup>5</sup> LINK           | 07A  | FOCS $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$                                               |
| 480 $\pm 20$                                                                  |      | <sup>6</sup> GOMEZ-DUM..04  | RVUE | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu_\tau$                                              |
| 580 $\pm 41$                                                                  | 90k  | SALVINI                     | 04   | OBLX $\bar{p} p \rightarrow 2\pi^+ 2\pi^-$                                                   |
| 460 $\pm 85$                                                                  | 205  | <sup>7</sup> DRUTSKOY       | 02   | BELL $B \rightarrow D^{(*)} K^- K^{*0}$                                                      |
| 814 $\pm 36 \pm 13$                                                           | 37k  | <sup>8</sup> ASNER          | 00   | CLE2 $10.6 e^+ e^- \rightarrow \tau^+ \tau^-, \tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |
| 450 $\pm 50$                                                                  | 22k  | <sup>9</sup> AKHMETSHIN     | 99E  | CMD2 $1.05\text{--}1.38 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \pi^0$                         |
| 570 $\pm 10$                                                                  |      | <sup>10</sup> BONDAR        | 99   | RVUE $e^+ e^- \rightarrow 4\pi, \tau \rightarrow 3\pi \nu_\tau$                              |
| 587 $\pm 27 \pm 21$                                                           | 5904 | <sup>11</sup> ABREU         | 98G  | DLPH $e^+ e^-$                                                                               |
| 478 $\pm 3 \pm 15$                                                            | 5904 | <sup>12</sup> ABREU         | 98G  | DLPH $e^+ e^-$                                                                               |
| 425 $\pm 14 \pm 8$                                                            | 5904 | <sup>13,14</sup> ABREU      | 98G  | DLPH $e^+ e^-$                                                                               |
| 400 $\pm 35$                                                                  |      | BARBERIS                    | 98B  | $450 p p \rightarrow p_f \pi^+ \pi^- \pi^0 p_s$                                              |
| 621 $\pm 32 \pm 58$                                                           |      | <sup>11,15</sup> ACKERSTAFF | 97R  | OPAL $E_{cm}^{ee} = 88\text{--}94, \tau \rightarrow 3\pi \nu$                                |

NODE=M010W

→ UNCHECKED ←

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OCCUR=3

|     |                  |                |       |            |     |      |                                                                       |         |
|-----|------------------|----------------|-------|------------|-----|------|-----------------------------------------------------------------------|---------|
| 457 | $\pm 15$         | $\pm 17$       | 12,15 | ACKERSTAFF | 97R | OPAL | $E_{\text{cm}}^{\text{ee}} = 88\text{--}94, \tau \rightarrow 3\pi\nu$ | OCCUR=2 |
| 446 | $\pm 21$         | $+^{140}_{-0}$ | 12    | ALBRECHT   | 93C | ARG  | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                            |         |
| 239 | $\pm 11$         |                |       | ANDO       | 92  | SPEC | $8 \pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$                           |         |
| 266 | $\pm 13$         | $\pm 4$        | 16    | ANDO       | 92  | SPEC | $8 \pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$                           | OCCUR=3 |
| 465 | $+^{228}_{-143}$ |                | 17    | IVANOV     | 91  | RVUE | $\tau \rightarrow \pi^+ \pi^+ \pi^- \nu$                              |         |
| 298 | $+^{40}_{-34}$   |                | 18    | IVANOV     | 91  | RVUE | $\tau \rightarrow \pi^+ \pi^+ \pi^- \nu$                              | OCCUR=2 |
| 488 | $\pm 32$         |                | 19    | IVANOV     | 91  | RVUE | $\tau \rightarrow \pi^+ \pi^+ \pi^- \nu$                              | OCCUR=3 |
| 430 | $\pm 50$         |                |       | ARMSTRONG  | 90  | OMEG | $300.0 p p \rightarrow p p \pi^+ \pi^- \pi^0$                         |         |
| 420 | $\pm 40$         |                | 20    | ISGUR      | 89  | RVUE | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                            |         |
| 396 | $\pm 43$         |                | 21    | BOWLER     | 88  | RVUE |                                                                       |         |
| 405 | $\pm 75$         | $\pm 25$       |       | BAND       | 87  | MAC  | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                            |         |
| 419 | $\pm 108$        | $\pm 57$       |       | BAND       | 87  | MAC  | $\tau^+ \rightarrow \pi^+ \pi^0 \pi^0 \nu$                            | OCCUR=2 |
| 521 | $\pm 27$         |                |       | ALBRECHT   | 86B | ARG  | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                            |         |
| 476 | $+^{132}_{-120}$ | $\pm 54$       |       | RUCKSTUHL  | 86  | DLCO | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                            |         |
| 462 | $\pm 56$         | $\pm 30$       |       | SCHMIDKE   | 86  | MRK2 | $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$                            |         |
| 292 | $\pm 40$         |                |       | BELLINI    | 85  | SPEC | $40 \pi^- A \rightarrow \pi^- \pi^+ \pi^- A$                          |         |
| 380 | $\pm 100$        |                | 22    | DANKOWY... | 81  | SPEC | $8.45 \pi^- p \rightarrow n 3\pi$                                     |         |
| 300 | $\pm 50$         |                | 22    | DAUM       | 81B | CNTR | $63.94 \pi^- p \rightarrow p 3\pi$                                    |         |
| 230 | $\pm 50$         |                | 23    | GAVILLET   | 77  | HBC  | $4.2 K^- p \rightarrow \Sigma 3\pi$                                   |         |

<sup>1</sup> Statistical error negligible.

<sup>2</sup> From the pole position. Using an amplitude analysis based on approximate three-body unitarity of  $\tau$  data from SCHAEEL 05C.

<sup>3</sup> Superseded by AGHASYAN 2018B.

<sup>4</sup> The  $\rho^\pm \pi^\mp$  state can be also due to the  $\pi(1300)$ .

<sup>5</sup> Using the Breit-Wigner parameterization; strong correlation between mass and width.

<sup>6</sup> Using the data of BARATE 98R.

<sup>7</sup> From a fit of the  $K^- K^{*0}$  distribution assuming  $m_{a_1} = 1230$  MeV and purely resonant production of the  $K^- K^{*0}$  system.

<sup>8</sup> From a fit to the  $3\pi$  mass spectrum including the  $K\bar{K}^*(892)$  threshold.

<sup>9</sup> Using the  $a_1(1260)$  mass of 1230 MeV.

<sup>10</sup> From AKHMETSHIN 99E and ASNER 00 data using the  $a_1(1260)$  mass of 1230 MeV.

<sup>11</sup> Uses the model of KUHN 90.

<sup>12</sup> Uses the model of ISGUR 89.

<sup>13</sup> Includes the effect of a possible  $a'_1$  state.

<sup>14</sup> Uses the model of FEINDT 90.

<sup>15</sup> Supersedes AKERS 95P.

<sup>16</sup> Average and spread of values using 2 variants of the model of BOWLER 75.

<sup>17</sup> Reanalysis of RUCKSTUHL 86.

<sup>18</sup> Reanalysis of SCHMIDKE 86.

<sup>19</sup> Reanalysis of ALBRECHT 86B.

<sup>20</sup> From a combined reanalysis of ALBRECHT 86B, SCHMIDKE 86, and RUCKSTUHL 86.

<sup>21</sup> From a combined reanalysis of ALBRECHT 86B and DAUM 81B.

<sup>22</sup> Uses the model of BOWLER 75.

<sup>23</sup> Produced in  $K^-$  backward scattering.

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## $a_1(1260)$ DECAY MODES

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| Mode                                                               | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------------------------------------------|--------------------------------|
| $\Gamma_1$ $3\pi$                                                  | seen                           |
| $\Gamma_2$ $(\rho\pi)S\text{-wave}, \rho \rightarrow \pi\pi$       | seen                           |
| $\Gamma_3$ $(\rho\pi)D\text{-wave}, \rho \rightarrow \pi\pi$       | seen                           |
| $\Gamma_4$ $(\rho(1450)\pi)S\text{-wave}, \rho \rightarrow \pi\pi$ | seen                           |
| $\Gamma_5$ $(\rho(1450)\pi)D\text{-wave}, \rho \rightarrow \pi\pi$ | seen                           |
| $\Gamma_6$ $f_0(500)\pi, f_0 \rightarrow \pi\pi$                   | seen                           |
| $\Gamma_7$ $f_0(980)\pi, f_0 \rightarrow \pi\pi$                   | not seen                       |
| $\Gamma_8$ $f_0(1370)\pi, f_0 \rightarrow \pi\pi$                  | seen                           |
| $\Gamma_9$ $f_2(1270)\pi, f_2 \rightarrow \pi\pi$                  | seen                           |
| $\Gamma_{10}$ $\pi^+ \pi^- \pi^0$                                  | seen                           |
| $\Gamma_{11}$ $\pi^0 \pi^0 \pi^0$                                  | not seen                       |
| $\Gamma_{12}$ $K K \pi$                                            | seen                           |
| $\Gamma_{13}$ $K^*(892) K$                                         | seen                           |
| $\Gamma_{14}$ $\pi \gamma$                                         | seen                           |

DESIG=17;OUR EST;→ UNCHECKED ←  
DESIG=7;OUR EST;→ UNCHECKED ←  
DESIG=8;OUR EST;→ UNCHECKED ←  
DESIG=9;OUR EST;→ UNCHECKED ←  
DESIG=10;OUR EST;→ UNCHECKED ←  
DESIG=16;OUR EST;→ UNCHECKED ←  
DESIG=11;OUR EST;→ UNCHECKED ←  
DESIG=12;OUR EST;→ UNCHECKED ←  
DESIG=13;OUR EST;→ UNCHECKED ←  
DESIG=22  
DESIG=23;OUR EST;→ UNCHECKED ←  
DESIG=18;OUR EST;→ UNCHECKED ←  
DESIG=14;OUR EST;→ UNCHECKED ←  
DESIG=4;OUR EST;→ UNCHECKED ←

**$a_1(1260)$  PARTIAL WIDTHS**

NODE=M010220

 $\Gamma(\pi\gamma)$  $\Gamma_{14}$ 

VALUE (keV)

DOCUMENT ID

TECN

COMMENT

 **$640 \pm 246$** 

ZIELINSKI

84C

SPEC

200  $\pi^+ Z \rightarrow Z 3\pi$ NODE=M010W4  
NODE=M010W4**D-wave/S-wave AMPLITUDE RATIO IN DECAY OF  $a_1(1260) \rightarrow \rho\pi$** 

NODE=M010DS

VALUE

DOCUMENT ID

TECN

COMMENT

 **$-0.062 \pm 0.020$  OUR AVERAGE**

below.

Error includes scale factor of 2.3. See the ideogram

NODE=M010DS

 $-0.043 \pm 0.009 \pm 0.005$ 

LINK

07A

FOCS

 $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$  $-0.14 \pm 0.04 \pm 0.07$ <sup>1</sup> CHUNG

02

B852

 $18.3 \pi^- \rho \rightarrow \pi^+ \pi^- \pi^- \rho$  $-0.10 \pm 0.02 \pm 0.02$ <sup>2,3</sup> ACKERSTAFF

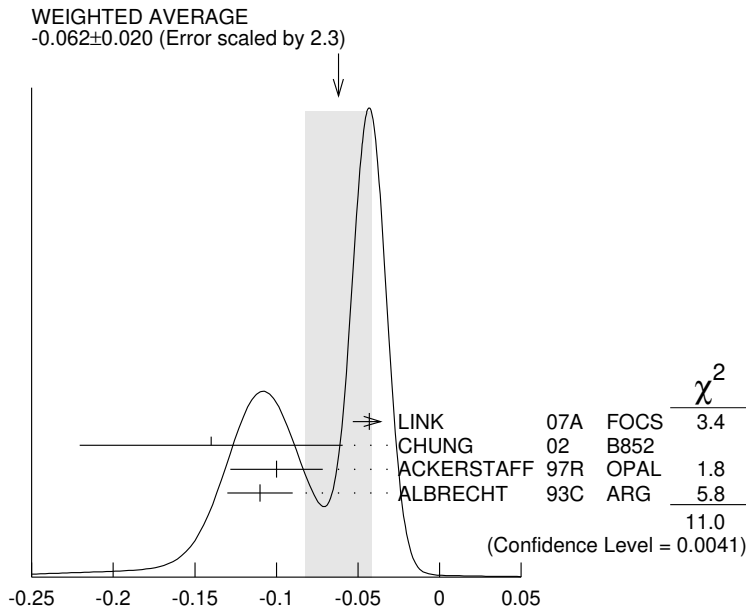
97R

OPAL

 $E_{cm}^e = 88-94, \tau \rightarrow 3\pi\nu$  $-0.11 \pm 0.02$ <sup>2</sup> ALBRECHT

93C

ARG

 $\tau^+ \rightarrow \pi^+ \pi^+ \pi^- \nu$ <sup>1</sup> Deck-type background not subtracted.<sup>2</sup> Uses the model of ISGUR 89.<sup>3</sup> Supersedes AKERS 95P.NODE=M010DS;LINKAGE=C  
NODE=M010DS;LINKAGE=IM  
NODE=M010DS;LINKAGE=XD-wave/S-wave AMPLITUDE RATIO IN DECAY OF  $a_1(1260) \rightarrow \rho\pi$  **$a_1(1260)$  BRANCHING RATIOS**

NODE=M010225

 $\Gamma((\rho\pi)_{S\text{-wave}}, \rho \rightarrow \pi\pi) / \Gamma_{\text{total}}$  $\Gamma_2 / \Gamma$ VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

60.19

37k

<sup>1</sup> ASNER

00

CLE2

 $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,  
 $\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ NODE=M010R5  
NODE=M010R5 $\Gamma((\rho\pi)_{D\text{-wave}}, \rho \rightarrow \pi\pi) / \Gamma_{\text{total}}$  $\Gamma_3 / \Gamma$ VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $1.30 \pm 0.60 \pm 0.22$ 

37k

<sup>1</sup> ASNER

00

CLE2

 $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,  
 $\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ NODE=M010R6  
NODE=M010R6 $\Gamma((\rho(1450)\pi)_{S\text{-wave}}, \rho \rightarrow \pi\pi) / \Gamma_{\text{total}}$  $\Gamma_4 / \Gamma$ VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $0.56 \pm 0.84 \pm 0.32$ 

37k

<sup>1,2</sup> ASNER

00

CLE2

 $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,  
 $\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ NODE=M010R7  
NODE=M010R7

$\Gamma((\rho(1450)\pi)_{D\text{-wave}}, \rho \rightarrow \pi\pi)/\Gamma_{\text{total}}$ 
 $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-2}$ )                                                      | EVTs | DOCUMENT ID | TECN    | COMMENT                                                                                       |
|-------------------------------------------------------------------------------|------|-------------|---------|-----------------------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |         |                                                                                               |
| $2.04 \pm 1.20 \pm 0.28$                                                      | 37k  | 1,2 ASNER   | 00 CLE2 | $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |

NODE=M010R8  
NODE=M010R8

 $\Gamma(f_0(500)\pi, f_0 \rightarrow \pi\pi)/\Gamma_{\text{total}}$ 
 $\Gamma_6/\Gamma$ 

| VALUE (units $10^{-2}$ )                                                      | EVTs | DOCUMENT ID | TECN    | COMMENT                                                                                       |
|-------------------------------------------------------------------------------|------|-------------|---------|-----------------------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |         |                                                                                               |
| seen                                                                          |      | CHUNG       | 02 B852 | $18.3 \pi^- p \rightarrow \pi^+ \pi^- \pi^- p$                                                |
| $18.76 \pm 4.29 \pm 1.48$                                                     | 37k  | 1,3 ASNER   | 00 CLE2 | $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |

NODE=M010R9  
NODE=M010R9

 $\Gamma(f_0(500)\pi, f_0 \rightarrow \pi\pi)/\Gamma((\rho\pi)_{S\text{-wave}}, \rho \rightarrow \pi\pi)$ 
 $\Gamma_6/\Gamma_2$ 

| VALUE                                                                         | EVTs | DOCUMENT ID | TECN     | COMMENT                                                         |
|-------------------------------------------------------------------------------|------|-------------|----------|-----------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |                                                                 |
| $0.06 \pm 0.05$                                                               | 90k  | SALVINI     | 04 OBLX  | $\bar{p} p \rightarrow 2\pi^+ 2\pi^-$                           |
| $\sim 0.3$                                                                    | 28k  | AKHMETSHIN  | 99E CMD2 | $1.05\text{--}1.38 e^+ e^- \rightarrow \pi^+ \pi^- \pi^+ \pi^-$ |
| $0.003 \pm 0.003$                                                             |      | 4 LONGACRE  | 82 RVUE  |                                                                 |

NODE=M010R4  
NODE=M010R4

 $\Gamma(f_0(980)\pi, f_0 \rightarrow \pi\pi)/\Gamma_{\text{total}}$ 
 $\Gamma_7/\Gamma$ 

| VALUE (units $10^{-2}$ )                                                      | EVTs | DOCUMENT ID | TECN    | COMMENT                                                                                       |
|-------------------------------------------------------------------------------|------|-------------|---------|-----------------------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |         |                                                                                               |
| not seen                                                                      | 37k  | ASNER       | 00 CLE2 | $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |

NODE=M010R10  
NODE=M010R10

 $\Gamma(f_0(1370)\pi, f_0 \rightarrow \pi\pi)/\Gamma_{\text{total}}$ 
 $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-2}$ )                                                      | EVTs | DOCUMENT ID | TECN    | COMMENT                                                                                       |
|-------------------------------------------------------------------------------|------|-------------|---------|-----------------------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |         |                                                                                               |
| $7.40 \pm 2.71 \pm 1.26$                                                      | 37k  | 1,5 ASNER   | 00 CLE2 | $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |

NODE=M010R11  
NODE=M010R11

 $\Gamma(f_2(1270)\pi, f_2 \rightarrow \pi\pi)/\Gamma_{\text{total}}$ 
 $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-2}$ )                                                      | EVTs | DOCUMENT ID | TECN    | COMMENT                                                                                       |
|-------------------------------------------------------------------------------|------|-------------|---------|-----------------------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |         |                                                                                               |
| $1.19 \pm 0.49 \pm 0.17$                                                      | 37k  | 1,6 ASNER   | 00 CLE2 | $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |

NODE=M010R12  
NODE=M010R12

 $\Gamma(\pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{10}/\Gamma$ 

| VALUE | DOCUMENT ID  | COMMENT                                         |
|-------|--------------|-------------------------------------------------|
| seen  | BARBERIS 98B | $450 p p \rightarrow p_f \pi^+ \pi^- \pi^0 p_s$ |

NODE=M010R00  
NODE=M010R00

 $\Gamma(\pi^0 \pi^0 \pi^0)/\Gamma(\pi^+ \pi^- \pi^0)$ 
 $\Gamma_{11}/\Gamma_{10}$ 

| VALUE                                                                         | CL% | DOCUMENT ID | COMMENT                              |
|-------------------------------------------------------------------------------|-----|-------------|--------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |                                      |
| $< 0.008$                                                                     | 90  | 7 BARBERIS  | $450 p p \rightarrow p_f 3\pi^0 p_s$ |

NODE=M010R15  
NODE=M010R15

 $\Gamma(K^*(892)K)/\Gamma_{\text{total}}$ 
 $\Gamma_{13}/\Gamma$ 

| VALUE (units $10^{-2}$ )                                                      | EVTs | DOCUMENT ID | TECN     | COMMENT                                                                                       |
|-------------------------------------------------------------------------------|------|-------------|----------|-----------------------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |                                                                                               |
| $2.2 \pm 0.5$                                                                 | 2255 | 8 COAN      | 04 CLEO  | $\tau^- \rightarrow K^- \pi^- K^+ \nu_\tau$                                                   |
| 8 to 15                                                                       | 205  | 9 DRUTSKOY  | 02 BELL  | $B \rightarrow D^{(*)} K^- K^{*0}$                                                            |
| $3.3 \pm 0.5 \pm 0.1$                                                         | 37k  | 10 ASNER    | 00 CLE2  | $10.6 e^+ e^- \rightarrow \tau^+ \tau^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$ |
| $2.6 \pm 0.3$                                                                 |      | 11 BARATE   | 99R ALEP | $\tau \rightarrow K \bar{K} \pi \nu_\tau$                                                     |

NODE=M010R13  
NODE=M010R13

- <sup>1</sup> From a fit to the Dalitz plot.
- <sup>2</sup> Assuming for  $\rho(1450)$  mass and width of 1370 and 386 MeV respectively.
- <sup>3</sup> Assuming for  $f_0(500)$  ( $\sigma$ ) mass and width of 860 and 880 MeV respectively.
- <sup>4</sup> Uses multichannel Aitchison-Bowler model (BOWLER 75). Uses data from GAVIL-LET 77, DAUM 80, and DANKOWYCH 81.
- <sup>5</sup> Assuming for  $f_0(1370)$  mass and width of 1186 and 350 MeV respectively.
- <sup>6</sup> Assuming for  $f_2(1270)$  mass and width of 1275 and 185 MeV respectively.
- <sup>7</sup> Inconsistent with observations of  $\sigma\pi$ ,  $f_0(1370)\pi$ , and  $f_2(1270)\pi$  decay modes.
- <sup>8</sup> Using structure functions from KUHN 92 and DECKER 93A and  $B(\tau^- \rightarrow K^- \pi^- K^+ \nu_\tau) = (0.155 \pm 0.006 \pm 0.009)\%$  from BRIERE 03.
- <sup>9</sup> From a comparison to ALAM 94 assuming purely resonant production of the  $K^- K^{*0}$  system.
- <sup>10</sup> From a fit to the  $3\pi$  mass spectrum including the  $K\bar{K}^*(892)$  threshold.
- <sup>11</sup> Assuming  $a_1(1260)$  dominance and taking  $B(\tau^- \rightarrow a_1(1260)\nu_\tau)$  from BUSKULIC 96.

NODE=M010R;LINKAGE=B1

NODE=M010R;LINKAGE=B2

NODE=M010R;LINKAGE=B3

NODE=M010R4;LINKAGE=E

NODE=M010R;LINKAGE=B4

NODE=M010R;LINKAGE=B5

NODE=M010R;LINKAGE=RB

NODE=M010R13;LINKAGE=CO

NODE=M010R;LINKAGE=DR

NODE=M010R;LINKAGE=B6

NODE=M010R13;LINKAGE=BA

## $a_1(1260)$ REFERENCES

|              |      |                              |                                        |                              |
|--------------|------|------------------------------|----------------------------------------|------------------------------|
| AAIJ         | 18AI | EPJ C78 443                  | R. Aaij <i>et al.</i>                  | (LHCb Collab.)               |
| AGHASYAN     | 18B  | PR D98 092003                | M. Aghasyan <i>et al.</i>              | (COMPASS Collab.)            |
| MIKHASENKO   | 18   | PR D98 096021                | M. Mikhaseenko <i>et al.</i>           | (JPAC Collab.)               |
| DARGENT      | 17   | JHEP 1705 143                | P. d'Argent <i>et al.</i>              | (HEID, BRIS)                 |
| ALEKSEEV     | 10   | PRL 104 241803               | M.G. Alekseev <i>et al.</i>            | (COMPASS Collab.)            |
| AUBERT       | 07AU | PR D76 092005                | B. Aubert <i>et al.</i>                | (BABAR Collab.)              |
| LINK         | 07A  | PR D75 052003                | J.M. Link <i>et al.</i>                | (FNAL FOCUS Collab.)         |
| PDG          | 06   | JP G33 1                     | W.-M. Yao <i>et al.</i>                | (PDG Collab.)                |
| SCHAEEL      | 05C  | PRPL 421 191                 | S. Schaeel <i>et al.</i>               | (ALEPH Collab.)              |
| COAN         | 04   | PRL 92 232001                | T.E. Coan <i>et al.</i>                | (CLEO Collab.)               |
| GOMEZ-DUM... | 04   | PR D69 073002                | D. Gomez Dumm, A. Pich, J. Portoles    |                              |
| SALVINI      | 04   | EPJ C35 21                   | P. Salvini <i>et al.</i>               | (OBELIX Collab.)             |
| BRIERE       | 03   | PRL 90 181802                | R. A. Briere <i>et al.</i>             | (CLEO Collab.)               |
| CHUNG        | 02   | PR D65 072001                | S.U. Chung <i>et al.</i>               | (BNL E852 Collab.)           |
| DRUTSKOY     | 02   | PL B542 171                  | A. Drutskoy <i>et al.</i>              | (BELLE Collab.)              |
| BARBERIS     | 01   | PL B507 14                   | D. Barberis <i>et al.</i>              |                              |
| ASNER        | 00   | PR D61 012002                | D.M. Asner <i>et al.</i>               | (CLEO Collab.)               |
| AKHMETSHIN   | 99E  | PL B466 392                  | R.R. Akhmetshin <i>et al.</i>          | (Novosibirsk CMD-2 Collab.)  |
| BARATE       | 99R  | EPJ C11 599                  | R. Barate <i>et al.</i>                | (ALEPH Collab.)              |
| BONDAR       | 99   | PL B466 403                  | A.E. Bondar <i>et al.</i>              | (Novosibirsk CMD-2 Collab.)  |
| ABREU        | 98G  | PL B426 411                  | P. Abreu <i>et al.</i>                 | (DELPHI Collab.)             |
| BARATE       | 98R  | EPJ C4 409                   | R. Barate <i>et al.</i>                | (ALEPH Collab.)              |
| BARBERIS     | 98B  | PL B422 399                  | D. Barberis <i>et al.</i>              | (WA 102 Collab.)             |
| ACKERSTAFF   | 97R  | ZPHY C75 593                 | K. Akerstaff <i>et al.</i>             | (OPAL Collab.)               |
| BUSKULIC     | 96   | ZPHY C70 579                 | D. Buskulic <i>et al.</i>              | (ALEPH Collab.)              |
| AKERS        | 95P  | ZPHY C67 45                  | R. Akers <i>et al.</i>                 | (OPAL Collab.)               |
| ALAM         | 94   | PR D50 43                    | M.S. Alam <i>et al.</i>                | (CLEO Collab.)               |
| ALBRECHT     | 93C  | ZPHY C58 61                  | H. Albrecht <i>et al.</i>              | (ARGUS Collab.)              |
| DECKER       | 93A  | ZPHY C58 445                 | R. Decker <i>et al.</i>                |                              |
| ANDO         | 92   | PL B291 496                  | A. Ando <i>et al.</i>                  | (KEK, KYOT, NIRS, SAGA+)     |
| KUHN         | 92   | ZPHY C56 661                 | J.H. Kuhn, E. Mirkes                   |                              |
| IVANOV       | 91   | ZPHY C49 563                 | Y.P. Ivanov, A.A. Osipov, M.K. Volkov  | (JINR)                       |
| ARMSTRONG    | 90   | ZPHY C48 213                 | T.A. Armstrong, M. Benayoun, W. Beusch | (WA76 Coll.)                 |
| FEINDT       | 90   | ZPHY C48 681                 | M. Feindt                              | (HAMB)                       |
| KUHN         | 90   | ZPHY C48 445                 | J.H. Kuhn <i>et al.</i>                | (MPIM)                       |
| ISGUR        | 89   | PR D39 1357                  | N. Isgur, C. Morningstar, C. Reader    | (TNTO)                       |
| BOWLER       | 88   | PL B209 99                   | M.G. Bowler                            | (OXF)                        |
| BAND         | 87   | PL B198 297                  | H.R. Band <i>et al.</i>                | (MAC Collab.)                |
| TORNQVIST    | 87   | ZPHY C36 695                 | N.A. Tornqvist                         | (HELS)                       |
| ALBRECHT     | 86B  | ZPHY C33 7                   | H. Albrecht <i>et al.</i>              | (ARGUS Collab.)              |
| RUCKSTUHL    | 86   | PRL 56 2132                  | W. Ruckstuhl <i>et al.</i>             | (DELCO Collab.)              |
| SCHMIDKE     | 86   | PRL 57 527                   | W.B. Schmidke <i>et al.</i>            | (Mark II Collab.)            |
| BELLINI      | 85   | SJNP 41 781                  | D. Bellini <i>et al.</i>               |                              |
|              |      | Translated from YAF 41 1223. |                                        |                              |
| ZIELINSKI    | 84C  | PRL 52 1195                  | M. Zielinski <i>et al.</i>             | (ROCH, MINN, FNAL)           |
| LONGACRE     | 82   | PR D26 82                    | R.S. Longacre                          | (BNL)                        |
| DANKOWY...   | 81   | PRL 46 580                   | J.A. Dankowych <i>et al.</i>           | (TNTO, BNL, CARL+)           |
| DAUM         | 81B  | NP B182 269                  | C. Daum <i>et al.</i>                  | (AMST, CERN, CRAC, MPIM+)    |
| DAUM         | 80   | PL 89B 281                   | C. Daum <i>et al.</i>                  | (AMST, CERN, CRAC, MPIM+) JP |
| GAVILLET     | 77   | PL 69B 119                   | P. Gavillet <i>et al.</i>              | (AMST, CERN, NIJ+)           |
| BOWLER       | 75   | NP B97 227                   | M.G. Bowler <i>et al.</i>              | (OXFTP, DARE)                |

NODE=M010

REFID=59187

REFID=59471

REFID=59487

REFID=58121

REFID=53356

REFID=52049

REFID=51713

REFID=51004

REFID=50845

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REFID=10350

REFID=47490

REFID=20882

REFID=20878

REFID=20572

REFID=20872

REFID=20868

REFID=20852

REFID=20571

$f_2(1270)$ 

$$I^G(J^{PC}) = 0^+(2^{++})$$

NODE=M005

 $f_2(1270)$  MASS

NODE=M005M

NODE=M005M

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID              | TECN     | COMMENT                                                                   |
|-------------------------------------------------------------------------------|-------|--------------------------|----------|---------------------------------------------------------------------------|
| <b>1275.5 ± 0.8 OUR AVERAGE</b>                                               |       |                          |          |                                                                           |
| 1275.8 ± 1.0 ± 0.4                                                            |       | <sup>1</sup> BOGOLYUB... | 13 SPEC  | $7\pi^+(K^+,p)A \rightarrow n\gamma + X$                                  |
| 1262 $\pm \frac{1}{2}$ ± 8                                                    |       | <sup>2</sup> ABLIKIM     | 06v BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$                  |
| 1275 ± 15                                                                     |       | ABLIKIM                  | 05 BES2  | $J/\psi \rightarrow \phi\pi^+\pi^-$                                       |
| 1283 ± 5                                                                      |       | ALDE                     | 98 GAM4  | $100\pi^-p \rightarrow \pi^0\pi^0n$                                       |
| 1278 ± 5                                                                      |       | <sup>3</sup> BERTIN      | 97c OBLX | $0.0\bar{p}p \rightarrow \pi^+\pi^-\pi^0$                                 |
| 1272 ± 8                                                                      | 200k  | PROKOSHKIN               | 94 GAM2  | $38\pi^-p \rightarrow \pi^0\pi^0n$                                        |
| 1269.7 ± 5.2                                                                  | 5730  | AUGUSTIN                 | 89 DM2   | $e^+e^- \rightarrow 5\pi$                                                 |
| 1283 ± 8                                                                      | 400   | <sup>4</sup> ALDE        | 87 GAM4  | $100\pi^-p \rightarrow 4\pi^0n$                                           |
| 1274 ± 5                                                                      |       | <sup>4</sup> AUGUSTIN    | 87 DM2   | $J/\psi \rightarrow \gamma\pi^+\pi^-$                                     |
| 1283 ± 6                                                                      |       | <sup>5</sup> LONGACRE    | 86 MPS   | $22\pi^-p \rightarrow n2K_S^0$                                            |
| 1276 ± 7                                                                      |       | COURAU                   | 84 DLCO  | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$                                     |
| 1273.3 ± 2.3                                                                  |       | <sup>6</sup> CHABAUD     | 83 ASPK  | $17\pi^-p$ polarized                                                      |
| 1280 ± 4                                                                      |       | <sup>7</sup> CASON       | 82 STRC  | $8\pi^+p \rightarrow \Delta^{++}\pi^0\pi^0$                               |
| 1281 ± 7                                                                      | 11600 | GIDAL                    | 81 MRK2  | $J/\psi$ decay                                                            |
| 1282 ± 5                                                                      |       | <sup>8</sup> CORDEN      | 79 OMEG  | $12-15\pi^-p \rightarrow n2\pi$                                           |
| 1269 ± 4                                                                      | 10k   | APEL                     | 75 NICE  | $40\pi^-p \rightarrow n2\pi^0$                                            |
| 1272 ± 4                                                                      | 4600  | ENGLER                   | 74 DBC   | $6\pi^+n \rightarrow \pi^+\pi^-p$                                         |
| 1277 ± 4                                                                      | 5300  | FLATTE                   | 71 HBC   | $7.0\pi^+p$                                                               |
| 1273 ± 8                                                                      |       | <sup>4</sup> STUNTEBECK  | 70 HBC   | $8\pi^-p, 5.4\pi^+d$                                                      |
| 1265 ± 8                                                                      |       | BOESEBECK                | 68 HBC   | $8\pi^+p$                                                                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                          |          |                                                                           |
| 1263.3 ± 0.2 ± 1.5                                                            |       | <sup>9</sup> ALBRECHT    | 20 RVUE  | $0.9\bar{p}p \rightarrow \pi^0\pi^0\eta, \pi^0\eta\eta,$<br>$\pi^0K^+K^-$ |
| 1259 ± 4 ± 4                                                                  | 1.7k  | <sup>10,11</sup> DOBBS   | 15       | $J/\psi \rightarrow \gamma\pi^+\pi^-$                                     |
| 1267 ± 4 ± 3                                                                  | 1.5k  | <sup>10,11</sup> DOBBS   | 15       | $\psi(2S) \rightarrow \gamma\pi^+\pi^-$                                   |
| 1270 ± 8                                                                      |       | <sup>12</sup> ANISOVICH  | 09 RVUE  | $0.0\bar{p}p, \pi N$                                                      |
| 1277 ± 6                                                                      | 870   | <sup>13</sup> SCHEGELSKY | 06A RVUE | $\gamma\gamma \rightarrow K_S^0K_S^0$                                     |
| 1251 ± 10                                                                     |       | TIKHOMIROV               | 03 SPEC  | $40.0\pi^-C \rightarrow K_S^0K_S^0K_L^0X$                                 |
| 1260 ± 10                                                                     |       | <sup>14</sup> ALDE       | 97 GAM2  | $450pp \rightarrow pp\pi^0\pi^0$                                          |
| 1278 ± 6                                                                      |       | <sup>14</sup> GRYGOREV   | 96 SPEC  | $40\pi^-N \rightarrow K_S^0K_S^0X$                                        |
| 1262 ± 11                                                                     |       | AGUILAR-...              | 91 EHS   | $400pp$                                                                   |
| 1275 ± 10                                                                     |       | AKER                     | 91 CBAR  | $0.0\bar{p}p \rightarrow 3\pi^0$                                          |
| 1220 ± 10                                                                     |       | BREAKSTONE               | 90 SFM   | $pp \rightarrow pp\pi^+\pi^-$                                             |
| 1288 ± 12                                                                     |       | ABACHI                   | 86B HRS  | $e^+e^- \rightarrow \pi^+\pi^-X$                                          |
| 1284 ± 30                                                                     | 3k    | BINON                    | 83 GAM2  | $38\pi^-p \rightarrow n2\eta$                                             |
| 1280 ± 20                                                                     | 3k    | APEL                     | 82 CNTR  | $25\pi^-p \rightarrow n2\pi^0$                                            |
| 1284 ± 10                                                                     | 16000 | DEUTSCH...               | 76 HBC   | $16\pi^+p$                                                                |
| 1258 ± 10                                                                     | 600   | TAKAHASHI                | 72 HBC   | $8\pi^-p \rightarrow n2\pi$                                               |
| 1275 ± 13                                                                     |       | ARMENISE                 | 70 HBC   | $9\pi^+n \rightarrow p\pi^+\pi^-$                                         |
| 1261 ± 5                                                                      | 1960  | <sup>4</sup> ARMENISE    | 68 DBC   | $5.1\pi^+n \rightarrow p\pi^+MM^-$                                        |
| 1270 ± 10                                                                     | 360   | <sup>4</sup> ARMENISE    | 68 DBC   | $5.1\pi^+n \rightarrow p\pi^0MM$                                          |
| 1268 ± 6                                                                      |       | <sup>15</sup> JOHNSON    | 68 HBC   | $3.7-4.2\pi^-p$                                                           |

OCCUR=2

OCCUR=2

OCCUR=2

NODE=M005M;LINKAGE=B

NODE=M005M;LINKAGE=K

NODE=M005M;LINKAGE=A

NODE=M005M;LINKAGE=T

NODE=M005M;LINKAGE=L

NODE=M005M;LINKAGE=O

NODE=M005M;LINKAGE=P

NODE=M005M;LINKAGE=S

NODE=M005M;LINKAGE=M

NODE=M005M;LINKAGE=C

NODE=M005M;LINKAGE=D

NODE=M005M;LINKAGE=AN

NODE=M005M;LINKAGE=SC

<sup>1</sup> Averaged over six nuclear targets, no statistically significant dependence on target nucleus observed.<sup>2</sup> Breit-Wigner mass.<sup>3</sup> T-matrix pole.<sup>4</sup> Mass errors enlarged by us to  $\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.<sup>5</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles.<sup>6</sup> From an energy-independent partial-wave analysis.<sup>7</sup> From an amplitude analysis of the reaction  $\pi^+\pi^- \rightarrow 2\pi^0$ .<sup>8</sup> From an amplitude analysis of  $\pi^+\pi^- \rightarrow \pi^+\pi^-$  scattering data.<sup>9</sup> T-matrix pole, 5 poles, 5 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).<sup>10</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>11</sup> From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 185$  MeV.<sup>12</sup> 4-poles, 5-channel K matrix fit.<sup>13</sup> From analysis of L3 data at 91 and 183–209 GeV.

<sup>14</sup> Systematic uncertainties not estimated.<sup>15</sup> JOHNSON 68 includes BONDAR 63, LEE 64, DERADO 65, EISNER 67.

NODE=M005M;LINKAGE=QQ

NODE=M005M;LINKAGE=J

 **$f_2(1270)$  WIDTH**

NODE=M005W

NODE=M005W

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**186.7<sup>+2.2</sup><sub>-2.5</sub> OUR FIT** Error includes scale factor of 1.4.**185.9<sup>+2.8</sup><sub>-2.1</sub> OUR AVERAGE** Error includes scale factor of 1.6. See the ideogram below.

|                                                                               |       |                          |     |      |                                                                           |  |
|-------------------------------------------------------------------------------|-------|--------------------------|-----|------|---------------------------------------------------------------------------|--|
| 190.3 $\pm$ 1.9 $\pm$ 1.8                                                     |       | <sup>1</sup> BOGOLYUB... | 13  | SPEC | $7\pi^+(K^+,p)A \rightarrow n\gamma + X$                                  |  |
| 175 $\pm$ 6 $\pm$ 10                                                          |       | <sup>2</sup> ABLIKIM     | 06v | BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$                  |  |
| 190 $\pm$ 20                                                                  |       | ABLIKIM                  | 05  | BES2 | $J/\psi \rightarrow \phi\pi^+\pi^-$                                       |  |
| 171 $\pm$ 10                                                                  |       | ALDE                     | 98  | GAM4 | $100\pi^-p \rightarrow \pi^0\pi^0n$                                       |  |
| 204 $\pm$ 20                                                                  |       | <sup>3</sup> BERTIN      | 97c | OBLX | $0.0\bar{p}p \rightarrow \pi^+\pi^-\pi^0$                                 |  |
| 192 $\pm$ 5                                                                   | 200k  | PROKOSHKIN               | 94  | GAM2 | $38\pi^-p \rightarrow \pi^0\pi^0n$                                        |  |
| 180 $\pm$ 24                                                                  |       | AGUILAR...               | 91  | EHS  | $400pp$                                                                   |  |
| 169 $\pm$ 9                                                                   | 5730  | <sup>4</sup> AUGUSTIN    | 89  | DM2  | $e^+e^- \rightarrow 5\pi$                                                 |  |
| 150 $\pm$ 30                                                                  | 400   | <sup>4</sup> ALDE        | 87  | GAM4 | $100\pi^-p \rightarrow 4\pi^0n$                                           |  |
| 186 $\pm$ 9 $\pm$ 2                                                           |       | <sup>5</sup> LONGACRE    | 86  | MPS  | $22\pi^-p \rightarrow n2K_S^0$                                            |  |
| 179.2 $\pm$ 6.9 $\pm$ 6.6                                                     |       | <sup>6</sup> CHABAUD     | 83  | ASPK | $17\pi^-p$ polarized                                                      |  |
| 160 $\pm$ 11                                                                  |       | DENNEY                   | 83  | LASS | $10\pi^+N$                                                                |  |
| 196 $\pm$ 10                                                                  | 3k    | APEL                     | 82  | CNTR | $25\pi^-p \rightarrow n2\pi^0$                                            |  |
| 152 $\pm$ 9                                                                   |       | <sup>7</sup> CASON       | 82  | STRC | $8\pi^+p \rightarrow \Delta^{++}\pi^0\pi^0$                               |  |
| 186 $\pm$ 27                                                                  | 11600 | GIDAL                    | 81  | MRK2 | $J/\psi$ decay                                                            |  |
| 216 $\pm$ 13                                                                  |       | <sup>8</sup> CORDEN      | 79  | OMEG | $12-15\pi^-p \rightarrow n2\pi$                                           |  |
| 190 $\pm$ 10                                                                  | 10k   | APEL                     | 75  | NICE | $40\pi^-p \rightarrow n2\pi^0$                                            |  |
| 192 $\pm$ 16                                                                  | 4600  | ENGLER                   | 74  | DBC  | $6\pi^+n \rightarrow \pi^+\pi^-p$                                         |  |
| 183 $\pm$ 15                                                                  | 5300  | FLATTE                   | 71  | HBC  | $7\pi^+p \rightarrow \Delta^{++}f_2$                                      |  |
| 196 $\pm$ 30                                                                  |       | <sup>4</sup> STUNTEBECK  | 70  | HBC  | $8\pi^-p, 5.4\pi^+d$                                                      |  |
| 216 $\pm$ 20                                                                  | 1960  | <sup>4</sup> ARMENISE    | 68  | DBC  | $5.1\pi^+n \rightarrow p\pi^+MM^-$                                        |  |
| 128 $\pm$ 27                                                                  |       | <sup>4</sup> BOESEBECK   | 68  | HBC  | $8\pi^+p$                                                                 |  |
| 176 $\pm$ 21                                                                  |       | <sup>4,9</sup> JOHNSON   | 68  | HBC  | $3.7-4.2\pi^-p$                                                           |  |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |       |                          |     |      |                                                                           |  |
| 193.7 $\pm$ 0.4 $\pm$ 1.6                                                     |       | <sup>10</sup> ALBRECHT   | 20  | RVUE | $0.9\bar{p}p \rightarrow \pi^0\pi^0\eta, \pi^0\eta\eta,$<br>$\pi^0K^+K^-$ |  |
| 194 $\pm$ 36                                                                  |       | <sup>11</sup> ANISOVICH  | 09  | RVUE | $0.0\bar{p}p, \pi N$                                                      |  |
| 195 $\pm$ 15                                                                  | 870   | <sup>12</sup> SCHEGELSKY | 06A | RVUE | $\gamma\gamma \rightarrow K_S^0K_S^0$                                     |  |
| 121 $\pm$ 26                                                                  |       | TIKHOMIROV               | 03  | SPEC | $40.0\pi^-C \rightarrow K_S^0K_S^0K_L^0X$                                 |  |
| 187 $\pm$ 20                                                                  |       | <sup>13</sup> ALDE       | 97  | GAM2 | $450pp \rightarrow pp\pi^0\pi^0$                                          |  |
| 184 $\pm$ 10                                                                  |       | <sup>13</sup> GRYGOREV   | 96  | SPEC | $40\pi^-N \rightarrow K_S^0K_S^0X$                                        |  |
| 200 $\pm$ 10                                                                  |       | AKER                     | 91  | CBAR | $0.0\bar{p}p \rightarrow 3\pi^0$                                          |  |
| 240 $\pm$ 40                                                                  | 3k    | BINON                    | 83  | GAM2 | $38\pi^-p \rightarrow n2\eta$                                             |  |
| 187 $\pm$ 30                                                                  | 650   | <sup>4</sup> ANTIPOV     | 77  | CIBS | $25\pi^-p \rightarrow p3\pi$                                              |  |
| 225 $\pm$ 38                                                                  | 16000 | DEUTSCH...               | 76  | HBC  | $16\pi^+p$                                                                |  |
| 166 $\pm$ 28                                                                  | 600   | <sup>4</sup> TAKAHASHI   | 72  | HBC  | $8\pi^-p \rightarrow n2\pi$                                               |  |
| 173 $\pm$ 53                                                                  |       | <sup>4</sup> ARMENISE    | 70  | HBC  | $9\pi^+n \rightarrow p\pi^+\pi^-$                                         |  |

OCCUR=2

OCCUR=2

<sup>1</sup> Averaged over six nuclear targets, no statistically significant dependence on target nucleus observed.<sup>2</sup> Breit-Wigner width<sup>3</sup> T-matrix pole.<sup>4</sup> Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.<sup>5</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles.<sup>6</sup> From an energy-independent partial-wave analysis.<sup>7</sup> From an amplitude analysis of the reaction  $\pi^+\pi^- \rightarrow 2\pi^0$ .<sup>8</sup> From an amplitude analysis of  $\pi^+\pi^- \rightarrow \pi^+\pi^-$  scattering data.<sup>9</sup> JOHNSON 68 includes BONDAR 63, LEE 64, DERADO 65, EISNER 67.<sup>10</sup> T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).<sup>11</sup> 4-poles, 5-channel K matrix fit.<sup>12</sup> From analysis of L3 data at 91 and 183–209 GeV.<sup>13</sup> Systematic uncertainties not estimated.

NODE=M005W;LINKAGE=C

NODE=M005W;LINKAGE=D

NODE=M005W;LINKAGE=QA

NODE=M005W;LINKAGE=T

NODE=M005W;LINKAGE=L

NODE=M005W;LINKAGE=R

NODE=M005W;LINKAGE=Q

NODE=M005W;LINKAGE=U

NODE=M005W;LINKAGE=J

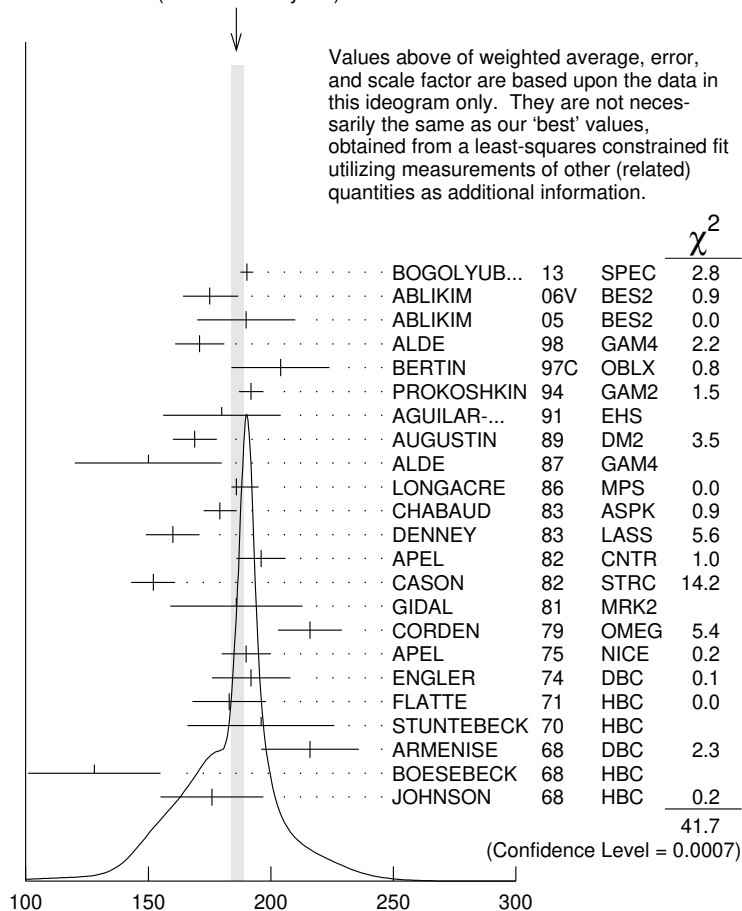
NODE=M005W;LINKAGE=F

NODE=M005W;LINKAGE=AN

NODE=M005W;LINKAGE=SC

NODE=M005W;LINKAGE=QQ

WEIGHTED AVERAGE  
185.9±2.8-2.1 (Error scaled by 1.6)



$f_2(1270)$  width (MeV)

### $f_2(1270)$ DECAY MODES

| Mode                                         | Fraction ( $\Gamma_i/\Gamma$ )   | Scale factor/<br>Confidence level |
|----------------------------------------------|----------------------------------|-----------------------------------|
| $\Gamma_1 \quad \pi\pi$                      | $(84.2^{+2.9}_{-0.9})\%$         | S=1.1                             |
| $\Gamma_2 \quad \pi^+\pi^-2\pi^0$            | $(7.7^{+1.1}_{-3.2})\%$          | S=1.2                             |
| $\Gamma_3 \quad K\bar{K}$                    | $(4.6^{+0.5}_{-0.4})\%$          | S=2.7                             |
| $\Gamma_4 \quad 2\pi^+2\pi^-$                | $(2.8 \pm 0.4)\%$                | S=1.2                             |
| $\Gamma_5 \quad \eta\eta$                    | $(4.0 \pm 0.8) \times 10^{-3}$   | S=2.1                             |
| $\Gamma_6 \quad 4\pi^0$                      | $(3.0 \pm 1.0) \times 10^{-3}$   |                                   |
| $\Gamma_7 \quad \gamma\gamma$                | $(1.42 \pm 0.24) \times 10^{-5}$ | S=1.4                             |
| $\Gamma_8 \quad \eta\pi\pi$                  | $< 8 \times 10^{-3}$             | CL=95%                            |
| $\Gamma_9 \quad K^0 K^- \pi^+ + \text{c.c.}$ | $< 3.4 \times 10^{-3}$           | CL=95%                            |
| $\Gamma_{10} \quad e^+e^-$                   | $< 6 \times 10^{-10}$            | CL=90%                            |

NODE=M005215;NODE=M005

DESIG=1

DESIG=3

DESIG=4

DESIG=2

DESIG=7

DESIG=9

DESIG=8

DESIG=6

DESIG=5

DESIG=10

### CONSTRAINED FIT INFORMATION



An overall fit to the total width, 4 partial widths, a combination of partial widths obtained from integrated cross sections, and 6 branching ratios uses 45 measurements and one constraint to determine 8 parameters. The overall fit has a  $\chi^2 = 83.0$  for 38 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |       |       |       |       |       |
|----------|-------|-------|-------|-------|-------|-------|-------|
| $x_2$    | −90   |       |       |       |       |       |       |
| $x_3$    | 10    | −39   |       |       |       |       |       |
| $x_4$    | 10    | −38   | 1     |       |       |       |       |
| $x_5$    | 1     | −6    | 0     | 0     |       |       |       |
| $x_6$    | 0     | −7    | 0     | 0     | 0     |       |       |
| $x_7$    | 3     | 1     | −15   | 0     | 0     | 0     |       |
| $\Gamma$ | −71   | 65    | −10   | −7    | −1    | 0     | −6    |
|          | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ | $x_6$ | $x_7$ |

| Mode                          | Rate (MeV)             | Scale factor |
|-------------------------------|------------------------|--------------|
| $\Gamma_1$ $\pi\pi$           | 157.2 $^{+4.0}_{-1.1}$ |              |
| $\Gamma_2$ $\pi^+\pi^-2\pi^0$ | 14.4 $^{+2.1}_{-6.0}$  | 1.2          |
| $\Gamma_3$ $K\bar{K}$         | 8.5 $\pm 0.8$          | 2.8          |
| $\Gamma_4$ $2\pi^+2\pi^-$     | 5.2 $\pm 0.7$          | 1.2          |
| $\Gamma_5$ $\eta\eta$         | 0.75 $\pm 0.14$        | 2.1          |
| $\Gamma_6$ $4\pi^0$           | 0.56 $\pm 0.19$        |              |
| $\Gamma_7$ $\gamma\gamma$     | 0.0026 $\pm 0.0005$    | 1.4          |

## $f_2(1270)$ PARTIAL WIDTHS

NODE=M005220

### $\Gamma(\pi\pi)$

$\Gamma_1$

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**157.2 $^{+4.0}_{-1.1}$  OUR FIT**

**157.0 $^{+6.0}_{-1.0}$**

<sup>1</sup> LONGACRE 86 MPS  $22\pi^-p \rightarrow n2K_S^0$

• • • We do not use the following data for averages, fits, limits, etc. • • •

152  $\pm 8$  870 <sup>2</sup> SCHEGELSKY 06A RVUE  $\gamma\gamma \rightarrow K_S^0 K_S^0$

<sup>1</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles.

<sup>2</sup> From analysis of L3 data at 91 and 183–209 GeV and using SU(3) relations.

NODE=M005W1;LINKAGE=L  
NODE=M005W1;LINKAGE=SC

### $\Gamma(K\bar{K})$

$\Gamma_3$

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**8.5 $\pm 0.8$  OUR FIT** Error includes scale factor of 2.8.

**9.0 $^{+0.7}_{-0.3}$**

<sup>1</sup> LONGACRE 86 MPS  $22\pi^-p \rightarrow n2K_S^0$

• • • We do not use the following data for averages, fits, limits, etc. • • •

7.5  $\pm 2.0$  870 <sup>2</sup> SCHEGELSKY 06A RVUE  $\gamma\gamma \rightarrow K_S^0 K_S^0$

<sup>1</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles.

<sup>2</sup> From analysis of L3 data at 91 and 183–209 GeV and using SU(3) relations.

NODE=M005W4;LINKAGE=L  
NODE=M005W4;LINKAGE=SC

### $\Gamma(\eta\eta)$

$\Gamma_5$

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**0.75 $\pm 0.14$  OUR FIT** Error includes scale factor of 2.1.

**1.0  $\pm 0.1$**

<sup>1</sup> LONGACRE 86 MPS  $22\pi^-p \rightarrow n2K_S^0$

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.8  $\pm 0.4$  870 <sup>2</sup> SCHEGELSKY 06A RVUE  $\gamma\gamma \rightarrow K_S^0 K_S^0$

<sup>1</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles.

<sup>2</sup> From analysis of L3 data at 91 and 183–209 GeV and using SU(3) relations.

NODE=M005W7;LINKAGE=L  
NODE=M005W7;LINKAGE=SC

$\Gamma(\gamma\gamma)$  $\Gamma_7$ 

The value of this width depends on the theoretical model used. Unitary approaches with scalars typically (with exception of PENNINGTON 08) give values clustering around 2.6 keV; without an  $S$ -wave contribution, values are systematically higher (typically around 3 keV).

| VALUE (keV)                                                                   | EVTS                                | DOCUMENT ID                  | TECN | COMMENT                                           |
|-------------------------------------------------------------------------------|-------------------------------------|------------------------------|------|---------------------------------------------------|
| <b>2.6 ±0.5 OUR FIT</b>                                                       | Error includes scale factor of 1.4. |                              |      |                                                   |
| <b>2.93±0.40</b>                                                              |                                     | <sup>1</sup> DAI             | 14A  | RVUE Compilation                                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |                              |      |                                                   |
| 3.14±0.20                                                                     |                                     | <sup>2,3</sup> PENNINGTON 08 | RVUE | Compilation                                       |
| 3.82±0.30                                                                     |                                     | <sup>3,4</sup> PENNINGTON 08 | RVUE | Compilation                                       |
| 2.55±0.15                                                                     | 870                                 | <sup>5</sup> SCHEGELSKY 06A  | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$            |
| 2.84±0.35                                                                     |                                     | BOGLIONE 99                  | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |
| 2.93±0.23±0.32                                                                |                                     | <sup>6</sup> YABUKI 95       | VNS  |                                                   |
| 2.58±0.13 <sup>+0.36</sup> <sub>-0.27</sub>                                   |                                     | <sup>7</sup> BEHREND 92      | CELL | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 3.10±0.35±0.35                                                                |                                     | <sup>8</sup> BLINOV 92       | MD1  | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 2.27±0.47±0.11                                                                |                                     | ADACHI 90D                   | TOPZ | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 3.15±0.04±0.39                                                                |                                     | BOYER 90                     | MRK2 | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 3.19±0.16 <sup>+0.29</sup> <sub>-0.28</sub>                                   |                                     | MARSISKE 90                  | CBAL | $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$             |
| 2.35±0.65                                                                     |                                     | <sup>9</sup> MORGAN 90       | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-, \pi^0\pi^0$ |
| 3.19±0.09 <sup>+0.22</sup> <sub>-0.38</sub>                                   | 2177                                | OEST 90                      | JADE | $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$             |
| 3.2 ±0.1 ±0.4                                                                 |                                     | <sup>10</sup> AIHARA 86B     | TPC  | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 2.5 ±0.1 ±0.5                                                                 |                                     | BEHREND 84B                  | CELL | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 2.85±0.25±0.5                                                                 |                                     | <sup>11</sup> BERGER 84      | PLUT | $e^+e^- \rightarrow e^+e^-2\pi$                   |
| 2.70±0.05±0.20                                                                |                                     | COURAU 84                    | DLCO | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 2.52±0.13±0.38                                                                |                                     | <sup>12</sup> SMITH 84C      | MRK2 | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 2.7 ±0.2 ±0.6                                                                 |                                     | EDWARDS 82F                  | CBAL | $e^+e^- \rightarrow e^+e^-2\pi^0$                 |
| 2.9 <sup>+0.6</sup> <sub>-0.4</sub> ±0.6                                      |                                     | <sup>13</sup> EDWARDS 82F    | CBAL | $e^+e^- \rightarrow e^+e^-2\pi^0$                 |
| 3.2 ±0.2 ±0.6                                                                 |                                     | BRANDELIK 81B                | TASS | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 3.6 ±0.3 ±0.5                                                                 |                                     | ROUSSARIE 81                 | MRK2 | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$             |
| 2.3 ±0.8                                                                      |                                     | <sup>14</sup> BERGER 80B     | PLUT | $e^+e^-$                                          |

<sup>1</sup> Based on a  $K$ -matrix analysis of BELLE data from MORI 07, UEHARA 08A, UEHARA 09 and UEHARA 13. The width is derived for the pole on the third sheet which is closest to the physical axis. Supersedes PENNINGTON 08.

<sup>2</sup> Solution A (preferred solution based on  $\chi^2$ -analysis).

<sup>3</sup> Dispersion theory based amplitude analysis of BOYER 90, MARSISKE 90, BEHREND 92, and MORI 07.

<sup>4</sup> Solution B (worse than solution A; still acceptable when systematic uncertainties are included).

<sup>5</sup> From analysis of L3 data at 91 and 183–209 GeV and using SU(3) relations.

<sup>6</sup> With a narrow scalar state around 1220 MeV.

<sup>7</sup> Using a unitarized model with a 300 - 500 keV wide scalar at 1100 MeV.

<sup>8</sup> Using the unitarized model of LYTH 85.

<sup>9</sup> Error includes spread of different solutions. Data of MARK2 and CRYSTAL BALL used in the analysis. Authors report strong correlations with  $\gamma\gamma$  width of  $f_0(1370)$ :  $\Gamma(f_2) + 1/4 \Gamma(f_0) = 3.6 \pm 0.3$  KeV.

<sup>10</sup> Radiative corrections modify the partial widths; for instance the COURAU 84 value becomes  $2.66 \pm 0.21$  in the calculation of LANDRO 86.

<sup>11</sup> Using the MENNESSIER 83 model.

<sup>12</sup> Superseded by BOYER 90.

<sup>13</sup> If helicity = 2 assumption is not made.

<sup>14</sup> Using mass, width and  $B(f_2(1270) \rightarrow 2\pi)$  from PDG 78.

 $\Gamma(e^+e^-)$  $\Gamma_{10}$ 

| VALUE (eV)                                                                    | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-------------------------------------------------------------------------------|-----|-------------|------|-------------------------------------|
| <b>&lt;0.11</b>                                                               | 90  | ACHASOV     | 00K  | SDN $e^+e^- \rightarrow \pi^0\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                     |
| <1.7                                                                          | 90  | VOROBIEV    | 88   | ND $e^+e^- \rightarrow \pi^0\pi^0$  |

NODE=M005W8

NODE=M005W8

NODE=M005W8

OCCUR=2

OCCUR=3

OCCUR=2

NODE=M005W8;LINKAGE=A

NODE=M005W8;LINKAGE=P1

NODE=M005W8;LINKAGE=P3

NODE=M005W8;LINKAGE=P2

NODE=M005W8;LINKAGE=SC

NODE=M005W8;LINKAGE=YA

NODE=M005W;LINKAGE=B

NODE=M005W;LINKAGE=A

NODE=M005PW;LINKAGE=C

NODE=M005PW;LINKAGE=B

NODE=M005PW;LINKAGE=X

NODE=M005PW;LINKAGE=V

NODE=M005PW;LINKAGE=H

NODE=M005PW;LINKAGE=A

NODE=M005W9

NODE=M005W9

$f_2(1270) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$ 

NODE=M005223

 $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$  $\Gamma_3 \Gamma_7 / \Gamma$ 

| VALUE (keV)                                                                   | DOCUMENT ID                         | TECN    | COMMENT                            |
|-------------------------------------------------------------------------------|-------------------------------------|---------|------------------------------------|
| <b>0.121<math>\pm</math>0.020 OUR FIT</b>                                     | Error includes scale factor of 1.3. |         |                                    |
| <b>0.091<math>\pm</math>0.007<math>\pm</math>0.027</b>                        | <sup>1</sup> ALBRECHT               | 90G ARG | $e^+e^- \rightarrow e^+e^- K^+K^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |         |                                    |
| 0.104 $\pm$ 0.007 $\pm$ 0.072                                                 | <sup>2</sup> ALBRECHT               | 90G ARG | $e^+e^- \rightarrow e^+e^- K^+K^-$ |
| <sup>1</sup> Using an incoherent background.                                  |                                     |         |                                    |
| <sup>2</sup> Using a coherent background.                                     |                                     |         |                                    |

NODE=M005G1  
NODE=M005G1

OCCUR=2

NODE=M005G1;LINKAGE=A  
NODE=M005G1;LINKAGE=K $\Gamma(\eta\eta) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$  $\Gamma_5 \Gamma_7 / \Gamma$ 

| VALUE (eV)                                                                                                                                             | DOCUMENT ID         | TECN     | COMMENT                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------|-------------------------------------------|
| <b>11.5<math>\pm</math>1.8<math>\pm</math>4.5<br/>-2.0-3.7</b>                                                                                         | <sup>1</sup> UEHARA | 10A BELL | 10.6 $e^+e^- \rightarrow e^+e^- \eta\eta$ |
| <sup>1</sup> Including interference with the $f_2'(1525)$ (parameters fixed to the values from the 2008 edition of this review, PDG 08) and $f_0(Y)$ . |                     |          |                                           |

NODE=M005G02  
NODE=M005G02

NODE=M005G02;LINKAGE=UE

**Helicity-0/Helicity-2 RATIO IN  $\gamma\gamma \rightarrow f_2(1270) \rightarrow \pi\pi$** 

| VALUE (units $10^{-2}$ )                                                                                                                                                                                  | DOCUMENT ID               | TECN     | COMMENT                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|----------|---------------------------------------------|
| <b>3.7<math>\pm</math>0.3<math>\pm</math>15.9<br/>-2.9</b>                                                                                                                                                | UEHARA                    | 08A BELL | 10.6 $e^+e^- \rightarrow e^+e^- \pi^0\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                             |                           |          |                                             |
| 9.5 $\pm$ 1.8                                                                                                                                                                                             | <sup>1</sup> DAI          | 14A RVUE | Compilation                                 |
| 13                                                                                                                                                                                                        | <sup>2,3</sup> PENNINGTON | 08 RVUE  | Compilation                                 |
| 26                                                                                                                                                                                                        | <sup>3,4</sup> PENNINGTON | 08 RVUE  | Compilation                                 |
| <sup>1</sup> Based on a $K$ -matrix analysis of BELLE data from MORI 07, UEHARA 08A, UEHARA 09 and UEHARA 13. The width is derived for the pole on the third sheet which is closest to the physical axis. |                           |          |                                             |
| <sup>2</sup> Solution A (preferred solution based on $\chi^2$ -analysis).                                                                                                                                 |                           |          |                                             |
| <sup>3</sup> Dispersion theory based amplitude analysis of BOYER 90, MARSISKE 90, BEHREND 92, and MORI 07.                                                                                                |                           |          |                                             |
| <sup>4</sup> Solution B (worse than solution A; still acceptable when systematic uncertainties are included).                                                                                             |                           |          |                                             |

NODE=M005HR0  
NODE=M005HR0

OCCUR=2

OCCUR=3

NODE=M005HR0;LINKAGE=A

NODE=M005HR0;LINKAGE=P1  
NODE=M005HR0;LINKAGE=P3

NODE=M005HR0;LINKAGE=P2

 **$f_2(1270)$  BRANCHING RATIOS**

NODE=M005225

 $\Gamma(\pi\pi) / \Gamma_{\text{total}}$  $\Gamma_1 / \Gamma$ 

| VALUE                                                                                                                                                                       | EVTS | DOCUMENT ID           | TECN    | COMMENT                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------|---------|----------------------------------------------------------------------------|
| <b>0.842<sup>+0.029</sup><sub>-0.009</sub> OUR FIT</b> Error includes scale factor of 1.1.                                                                                  |      |                       |         |                                                                            |
| <b>0.837<math>\pm</math>0.020 OUR AVERAGE</b>                                                                                                                               |      |                       |         |                                                                            |
| 0.849 $\pm$ 0.025                                                                                                                                                           |      | CHABAUD               | 83 ASPK | 17 $\pi^-p$ polarized                                                      |
| 0.85 $\pm$ 0.05                                                                                                                                                             | 250  | BEAUPRE               | 71 HBC  | 8 $\pi^+p \rightarrow \Delta^{++}f_2$                                      |
| 0.8 $\pm$ 0.04                                                                                                                                                              | 600  | OH                    | 70 HBC  | 1.26 $\pi^-p \rightarrow \pi^+\pi^-n$                                      |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                                                                                               |      |                       |         |                                                                            |
| 0.856 $\pm$ 0.001 $\pm$ 0.05                                                                                                                                                |      | <sup>1</sup> ALBRECHT | 20 RVUE | 0.9 $\bar{p}p \rightarrow \pi^0\pi^0\eta,$<br>$\pi^0\eta\eta, \pi^0K^+K^-$ |
| <sup>1</sup> Residue from T-matrix pole, 4 poles, 4 channels, including scattering data from<br>HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ). |      |                       |         |                                                                            |

NODE=M005R10  
NODE=M005R10

NODE=M005R10;LINKAGE=A

 $\Gamma(\pi^+\pi^-2\pi^0) / \Gamma(\pi\pi)$  $\Gamma_2 / \Gamma_1$ Should be twice  $\Gamma(2\pi^+2\pi^-) / \Gamma(\pi\pi)$  if decay is  $\rho\rho$ . (See ASCOLI 68D.)

| VALUE                                                                         | EVTS                                               | DOCUMENT ID | TECN    | COMMENT                                 |
|-------------------------------------------------------------------------------|----------------------------------------------------|-------------|---------|-----------------------------------------|
| <b>0.091<math>\pm</math>0.014<br/>-0.040</b>                                  | <b>OUR FIT</b> Error includes scale factor of 1.2. |             |         |                                         |
| <b>0.15 <math>\pm</math>0.06</b>                                              | 600                                                | EISENBERG   | 74 HBC  | 4.9 $\pi^+p \rightarrow \Delta^{++}f_2$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                    |             |         |                                         |
| 0.07                                                                          |                                                    | EMMS        | 75D DBC | 4 $\pi^+n \rightarrow pf_2$             |

NODE=M005R2

NODE=M005R2  
NODE=M005R2 $\Gamma(K\bar{K}) / \Gamma_{\text{total}}$  $\Gamma_3 / \Gamma$ 

| VALUE                                                                                                                                                                    | DOCUMENT ID           | TECN    | COMMENT                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------|----------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                            |                       |         |                                                                            |
| 0.033 $\pm$ 0.001 $\pm$ 0.005                                                                                                                                            | <sup>1</sup> ALBRECHT | 20 RVUE | 0.9 $\bar{p}p \rightarrow \pi^0\pi^0\eta,$<br>$\pi^0\eta\eta, \pi^0K^+K^-$ |
| <sup>1</sup> Residue from T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ). |                       |         |                                                                            |

NODE=M005R00  
NODE=M005R00

NODE=M005R00;LINKAGE=A

$\Gamma(K\bar{K})/\Gamma(\pi\pi)$  $\Gamma_3/\Gamma_1$ 

We average only experiments which either take into account  $f_2(1270)$ - $a_2(1320)$  interference explicitly or demonstrate that  $a_2(1320)$  production is negligible.

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.054<sup>+0.005</sup><sub>-0.006</sub> OUR FIT** Error includes scale factor of 2.7.

**0.041<sup>+0.004</sup><sub>-0.005</sub> OUR AVERAGE**

|                                                                               |    |                          |     |      |                                         |
|-------------------------------------------------------------------------------|----|--------------------------|-----|------|-----------------------------------------|
| 0.045 $\pm$ 0.01                                                              |    | <sup>1</sup> BARGIOTTI   | 03  | OBLX | $\bar{p}p$                              |
| 0.037 <sup>+0.008</sup> <sub>-0.021</sub>                                     |    | ETKIN                    | 82B | MPS  | $23 \pi^- p \rightarrow n 2 K_S^0$      |
| 0.045 $\pm$ 0.009                                                             |    | CHABAUD                  | 81  | ASPK | $17 \pi^- p$ polarized                  |
| 0.039 $\pm$ 0.008                                                             |    | LOVERRE                  | 80  | HBC  | $4 \pi^- p \rightarrow K \bar{K} N$     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |    |                          |     |      |                                         |
| 0.052 $\pm$ 0.025                                                             |    | ABLIKIM                  | 04E | BES2 | $J/\psi \rightarrow \omega K^+ K^-$     |
| 0.036 $\pm$ 0.005                                                             |    | <sup>2</sup> COSTA       | 80  | OMEG | $1-2.2 \pi^- p \rightarrow K^+ K^- n$   |
| 0.030 $\pm$ 0.005                                                             |    | <sup>3</sup> MARTIN      | 79  | RVUE |                                         |
| 0.027 $\pm$ 0.009                                                             |    | <sup>4</sup> POLYCHRO... | 79  | STRC | $7 \pi^- p \rightarrow n 2 K_S^0$       |
| 0.025 $\pm$ 0.015                                                             |    | EMMS                     | 75D | DBC  | $4 \pi^+ n \rightarrow p f_2$           |
| 0.031 $\pm$ 0.012                                                             | 20 | ADERHOLZ                 | 69  | HBC  | $8 \pi^+ p \rightarrow K^+ K^- \pi^+ p$ |

<sup>1</sup> Coupled channel analysis of  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ , and  $K^\pm K_S^0 \pi^\mp$ .

<sup>2</sup> Re-evaluated by CHABAUD 83.

<sup>3</sup> Includes PAWLICKI 77 data.

<sup>4</sup> Takes into account the  $f_2(1270)$ - $f_2'(1525)$  interference.

NODE=M005R3

NODE=M005R3

NODE=M005R3

NODE=M005R;LINKAGE=BG

NODE=M005R3;LINKAGE=D

NODE=M005R3;LINKAGE=F

NODE=M005R3;LINKAGE=M

 $\Gamma(2\pi^+ 2\pi^-)/\Gamma(\pi\pi)$  $\Gamma_4/\Gamma_1$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.033 $\pm$ 0.005 OUR FIT** Error includes scale factor of 1.2.

**0.033 $\pm$ 0.004 OUR AVERAGE** Error includes scale factor of 1.1.

|                                           |     |                    |     |     |                                           |
|-------------------------------------------|-----|--------------------|-----|-----|-------------------------------------------|
| 0.024 $\pm$ 0.006                         | 160 | EMMS               | 75D | DBC | $4 \pi^+ n \rightarrow p f_2$             |
| 0.051 $\pm$ 0.025                         | 70  | EISENBERG          | 74  | HBC | $4.9 \pi^+ p \rightarrow \Delta^{++} f_2$ |
| 0.043 <sup>+0.007</sup> <sub>-0.011</sub> | 285 | <sup>1</sup> LOUIE | 74  | HBC | $3.9 \pi^- p \rightarrow n f_2$           |
| 0.037 $\pm$ 0.007                         | 154 | ANDERSON           | 73  | DBC | $6 \pi^+ n \rightarrow p f_2$             |
| 0.047 $\pm$ 0.013                         |     | OH                 | 70  | HBC | $1.26 \pi^- p \rightarrow \pi^+ \pi^- n$  |

<sup>1</sup> LOUIE 74 was quoted as 0.065 in PDG 74. Factor 2/3 to go from  $\pi^+ \pi^- \rightarrow \pi\pi$  forgotten. Mike L.

NODE=M005R1

NODE=M005R1

NODE=M005R1;LINKAGE=02

 $\Gamma(\eta\eta)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**4.0 $\pm$ 0.8 OUR FIT** Error includes scale factor of 2.1.

**2.9 $\pm$ 0.5 OUR AVERAGE**

|               |       |     |      |                                     |
|---------------|-------|-----|------|-------------------------------------|
| 2.7 $\pm$ 0.7 | BINON | 05  | GAMS | $33 \pi^- p \rightarrow \eta\eta n$ |
| 2.8 $\pm$ 0.7 | ALDE  | 86D | GAM4 | $100 \pi^- p \rightarrow 2\eta n$   |
| 5.2 $\pm$ 1.7 | BINON | 83  | GAM2 | $38 \pi^- p \rightarrow 2\eta n$    |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                         |                       |    |      |                                                                                  |
|-------------------------|-----------------------|----|------|----------------------------------------------------------------------------------|
| 4.0 $\pm$ 1.0 $\pm$ 2.0 | <sup>1</sup> ALBRECHT | 20 | RVUE | $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta,$<br>$\pi^0 \eta \eta, \pi^0 K^+ K^-$ |
|-------------------------|-----------------------|----|------|----------------------------------------------------------------------------------|

<sup>1</sup> Residue from T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).

NODE=M005R7

NODE=M005R7

NODE=M005R7;LINKAGE=A

 $\Gamma(\eta\eta)/\Gamma(\pi\pi)$  $\Gamma_5/\Gamma_1$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

**0.003 $\pm$ 0.001**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |           |     |      |                                           |
|--------|----|-----------|-----|------|-------------------------------------------|
| <0.05  | 95 | EDWARDS   | 82F | CBAL | $e^+ e^- \rightarrow e^+ e^- 2\eta$       |
| <0.016 | 95 | EMMS      | 75D | DBC  | $4 \pi^+ n \rightarrow p f_2$             |
| <0.09  | 95 | EISENBERG | 74  | HBC  | $4.9 \pi^+ p \rightarrow \Delta^{++} f_2$ |

NODE=M005R6

NODE=M005R6

 $\Gamma(4\pi^0)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.0030 $\pm$ 0.0010 OUR FIT**

**0.003  $\pm$ 0.001** 400  $\pm$  50 ALDE 87 GAM4 100  $\pi^- p \rightarrow 4\pi^0 n$

NODE=M005R11

NODE=M005R11

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

NODE=M005R13  
NODE=M005R13

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $1.57 \pm 0.01^{+1.39}_{-0.14}$ 

UEHARA

08A BELL

 $10.6 e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$  $\Gamma(\eta\pi\pi)/\Gamma(\pi\pi)$  $\Gamma_8/\Gamma_1$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

NODE=M005R5  
NODE=M005R5

&lt;0.010

95

EMMS

75D

DBC

 $4 \pi^+ n \rightarrow p f_2$  $\Gamma(K^0 K^- \pi^+ + \text{c.c.})/\Gamma(\pi\pi)$  $\Gamma_9/\Gamma_1$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

NODE=M005R4  
NODE=M005R4

&lt;0.004

95

EMMS

75D

DBC

 $4 \pi^+ n \rightarrow p f_2$  $\Gamma(e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ VALUE (units  $10^{-10}$ )

CL%

DOCUMENT ID

TECN

COMMENT

NODE=M005R12  
NODE=M005R12

&lt;6

90

ACHASOV

00K

SND

 $e^+ e^- \rightarrow \pi^0 \pi^0$ 

## $f_2(1270)$ REFERENCES

NODE=M005

|             |     |                               |                                            |                           |             |
|-------------|-----|-------------------------------|--------------------------------------------|---------------------------|-------------|
| ALBRECHT    | 20  | EPJ C80 453                   | M. Albrecht <i>et al.</i>                  | (Crystal Barrel Collab.)  | REFID=60439 |
| DOBBS       | 15  | PR D91 052006                 | S. Dobbs <i>et al.</i>                     | (NWES)                    | REFID=56805 |
| DAI         | 14A | PR D90 036004                 | L.-Y. Dai, M.R. Pennington                 | (CEBAF)                   | REFID=55923 |
| BOGOLYUB... | 13  | PAN 76 1324                   | M.Yu. Bogolyubsky <i>et al.</i>            | (HYPERON-M Collab.)       | REFID=55585 |
| UEHARA      | 13  | Translated from YAF 76 1389.  |                                            |                           |             |
| UEHARA      | 10A | PTEP 2013 123C01              | S. Uehara <i>et al.</i>                    | (BELLE Collab.)           | REFID=55592 |
| ANISOVICH   | 09  | PR D82 114031                 | S. Uehara <i>et al.</i>                    | (BELLE Collab.)           | REFID=53641 |
| UEHARA      | 09  | IJMP A24 2481                 | V.V. Anisovich, A.V. Sarantsev             |                           | REFID=52719 |
| PDG         | 08  | PR D79 052009                 | S. Uehara <i>et al.</i>                    | (BELLE Collab.)           | REFID=52761 |
| PENNINGTON  | 08  | PL B667 1                     | C. Amsler <i>et al.</i>                    | (PDG Collab.)             | REFID=52166 |
| UEHARA      | 08A | EPJ C56 1                     | M.R. Pennington <i>et al.</i>              |                           | REFID=52303 |
| MORI        | 07  | PR D78 052004                 | S. Uehara <i>et al.</i>                    | (BELLE Collab.)           | REFID=52309 |
| ABLIKIM     | 06V | PR D75 051101                 | T. Mori <i>et al.</i>                      | (BELLE Collab.)           | REFID=51652 |
| SCHEGELSKY  | 06A | PL B642 441                   | M. Ablikim <i>et al.</i>                   | (BES Collab.)             | REFID=51507 |
| ABLIKIM     | 05  | EPJ A27 207                   | V.A. Schegelsky <i>et al.</i>              |                           | REFID=51185 |
| BINON       | 05  | PL B607 243                   | M. Ablikim <i>et al.</i>                   | (BES Collab.)             | REFID=50450 |
|             |     | PAN 68 960                    | F. Binon <i>et al.</i>                     |                           | REFID=50780 |
| ABLIKIM     | 04E | Translated from YAF 68 998.   |                                            |                           |             |
| BARGIOTTI   | 03  | PL B603 138                   | M. Ablikim <i>et al.</i>                   | (BES Collab.)             | REFID=50174 |
| TIKHOMIROV  | 03  | EPJ C26 371                   | M. Bargiotti <i>et al.</i>                 | (OBELIX Collab.)          | REFID=49217 |
|             |     | PAN 66 828                    | G.D. Tikhomirov <i>et al.</i>              |                           | REFID=49423 |
| ACHASOV     | 00K | Translated from YAF 66 860.   |                                            |                           |             |
| BARBERIS    | 00E | PL B492 8                     | M.N. Achasov <i>et al.</i>                 | (Novosibirsk SND Collab.) | REFID=47933 |
| BOGLIONE    | 99  | PL B479 59                    | D. Barberis <i>et al.</i>                  | (WA 102 Collab.)          | REFID=47961 |
| ALDE        | 98  | EPJ C9 11                     | M. Boglione, M.R. Pennington               |                           | REFID=46931 |
| Also        |     | EPJ A3 361                    | D. Alde <i>et al.</i>                      | (GAM4 Collab.)            | REFID=46605 |
|             |     | PAN 62 405                    | D. Alde <i>et al.</i>                      | (GAMS Collab.)            | REFID=46914 |
| ALDE        | 97  | Translated from YAF 62 446.   |                                            |                           |             |
| BERTIN      | 97C | PL B397 350                   | D.M. Alde <i>et al.</i>                    | (GAMS Collab.)            | REFID=45392 |
| GRYGOREV    | 96  | PL B408 476                   | A. Bertin <i>et al.</i>                    | (OBELIX Collab.)          | REFID=45701 |
|             |     | PAN 59 2105                   | V.K. Grigoriev, O.N. Baloshin, B.P. Barkov | (ITEP)                    | REFID=45566 |
| YABUKI      | 95  | Translated from YAF 59 2187.  |                                            |                           |             |
| PROKOSHKIN  | 94  | JPSJ 64 435                   | F. Yabuki <i>et al.</i>                    | (VENUS Collab.)           | REFID=46384 |
|             |     | PD 39 420                     | Y.D. Prokoshkin, A.A. Kondashov            | (SERP)                    | REFID=44094 |
| BEHREND     | 92  | Translated from DANS 336 613. |                                            |                           |             |
| BLINOV      | 92  | ZPHY C56 381                  | H.J. Behrend                               | (CELLO Collab.)           | REFID=43172 |
| AGUILAR-... | 91  | ZPHY C53 33                   | A.E. Blinov <i>et al.</i>                  | (NOVO)                    | REFID=41858 |
| AKER        | 91  | ZPHY C50 405                  | M. Aguilar-Benitez <i>et al.</i>           | (LEBC-EHS Collab.)        | REFID=41637 |
| ADACHI      | 90D | PL B260 249                   | E. Aker <i>et al.</i>                      | (Crystal Barrel Collab.)  | REFID=41587 |
| ALBRECHT    | 90G | PL B234 185                   | I. Adachi <i>et al.</i>                    | (TOPAZ Collab.)           | REFID=41345 |
| BOYER       | 90  | ZPHY C48 183                  | H. Albrecht <i>et al.</i>                  | (ARGUS Collab.)           | REFID=41374 |
| BREAKSTONE  | 90  | PR D42 1350                   | J. Boyer <i>et al.</i>                     | (Mark II Collab.)         | REFID=41362 |
| MARSISKE    | 90  | ZPHY C48 569                  | A.M. Breakstone <i>et al.</i>              | (ISU, BGNA, CERN+)        | REFID=41376 |
| MORGAN      | 90  | PR D41 3324                   | H. Marsiske <i>et al.</i>                  | (Crystal Ball Collab.)    | REFID=41351 |
| OEST        | 90  | ZPHY C48 623                  | D. Morgan, M.R. Pennington                 | (RAL, DURH)               | REFID=41583 |
| AUGUSTIN    | 89  | ZPHY C47 343                  | T. Oest <i>et al.</i>                      | (JADE Collab.)            | REFID=41358 |
| VOROBIEV    | 88  | NP B320 1                     | J.E. Augustin, G. Cosme                    | (DM2 Collab.)             | REFID=41004 |
|             |     | SJNP 48 273                   | P.V. Vorobiev <i>et al.</i>                | (NOVO)                    | REFID=41023 |
| ALDE        | 87  | Translated from YAF 48 436.   |                                            |                           |             |
| AUGUSTIN    | 87  | PL B198 286                   | D.M. Alde <i>et al.</i>                    | (LANL, BRUX, SERP, LAPP)  | REFID=40221 |
| ABACHI      | 86B | ZPHY C36 369                  | J.E. Augustin <i>et al.</i>                | (LALO, CLER, FRAS+)       | REFID=40268 |
| AIHARA      | 86B | PRL 57 1990                   | S. Abachi <i>et al.</i>                    | (PURD, ANL, IND, MICH+)   | REFID=20394 |
| ALDE        | 86D | PRL 57 404                    | H. Aihara <i>et al.</i>                    | (TPC-2 $\gamma$ Collab.)  | REFID=20764 |
| LANDRO      | 86  | NP B269 485                   | D.M. Alde <i>et al.</i>                    | (BELG, LAPP, SERP, CERN+) | REFID=20765 |
| LONGACRE    | 86  | PL B172 445                   | M. Landro, K.J. Mork, H.A. Olsen           | (UTRO)                    | REFID=20767 |
| LYTH        | 85  | PL B177 223                   | R.S. Longacre <i>et al.</i>                | (BNL, BRAN, CUNY+)        | REFID=20768 |
| BEHREND     | 84B | JP G11 459                    | D.H. Lyth                                  |                           | REFID=42169 |
| BERGER      | 84  | ZPHY C23 223                  | H.J. Behrend <i>et al.</i>                 | (CELLO Collab.)           | REFID=20757 |
| COURAU      | 84  | ZPHY C26 199                  | C. Berger <i>et al.</i>                    | (PLUTO Collab.)           | REFID=20760 |
| SMITH       | 84C | PL 147B 227                   | A. Courau <i>et al.</i>                    | (CIT, SLAC)               | REFID=20758 |
| BINON       | 83  | PR D30 851                    | J.R. Smith <i>et al.</i>                   | (SLAC, LBL, HARV)         | REFID=20759 |
| Also        |     | NC 78A 313                    | F.G. Binon <i>et al.</i>                   | (BELG, LAPP, SERP+)       | REFID=20750 |
|             |     | SJNP 38 561                   | F.G. Binon <i>et al.</i>                   | (BELG, LAPP, SERP+)       | REFID=20751 |
|             |     | Translated from YAF 38 934.   |                                            |                           |             |

|             |     |              |                                  |                             |
|-------------|-----|--------------|----------------------------------|-----------------------------|
| CHABAUD     | 83  | NP B223 1    | V. Chabaud <i>et al.</i>         | (CERN, CRAC, MPIM)          |
| DENNEY      | 83  | PR D28 2726  | D.L. Denney <i>et al.</i>        | (IOWA, MICH)                |
| MENNESSIER  | 83  | ZPHY C16 241 | G. Mennessier                    | (MONP)                      |
| APEL        | 82  | NP B201 197  | W.D. Apel <i>et al.</i>          | (KARLK, KARLE, PISA, SERP+) |
| CASON       | 82  | PRL 48 1316  | N.M. Cason <i>et al.</i>         | (NDAM, ANL)                 |
| EDWARDS     | 82F | PL 110B 82   | C. Edwards <i>et al.</i>         | (CIT, HARV, PRIN+)          |
| ETKIN       | 82B | PR D25 1786  | A. Etkin <i>et al.</i>           | (BNL, CUNY, TUFTS, VAND)    |
| BRANDELIK   | 81B | ZPHY C10 117 | R. Brandelik <i>et al.</i>       | (TASSO Collab.)             |
| CHABAUD     | 81  | APP B12 575  | V. Chabaud <i>et al.</i>         | (CERN, CRAC, MPIM)          |
| GIDAL       | 81  | PL 107B 153  | G. Gidal <i>et al.</i>           | (SLAC, LBL)                 |
| ROUSSARIE   | 81  | PL 105B 304  | A. Roussarie <i>et al.</i>       | (SLAC, LBL)                 |
| BERGER      | 80B | PL 94B 254   | C. Berger <i>et al.</i>          | (PLUTO Collab.)             |
| COSTA       | 80  | NP B175 402  | G. Costa <i>et al.</i>           | (BARI, BONN, CERN, GLAS+)   |
| LOVERRE     | 80  | ZPHY C6 187  | P.F. Loverre <i>et al.</i>       | (CERN, CDEF, MADR+)         |
| CORDEN      | 79  | NP B157 250  | M.J. Corden <i>et al.</i>        | (BIRM, RHEL, TELA+)         |
| MARTIN      | 79  | NP B158 520  | A.D. Martin, E.N. Ozmutlu        | (DURH)                      |
| POLYCHRO... | 79  | PR D19 1317  | V.A. Polychronakos <i>et al.</i> | (NDAM, ANL)                 |
| PDG         | 78  | PL 75B 1     | C. Bricman <i>et al.</i>         |                             |
| ANTIPOV     | 77  | NP B119 45   | Y.M. Antipov <i>et al.</i>       | (SERP, GEVA)                |
| PAWLICKI    | 77  | PR D15 3196  | A.J. Pawlicki <i>et al.</i>      | (ANL)                       |
| DEUTSCH...  | 76  | NP B103 426  | M. Deuschmann <i>et al.</i>      | (AACH3, BERL, BONN+)        |
| APEL        | 75  | PL 57B 398   | W.D. Apel <i>et al.</i>          | (KARLK, KARLE, PISA, SERP+) |
| EMMS        | 75D | NP B96 155   | M.J. Emms <i>et al.</i>          | (BIRM, DURH, RHEL)          |
| HYAMS       | 75  | NP B100 205  | B.D. Hyams <i>et al.</i>         | (CERN, MPIM)                |
| EISENBERG   | 74  | PL 52B 239   | Y. Eisenberg <i>et al.</i>       | (REHO)                      |
| ENGLER      | 74  | PR D10 2070  | A. Engler <i>et al.</i>          | (CMU, CASE)                 |
| LOUIE       | 74  | PL 48B 385   | J. Louie <i>et al.</i>           | (SACL, CERN)                |
| PDG         | 74  | PL 50B 1     | V. Chaloupka <i>et al.</i>       |                             |
| ANDERSON    | 73  | PRL 31 562   | J.C. Anderson <i>et al.</i>      | (CMU, CASE)                 |
| TAKAHASHI   | 72  | PR D6 1266   | K. Takahashi <i>et al.</i>       | (TOHOK, PENN, NDAM+)        |
| BEAUPRE     | 71  | NP B28 77    | J.V. Beaupre <i>et al.</i>       | (AACH, BERL, CERN)          |
| FLATTE      | 71  | PL 34B 551   | S.M. Flatte <i>et al.</i>        | (LBL)                       |
| ARMENISE    | 70  | LNC 4 199    | N. Armenise <i>et al.</i>        | (BARI, BGNA, FIRZ)          |
| OH          | 70  | PR D1 2494   | B.Y. Oh <i>et al.</i>            | (WISC, TNT0) JP             |
| STUNTEBECK  | 70  | PL 32B 391   | P.H. Stuntebeck <i>et al.</i>    | (NDAM)                      |
| ADERHOLZ    | 69  | NP B11 259   | M. Aderholz <i>et al.</i>        | (AACH3, BERL, CERN+)        |
| ARMENISE    | 68  | NC 54A 999   | N. Armenise <i>et al.</i>        | (BARI, BGNA, FIRZ+)         |
| ASCOLI      | 68D | PRL 21 1712  | G. Ascoli <i>et al.</i>          | (ILL)                       |
| BOESEBECK   | 68  | NP B4 501    | K. Boesebeck <i>et al.</i>       | (AACH, BERL, CERN)          |
| JOHNSON     | 68  | PR 176 1651  | P.B. Johnson <i>et al.</i>       | (NDAM, PURD, SLAC)          |
| EISNER      | 67  | PR 164 1699  | R.L. Eisner <i>et al.</i>        | (PURD)                      |
| DERADO      | 65  | PRL 14 872   | I. Derado <i>et al.</i>          | (NDAM)                      |
| LEE         | 64  | PRL 12 342   | Y.Y. Lee <i>et al.</i>           | (MICH)                      |
| BONDAR      | 63  | PL 5 153     | L. Bondar <i>et al.</i>          | (AACH, BIRM, BONN, DESY+)   |

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$f_1(1285)$

$$I^G(J^{PC}) = 0^+(1^{++})$$

NODE=M008

### $f_1(1285)$ MASS

NODE=M008M

| VALUE (MeV)                 | EVTS               | DOCUMENT ID                                                 | TECN      | COMMENT                                                     |
|-----------------------------|--------------------|-------------------------------------------------------------|-----------|-------------------------------------------------------------|
| <b>1281.9 ± 0.5</b>         | <b>OUR AVERAGE</b> | Error includes scale factor of 1.8. See the ideogram below. |           |                                                             |
| 1281.0 ± 0.8                |                    | DICKSON                                                     | 16 CLAS   | 2.55 $\gamma p \rightarrow \eta \pi^+ \pi^- p$              |
| 1287.4 ± 3.0                | 87                 | ABLIKIM                                                     | 15P BES3  | $J/\psi \rightarrow K^+ K^- 3\pi$                           |
| 1281.16 ± 0.39 ± 0.45       |                    | 1 LEES                                                      | 12X BABR  | $\tau^- \rightarrow \pi^- f_1(1285) \nu_\tau$               |
| 1285.1 ± 1.0 ± 1.6<br>- 0.3 |                    | 2 ABLIKIM                                                   | 11J BES3  | $J/\psi \rightarrow \omega(\eta \pi^+ \pi^-)$               |
| 1281 ± 2 ± 1                |                    | AUBERT                                                      | 07AU BABR | 10.6 $e^+ e^- \rightarrow f_1(1285) \pi^+ \pi^- \gamma$     |
| 1276.1 ± 8.1 ± 8.0          | 203                | BAI                                                         | 04J BES2  | $J/\psi \rightarrow \gamma \gamma \pi^+ \pi^-$              |
| 1274 ± 6                    | 237                | ABDALLAH                                                    | 03H DLPH  | 91.2 $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp + X$          |
| 1280 ± 4                    |                    | ACCIARRI                                                    | 01G L3    |                                                             |
| 1288 ± 4 ± 5                | 20k                | ADAMS                                                       | 01B B852  | 18 GeV $\pi^- p \rightarrow K^+ K^- \pi^0 n$                |
| 1284 ± 6                    | 1400               | ALDE                                                        | 97B GAM4  | 100 $\pi^- p \rightarrow \eta \pi^0 \pi^0 n$                |
| 1281 ± 1                    |                    | BARBERIS                                                    | 97B OMEG  | 450 $pp \rightarrow pp 2(\pi^+ \pi^-)$                      |
| 1281 ± 1                    |                    | BARBERIS                                                    | 97C OMEG  | 450 $pp \rightarrow pp K_S^0 K^\pm \pi^\mp$                 |
| 1280 ± 2                    |                    | 3 ANTINORI                                                  | 95 OMEG   | 300,450 $pp \rightarrow pp 2(\pi^+ \pi^-)$                  |
| 1282.2 ± 1.5                |                    | LEE                                                         | 94 MPS2   | 18 $\pi^- p \rightarrow K^+ \bar{K}^0 2\pi^- p$             |
| 1279 ± 5                    |                    | FUKUI                                                       | 91C SPEC  | 8.95 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$               |
| 1278 ± 2                    | 140                | ARMSTRONG                                                   | 89 OMEG   | 300 $pp \rightarrow K \bar{K} \pi p$                        |
| 1278 ± 2                    |                    | ARMSTRONG                                                   | 89G OMEG  | 85 $\pi^+ p \rightarrow 4\pi \pi p, pp \rightarrow 4\pi pp$ |

NODE=M008M

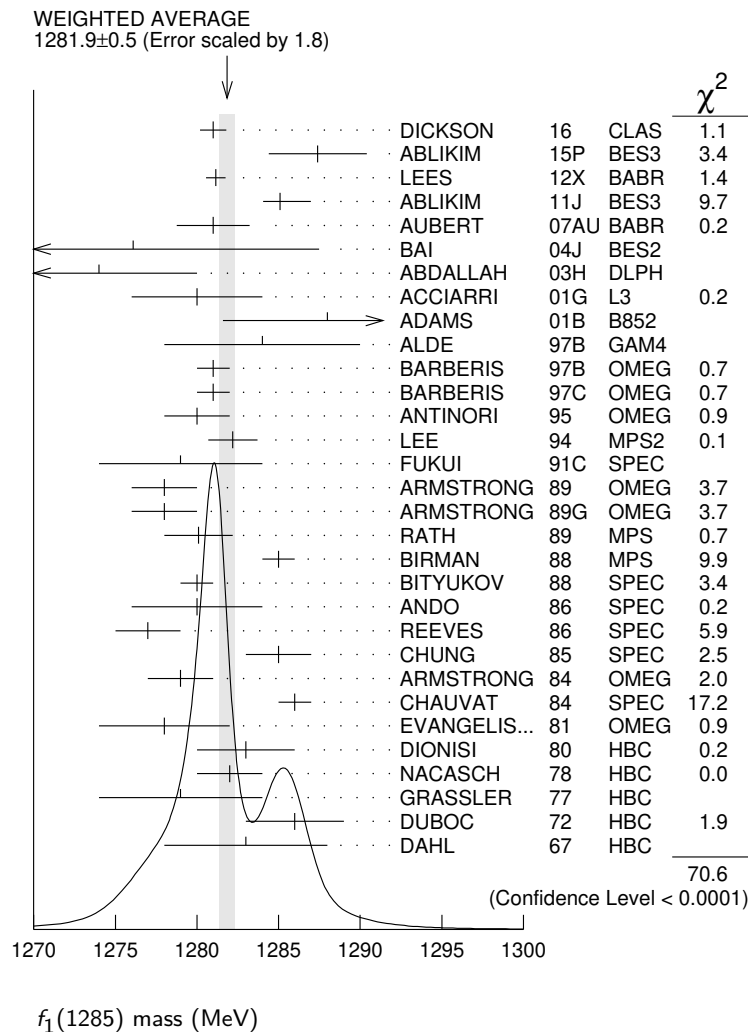
|                                                                               |      |                        |      |      |                                                                                       |
|-------------------------------------------------------------------------------|------|------------------------|------|------|---------------------------------------------------------------------------------------|
| 1280.1 ± 2.1                                                                  | 60   | RATH                   | 89   | MPS  | 21.4 $\pi^- p \rightarrow K_S^0 K_S^0 \pi^0 n$                                        |
| 1285 ± 1                                                                      | 4750 | <sup>4</sup> BIRMAN    | 88   | MPS  | 8 $\pi^- p \rightarrow K^+ \bar{K}^0 \pi^- n$                                         |
| 1280 ± 1                                                                      | 504  | BITYUKOV               | 88   | SPEC | 32.5 $\pi^- p \rightarrow K^+ K^- \pi^0 n$                                            |
| 1280 ± 4                                                                      |      | ANDO                   | 86   | SPEC | 8 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$                                            |
| 1277 ± 2                                                                      | 420  | REEVES                 | 86   | SPEC | 6.6 $p \bar{p} \rightarrow K K \pi X$                                                 |
| 1285 ± 2                                                                      |      | CHUNG                  | 85   | SPEC | 8 $\pi^- p \rightarrow N K \bar{K} \pi$                                               |
| 1279 ± 2                                                                      | 604  | ARMSTRONG              | 84   | OMEG | 85 $\pi^+ p \rightarrow K \bar{K} \pi \pi p$ ,<br>$p p \rightarrow K \bar{K} \pi p p$ |
| 1286 ± 1                                                                      |      | CHAUVAT                | 84   | SPEC | ISR 31.5 $p p$                                                                        |
| 1278 ± 4                                                                      |      | EVANGELIS...           | 81   | OMEG | 12 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$                                     |
| 1283 ± 3                                                                      | 103  | DIONISI                | 80   | HBC  | 4 $\pi^- p \rightarrow K \bar{K} \pi n$                                               |
| 1282 ± 2                                                                      | 320  | NACASCH                | 78   | HBC  | 0.7, 0.76 $\bar{p} p \rightarrow K \bar{K} 3\pi$                                      |
| 1279 ± 5                                                                      | 210  | GRASSLER               | 77   | HBC  | 16 $\pi^\mp p$                                                                        |
| 1286 ± 3                                                                      | 180  | DUBOC                  | 72   | HBC  | 1.2 $\bar{p} p \rightarrow 2K 4\pi$                                                   |
| 1283 ± 5                                                                      |      | DAHL                   | 67   | HBC  | 1.6-4.2 $\pi^- p$                                                                     |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                        |      |      |                                                                                       |
| 1289.3 ± 2.8                                                                  | 234  | ABLIKIM                | 19BA | BES3 | $e^+ e^- \rightarrow \psi(2S)$                                                        |
| 1284.2 ± 2.2                                                                  |      | <sup>5</sup> AAIJ      | 14Y  | LHCB | $\bar{B}_{(s)}^0 \rightarrow J/\psi 2(\pi^+ \pi^-)$                                   |
| 1281.9 ± 0.5                                                                  |      | <sup>5</sup> SOSA      | 99   | SPEC | $p p \rightarrow p_{\text{slow}} (K_S^0 K^+ \pi^-) p_{\text{fast}}$                   |
| 1282.8 ± 0.6                                                                  |      | <sup>5</sup> SOSA      | 99   | SPEC | $p p \rightarrow p_{\text{slow}} (K_S^0 K^- \pi^+) p_{\text{fast}}$                   |
| 1270 ± 10                                                                     |      | AMELIN                 | 95   | VES  | 37 $\pi^- N \rightarrow \pi^- \pi^+ \pi^- \gamma N$                                   |
| 1280 ± 2                                                                      |      | ABATZIS                | 94   | OMEG | 450 $p p \rightarrow p p 2(\pi^+ \pi^-)$                                              |
| 1282 ± 4                                                                      |      | ARMSTRONG              | 93C  | E760 | $\bar{p} p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$                           |
| 1270 ± 6 ± 10                                                                 |      | ARMSTRONG              | 92C  | OMEG | 300 $p p \rightarrow p p \pi^+ \pi^- \gamma$                                          |
| 1281 ± 1                                                                      |      | ARMSTRONG              | 89E  | OMEG | 300 $p p \rightarrow p p 2(\pi^+ \pi^-)$                                              |
| 1279 ± 6 ± 10                                                                 | 16   | BECKER                 | 87   | MRK3 | $e^+ e^- \rightarrow \phi K \bar{K} \pi$                                              |
| 1286 ± 9                                                                      |      | GIDAL                  | 87   | MRK2 | $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$                                        |
| 1287 ± 5                                                                      | 353  | BITYUKOV               | 84B  | SPEC | 32 $\pi^- p \rightarrow K^+ K^- \pi^0 n$                                              |
| ~ 1279                                                                        |      | <sup>6</sup> TORNQVIST | 82B  | RVUE |                                                                                       |
| 1275 ± 6                                                                      | 31   | BROMBERG               | 80   | SPEC | 100 $\pi^- p \rightarrow K \bar{K} \pi X$                                             |
| 1288 ± 9                                                                      | 200  | GURTU                  | 79   | HBC  | 4.2 $K^- p \rightarrow n \eta 2\pi$                                                   |
| ~ 1275.0                                                                      | 46   | <sup>7</sup> STANTON   | 79   | CNTR | 8.5 $\pi^- p \rightarrow n 2\gamma 2\pi$                                              |
| 1271 ± 10                                                                     | 34   | CORDEN                 | 78   | OMEG | 12-15 $\pi^- p \rightarrow K^+ K^- \pi n$                                             |
| 1295 ± 12                                                                     | 85   | CORDEN                 | 78   | OMEG | 12-15 $\pi^- p \rightarrow n 5\pi$                                                    |
| 1292 ± 10                                                                     | 150  | DEFOIX                 | 72   | HBC  | 0.7 $\bar{p} p \rightarrow 7\pi$                                                      |
| 1280 ± 3                                                                      | 500  | <sup>8</sup> THUN      | 72   | MMS  | 13.4 $\pi^- p$                                                                        |
| 1303 ± 8                                                                      |      | BARDADIN-...           | 71   | HBC  | 8 $\pi^+ p \rightarrow p 6\pi$                                                        |
| 1283 ± 6                                                                      |      | BOESEBECK              | 71   | HBC  | 16.0 $\pi p \rightarrow p 5\pi$                                                       |
| 1270 ± 10                                                                     |      | CAMPBELL               | 69   | DBC  | 2.7 $\pi^+ d$                                                                         |
| 1285 ± 7                                                                      |      | LORSTAD                | 69   | HBC  | 0.7 $\bar{p} p$ , 4,5-body                                                            |
| 1290 ± 7                                                                      |      | D'ANDLAU               | 68   | HBC  | 1.2 $\bar{p} p$ , 5-6 body                                                            |

OCCUR=2

OCCUR=2

<sup>1</sup> Using the  $2\pi^+ 2\pi^-$  and  $\pi^+ \pi^- \eta$  modes of  $f_1(1285)$  decay.<sup>2</sup> The selected process is  $J/\psi \rightarrow \omega a_0(980)\pi$ .<sup>3</sup> Supersedes ABATZIS 94, ARMSTRONG 89E.<sup>4</sup> From partial wave analysis of  $K^+ \bar{K}^0 \pi^-$  system.<sup>5</sup> No systematic error given.<sup>6</sup> From a unitarized quark-model calculation.<sup>7</sup> From phase shift analysis of  $\eta \pi^+ \pi^-$  system.<sup>8</sup> Seen in the missing mass spectrum.

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 NODE=M008M;LINKAGE=A  
 NODE=M008M;LINKAGE=N1  
 NODE=M008M;LINKAGE=T  
 NODE=M008M;LINKAGE=P  
 NODE=M008M;LINKAGE=S



### $f_1(1285)$ WIDTH

NODE=M008W

Only experiments giving width error less than 20 MeV are kept for averaging.

NODE=M008W

| VALUE (MeV)                               | EVTS | DOCUMENT ID                                                 | TECN      | COMMENT                                                 |
|-------------------------------------------|------|-------------------------------------------------------------|-----------|---------------------------------------------------------|
| <b>22.7± 1.1 OUR AVERAGE</b>              |      | Error includes scale factor of 1.5. See the ideogram below. |           |                                                         |
| 18.4± 1.4                                 |      | DICKSON                                                     | 16 CLAS   | 2.55 $\gamma p \rightarrow \eta \pi^+ \pi^- p$          |
| 18.3± 6.3                                 | 87   | ABLIKIM                                                     | 15P BES3  | $J/\psi \rightarrow K^+ K^- 3\pi$                       |
| 22.0± 3.1 <sup>+2.0</sup> <sub>-1.5</sub> |      | <sup>1</sup> ABLIKIM                                        | 11J BES3  | $J/\psi \rightarrow \omega(\eta \pi^+ \pi^-)$           |
| 35 ± 6 ± 4                                |      | AUBERT                                                      | 07AU BABR | 10.6 $e^+ e^- \rightarrow f_1(1285) \pi^+ \pi^- \gamma$ |
| 40.0± 8.6± 9.3                            | 203  | BAI                                                         | 04J BES2  | $J/\psi \rightarrow \gamma \gamma \pi^+ \pi^-$          |
| 29 ± 12                                   | 237  | ABDALLAH                                                    | 03H DLPH  | 91.2 $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp + X$      |
| 45 ± 9 ± 7                                | 20k  | ADAMS                                                       | 01B B852  | 18 GeV $\pi^- p \rightarrow K^+ K^- \pi^0 n$            |
| 55 ± 18                                   | 1400 | ALDE                                                        | 97B GAM4  | 100 $\pi^- p \rightarrow \eta \pi^0 \pi^0 n$            |
| 24 ± 3                                    |      | BARBERIS                                                    | 97B OMEG  | 450 $pp \rightarrow pp2(\pi^+ \pi^-)$                   |
| 20 ± 2                                    |      | BARBERIS                                                    | 97C OMEG  | 450 $pp \rightarrow pp K_S^0 K^\pm \pi^\mp$             |
| 36 ± 5                                    |      | <sup>2</sup> ANTINORI                                       | 95 OMEG   | 300,450 $pp \rightarrow pp2(\pi^+ \pi^-)$               |
| 29.0± 4.1                                 |      | LEE                                                         | 94 MPS2   | 18 $\pi^- p \rightarrow K^+ \bar{K}^0 2\pi^- p$         |
| 25 ± 4                                    | 140  | ARMSTRONG                                                   | 89 OMEG   | 300 $pp \rightarrow K \bar{K} \pi pp$                   |
| 22 ± 2                                    | 4750 | <sup>3</sup> BIRMAN                                         | 88 MPS    | 8 $\pi^- p \rightarrow K^+ \bar{K}^0 \pi^- n$           |
| 25 ± 4                                    | 504  | BITYUKOV                                                    | 88 SPEC   | 32.5 $\pi^- p \rightarrow K^+ K^- \pi^0 n$              |
| 19 ± 5                                    |      | ANDO                                                        | 86 SPEC   | 8 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$              |
| 32 ± 8                                    | 420  | REEVES                                                      | 86 SPEC   | 6.6 $p \bar{p} \rightarrow K K \pi X$                   |

NODE=M008W



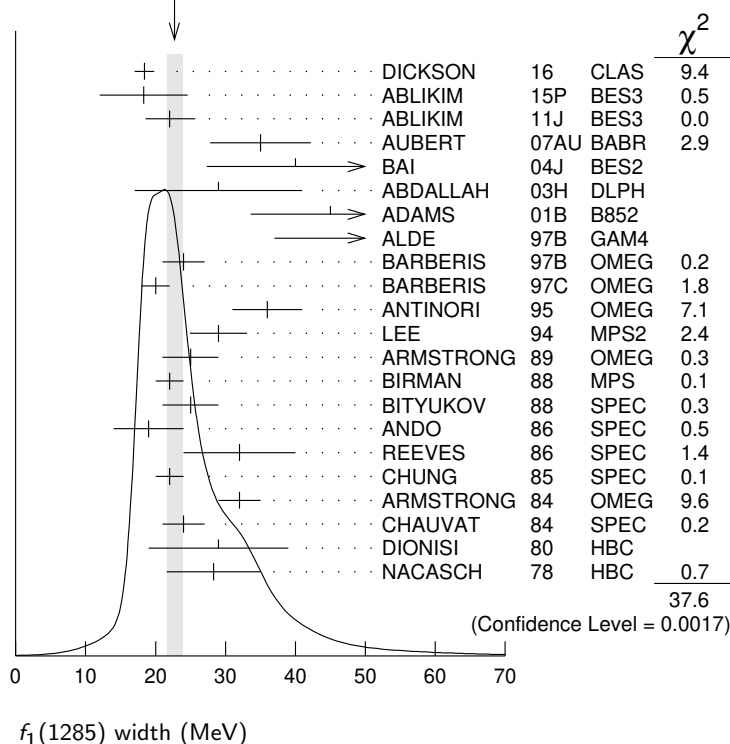
|                                                                               |     |              |      |      |                                                                               |
|-------------------------------------------------------------------------------|-----|--------------|------|------|-------------------------------------------------------------------------------|
| 22 ± 2                                                                        |     | CHUNG        | 85   | SPEC | $8 \pi^- p \rightarrow NK\bar{K}\pi$                                          |
| 32 ± 3                                                                        | 604 | ARMSTRONG    | 84   | OMEG | $85 \pi^+ p \rightarrow K\bar{K}\pi\pi p,$<br>$pp \rightarrow K\bar{K}\pi pp$ |
| 24 ± 3                                                                        |     | CHAUVAT      | 84   | SPEC | ISR 31.5 $pp$                                                                 |
| 29 ± 10                                                                       | 103 | DIONISI      | 80   | HBC  | $4 \pi^- p \rightarrow K\bar{K}\pi n$                                         |
| 28.3 ± 6.7                                                                    | 320 | NACASCH      | 78   | HBC  | $0.7, 0.76 \bar{p} p \rightarrow K\bar{K}3\pi$                                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |              |      |      |                                                                               |
| 17.1 ± 3.4                                                                    | 234 | ABLIKIM      | 19BA | BES3 | $e^+e^- \rightarrow \psi(2S)$                                                 |
| 32.4 ± 5.8                                                                    |     | 4 AAIJ       | 14Y  | LHCB | $\bar{B}_{(s)}^0 \rightarrow J/\psi 2(\pi^+\pi^-)$                            |
| 18.2 ± 1.2                                                                    |     | 4 SOSA       | 99   | SPEC | $pp \rightarrow p_{\text{slow}} (K_S^0 K^+\pi^-)$<br>$p_{\text{fast}}$        |
| 19.4 ± 1.5                                                                    |     | 4 SOSA       | 99   | SPEC | $pp \rightarrow p_{\text{slow}} (K_S^0 K^-\pi^+)$<br>$p_{\text{fast}}$        |
| 40 ± 5                                                                        |     | ABATZIS      | 94   | OMEG | 450 $pp \rightarrow pp2(\pi^+\pi^-)$                                          |
| 31 ± 5                                                                        |     | ARMSTRONG    | 89E  | OMEG | 300 $pp \rightarrow pp2(\pi^+\pi^-)$                                          |
| 41 ± 12                                                                       |     | ARMSTRONG    | 89G  | OMEG | $85 \pi^+ p \rightarrow 4\pi\pi p, pp \rightarrow$<br>$4\pi pp$               |
| 17.9 ± 10.9                                                                   | 60  | RATH         | 89   | MPS  | $21.4 \pi^- p \rightarrow K_S^0 K_S^0 \pi^0 n$                                |
| 14 $^{+20}_{-14}$ ± 10                                                        | 16  | BECKER       | 87   | MRK3 | $e^+e^- \rightarrow \phi K\bar{K}\pi$                                         |
| 26 ± 12                                                                       |     | EVANGELIS... | 81   | OMEG | $12 \pi^- p \rightarrow \eta\pi^+\pi^-\pi^-p$                                 |
| 25 ± 15                                                                       | 200 | GURTU        | 79   | HBC  | $4.2 K^- p \rightarrow n\eta 2\pi$                                            |
| ~ 10                                                                          |     | 5 STANTON    | 79   | CNTR | $8.5 \pi^- p \rightarrow n2\gamma 2\pi$                                       |
| 24 ± 18                                                                       | 210 | GRASSLER     | 77   | HBC  | $16 \pi^\mp p$                                                                |
| 28 ± 5                                                                        | 150 | 6 DEFOIX     | 72   | HBC  | $0.7 \bar{p} p \rightarrow 7\pi$                                              |
| 46 ± 9                                                                        | 180 | 6 DUBOC      | 72   | HBC  | $1.2 \bar{p} p \rightarrow 2K4\pi$                                            |
| 37 ± 5                                                                        | 500 | 7 THUN       | 72   | MMS  | $13.4 \pi^- p$                                                                |
| 10 ± 10                                                                       |     | BOESEBECK    | 71   | HBC  | $16.0 \pi p \rightarrow p5\pi$                                                |
| 30 ± 15                                                                       |     | CAMPBELL     | 69   | DBC  | $2.7 \pi^+ d$                                                                 |
| 60 ± 15                                                                       |     | 6 LORSTAD    | 69   | HBC  | $0.7 \bar{p} p, 4,5\text{-body}$                                              |
| 35 ± 10                                                                       |     | 6 DAHL       | 67   | HBC  | $1.6\text{--}4.2 \pi^- p$                                                     |

OCCUR=2

<sup>1</sup> The selected process is  $J/\psi \rightarrow \omega a_0(980)\pi$ .<sup>2</sup> Supersedes ABATZIS 94, ARMSTRONG 89E.<sup>3</sup> From partial wave analysis of  $K^+ \bar{K}^0 \pi^-$  system.<sup>4</sup> No systematic error given.<sup>5</sup> From phase shift analysis of  $\eta\pi^+\pi^-$  system.<sup>6</sup> Resolution is not unfolded.<sup>7</sup> Seen in the missing mass spectrum.

NODE=M008W;LINKAGE=BL  
 NODE=M008W;LINKAGE=B  
 NODE=M008W;LINKAGE=A  
 NODE=M008W;LINKAGE=N1  
 NODE=M008W;LINKAGE=P  
 NODE=M008W;LINKAGE=R  
 NODE=M008W;LINKAGE=S

WEIGHTED AVERAGE  
 $22.7 \pm 1.1$  (Error scaled by 1.5)



**$f_1(1285)$  DECAY MODES**

NODE=M008215;NODE=M008

| Mode                                                                   | Fraction ( $\Gamma_i/\Gamma$ ) | Scale factor/<br>Confidence level |           |
|------------------------------------------------------------------------|--------------------------------|-----------------------------------|-----------|
| $\Gamma_1$ $4\pi$                                                      | $(32.7 \pm 1.9) \%$            | $S=1.2$                           | DESIG=21  |
| $\Gamma_2$ $\pi^0 \pi^0 \pi^+ \pi^-$                                   | $(21.8 \pm 1.3) \%$            | $S=1.2$                           | DESIG=22  |
| $\Gamma_3$ $2\pi^+ 2\pi^-$                                             | $(10.9 \pm 0.6) \%$            | $S=1.2$                           | DESIG=20  |
| $\Gamma_4$ $\rho^0 \pi^+ \pi^-$                                        | $(10.9 \pm 0.6) \%$            | $S=1.2$                           | DESIG=191 |
| $\Gamma_5$ $\rho^0 \rho^0$                                             | seen                           |                                   | DESIG=23  |
| $\Gamma_6$ $4\pi^0$                                                    | $< 7 \times 10^{-4}$           | CL=90%                            | DESIG=7   |
| $\Gamma_7$ $\eta \pi^+ \pi^-$                                          | $(35 \pm 15) \%$               |                                   | DESIG=198 |
| $\Gamma_8$ $\eta \pi \pi$                                              | $(52.2 \pm 2.0) \%$            | $S=1.2$                           | DESIG=3   |
| $\Gamma_9$ $a_0(980) \pi$ [ignoring $a_0(980) \rightarrow K \bar{K}$ ] | $(38 \pm 4) \%$                |                                   | DESIG=4   |
| $\Gamma_{10}$ $\eta \pi \pi$ [excluding $a_0(980) \pi$ ]               | $(14 \pm 4) \%$                |                                   | DESIG=5   |
| $\Gamma_{11}$ $K \bar{K} \pi$                                          | $(9.0 \pm 0.4) \%$             | $S=1.1$                           | DESIG=1   |
| $\Gamma_{12}$ $K \bar{K}^*(892)$                                       | not seen                       |                                   | DESIG=6   |
| $\Gamma_{13}$ $\pi^+ \pi^- \pi^0$                                      | $(3.0 \pm 0.9) \times 10^{-3}$ |                                   | DESIG=197 |
| $\Gamma_{14}$ $\rho^\pm \pi^\mp$                                       | $< 3.1 \times 10^{-3}$         | CL=95%                            | DESIG=199 |
| $\Gamma_{15}$ $\gamma \rho^0$                                          | $(6.1 \pm 1.0) \%$             | $S=1.7$                           | DESIG=13  |
| $\Gamma_{16}$ $\phi \gamma$                                            | $(7.4 \pm 2.6) \times 10^{-4}$ |                                   | DESIG=10  |
| $\Gamma_{17}$ $e^+ e^-$                                                | $< 9.4 \times 10^{-9}$         | CL=90%                            | DESIG=200 |
| $\Gamma_{18}$ $\gamma \gamma^*$                                        |                                |                                   | DESIG=9   |
| $\Gamma_{19}$ $\gamma \gamma$                                          |                                |                                   | DESIG=8   |

**CONSTRAINED FIT INFORMATION**

An overall fit to 6 branching ratios uses 18 measurements and one constraint to determine 5 parameters. The overall fit has a  $\chi^2 = 24.0$  for 14 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |          |          |
|----------|-------|-------|----------|----------|
| $x_9$    | -30   |       |          |          |
| $x_{10}$ | -12   | -88   |          |          |
| $x_{11}$ | 22    | -10   | -4       |          |
| $x_{15}$ | -25   | -7    | -3       | -27      |
|          | $x_1$ | $x_9$ | $x_{10}$ | $x_{11}$ |

 **$f_1(1285) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$** 

NODE=M008217

| $\Gamma(\eta\pi\pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |     | $\Gamma_8 \Gamma_{19} / \Gamma = (\Gamma_9 + \Gamma_{10}) \Gamma_{19} / \Gamma$ |      |                                                     |
|--------------------------------------------------------------------------|-----|---------------------------------------------------------------------------------|------|-----------------------------------------------------|
| VALUE (keV)                                                              | CL% | DOCUMENT ID                                                                     | TECN | COMMENT                                             |
| <b>&lt;0.62</b>                                                          | 95  | GIDAL                                                                           | 87   | MRK2 $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$ |

NODE=M008G2  
NODE=M008G2

| $\Gamma(\eta\pi\pi) \times \Gamma(\gamma\gamma^*) / \Gamma_{\text{total}}$    |      | $\Gamma_8 \Gamma_{18} / \Gamma = (\Gamma_9 + \Gamma_{10}) \Gamma_{18} / \Gamma$ |      |                                                           |
|-------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------|------|-----------------------------------------------------------|
| VALUE (keV)                                                                   | EVTS | DOCUMENT ID                                                                     | TECN | COMMENT                                                   |
| <b>1.4 <math>\pm</math> 0.4 OUR AVERAGE</b>                                   |      | Error includes scale factor of 1.4.                                             |      |                                                           |
| 1.18 $\pm$ 0.25 $\pm$ 0.20                                                    | 26   | <sup>1,2</sup> AIHARA                                                           | 88B  | TPC $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$        |
| 2.30 $\pm$ 0.61 $\pm$ 0.42                                                    |      | <sup>1,3</sup> GIDAL                                                            | 87   | MRK2 $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                                                 |      |                                                           |
| 1.8 $\pm$ 0.3 $\pm$ 0.3                                                       | 420  | <sup>4</sup> ACHARD                                                             | 02B  | L3 183-209 $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$ |

NODE=M008G3  
NODE=M008G3<sup>1</sup> Assuming a  $\rho$ -pole form factor.<sup>2</sup> Published value multiplied by  $\eta\pi\pi$  branching ratio 0.49.<sup>3</sup> Published value divided by 2 and multiplied by the  $\eta\pi\pi$  branching ratio 0.49.<sup>4</sup> Published value multiplied by the  $\eta\pi\pi$  branching ratio 0.52.NODE=M008G3;LINKAGE=A  
NODE=M008G3;LINKAGE=F  
NODE=M008G3;LINKAGE=B  
NODE=M008G3;LINKAGE=AC

**$f_1(1285)$  BRANCHING RATIOS**

NODE=M008220

 **$\Gamma(K\bar{K}\pi)/\Gamma(4\pi)$**  **$\Gamma_{11}/\Gamma_1$** 

| VALUE                          | DOCUMENT ID                         | TECN | COMMENT                                         |
|--------------------------------|-------------------------------------|------|-------------------------------------------------|
| <b>0.274±0.017 OUR FIT</b>     | Error includes scale factor of 1.4. |      |                                                 |
| <b>0.271±0.016 OUR AVERAGE</b> | Error includes scale factor of 1.2. |      |                                                 |
| 0.265±0.014                    | <sup>1</sup> BARBERIS               | 97C  | OMEG 450 $pp \rightarrow ppK_S^0 K^\pm \pi^\mp$ |
| 0.28 ±0.05                     | <sup>2</sup> ARMSTRONG              | 89E  | OMEG 300 $pp \rightarrow pp f_1(1285)$          |
| 0.37 ±0.03 ±0.05               | <sup>3</sup> ARMSTRONG              | 89G  | OMEG 85 $\pi p \rightarrow 4\pi X$              |

<sup>1</sup> Using  $2(\pi^+\pi^-)$  data from BARBERIS 97B.<sup>2</sup> Assuming  $\rho\pi\pi$  and  $a_0(980)\pi$  intermediate states.<sup>3</sup>  $4\pi$  consistent with being entirely  $\rho\pi\pi$ .NODE=M008R1  
NODE=M008R1NODE=M008R1;LINKAGE=B  
NODE=M008R1;LINKAGE=M  
NODE=M008R1;LINKAGE=A **$\Gamma(\pi^0\pi^0\pi^+\pi^-)/\Gamma_{\text{total}}$**  **$\Gamma_2/\Gamma = \frac{2}{3}\Gamma_1/\Gamma$** 

| VALUE                      | DOCUMENT ID                         |
|----------------------------|-------------------------------------|
| <b>0.218±0.013 OUR FIT</b> | Error includes scale factor of 1.2. |

NODE=M008R18  
NODE=M008R18 **$\Gamma(2\pi^+2\pi^-)/\Gamma_{\text{total}}$**  **$\Gamma_3/\Gamma = \frac{1}{3}\Gamma_1/\Gamma$** 

| VALUE                      | DOCUMENT ID                         |
|----------------------------|-------------------------------------|
| <b>0.109±0.006 OUR FIT</b> | Error includes scale factor of 1.2. |

NODE=M008R17  
NODE=M008R17 **$\Gamma(\rho^0\pi^+\pi^-)/\Gamma_{\text{total}}$**  **$\Gamma_4/\Gamma = \frac{1}{3}\Gamma_1/\Gamma$** 

| VALUE                      | DOCUMENT ID                         |
|----------------------------|-------------------------------------|
| <b>0.109±0.006 OUR FIT</b> | Error includes scale factor of 1.2. |

NODE=M008R19  
NODE=M008R19 **$\Gamma(\rho^0\pi^+\pi^-)/\Gamma(2\pi^+2\pi^-)$**  **$\Gamma_4/\Gamma_3$** 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                |
|-------------------------------------------------------------------------------|-------------|------|------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                        |
| 1.0±0.4                                                                       | GRASSLER    | 77   | HBC 16 GeV $\pi^\pm p$ |

NODE=M008R6  
NODE=M008R6 **$\Gamma(\rho^0\rho^0)/\Gamma_{\text{total}}$**  **$\Gamma_5/\Gamma$** 

| VALUE       | DOCUMENT ID | COMMENT                               |
|-------------|-------------|---------------------------------------|
| <b>seen</b> | BARBERIS    | 00C 450 $pp \rightarrow p_f 4\pi p_s$ |

NODE=M008R21  
NODE=M008R21 **$\Gamma(4\pi^0)/\Gamma_{\text{total}}$**  **$\Gamma_6/\Gamma$** 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|--------------------------|-----|-------------|------|-----------------------------------------|
| <b>&lt;7</b>             | 90  | ALDE        | 87   | GAM4 100 $\pi^- p \rightarrow 4\pi^0 n$ |

NODE=M008R8  
NODE=M008R8 **$\Gamma(\pi^+\pi^-\pi^0)/\Gamma(\eta\pi^+\pi^-)$**  **$\Gamma_{13}/\Gamma_7$** 

| VALUE (%)             | EVTS | DOCUMENT ID           | TECN | COMMENT                                     |
|-----------------------|------|-----------------------|------|---------------------------------------------|
| <b>0.86±0.16±0.20</b> | 2.3k | <sup>1</sup> DOROFEEV | 11   | VES $\pi^- N \rightarrow \pi^- f_1(1285) N$ |

<sup>1</sup> Value obtained selecting the region corresponding to  $f_0(980)$  in the  $\pi^+\pi^-$  mass spectrum.NODE=M008R02  
NODE=M008R02

NODE=M008R02;LINKAGE=DO

 **$\Gamma(\eta\pi\pi)/\Gamma_{\text{total}}$**  **$\Gamma_8/\Gamma = (\Gamma_9+\Gamma_{10})/\Gamma$** 

| VALUE                      | DOCUMENT ID                         |
|----------------------------|-------------------------------------|
| <b>0.522±0.020 OUR FIT</b> | Error includes scale factor of 1.2. |

NODE=M008R22  
NODE=M008R22 **$\Gamma(4\pi)/\Gamma(\eta\pi\pi)$**  **$\Gamma_1/\Gamma_8 = \Gamma_1/(\Gamma_9+\Gamma_{10})$** 

| VALUE                        | DOCUMENT ID                         | TECN | COMMENT |
|------------------------------|-------------------------------------|------|---------|
| <b>0.63±0.06 OUR FIT</b>     | Error includes scale factor of 1.3. |      |         |
| <b>0.41±0.14 OUR AVERAGE</b> |                                     |      |         |

0.37±0.11±0.11 BOLTON 92 MRK3  $J/\psi \rightarrow \gamma f_1(1285)$ 0.64±0.40 GURTU 79 HBC 4.2  $K^- p$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.93±0.30 <sup>1</sup> GRASSLER 77 HBC 16  $\pi^\mp p$ <sup>1</sup> Assuming  $\rho\pi\pi$  and  $a_0(980)\pi$  intermediate states.NODE=M008R4  
NODE=M008R4

NODE=M008R4;LINKAGE=M

 **$\Gamma(2\pi^+2\pi^-)/\Gamma(\eta\pi\pi)$**  **$\Gamma_3/\Gamma_8$** 

| VALUE                 | DOCUMENT ID       | TECN | COMMENT                                            |
|-----------------------|-------------------|------|----------------------------------------------------|
| <b>0.28±0.02±0.02</b> | <sup>1</sup> LEES | 12X  | BABR $\tau^- \rightarrow \pi^- f_1(1285) \nu_\tau$ |

<sup>1</sup> Assuming  $B(f_1(1285) \rightarrow \pi\pi\eta) = 3/2 B(f_1(1285) \rightarrow \pi^+\pi^-\eta)$ .NODE=M008R04  
NODE=M008R04

NODE=M008R04;LINKAGE=LE

$\Gamma(a_0(980)\pi \text{ [ignoring } a_0(980) \rightarrow K\bar{K}])/\Gamma(\eta\pi\pi)$ 
 $\Gamma_9/\Gamma_8 = \Gamma_9/(\Gamma_9+\Gamma_{10})$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

**0.72±0.08 OUR FIT****0.72±0.07 OUR AVERAGE**0.74±0.02±0.09 DICKSON 16 CLAS  $\gamma p \rightarrow f_1(1285)p$ 0.72±0.15 GURTU 79 HBC 4.2  $K^- p$ 0.6  $^{+0.3}_{-0.2}$  CORDEN 78 OMEG 12-15  $\pi^- p$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

>0.69 95 ACHARD 02B L3 183-209  $e^+e^- \rightarrow e^+e^-\eta\pi^+\pi^-$ 0.28±0.07 ALDE 97B GAM4 100  $\pi^- p \rightarrow \eta\pi^0\pi^0 n$ 1.0 ±0.3 GRASSLER 77 HBC 16  $\pi^\mp p$ NODE=M008R3  
NODE=M008R3 $\Gamma(K\bar{K}\pi)/\Gamma(\eta\pi\pi)$  $\Gamma_{11}/\Gamma_8 = \Gamma_{11}/(\Gamma_9+\Gamma_{10})$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.172±0.012 OUR FIT** Error includes scale factor of 1.1.**0.176±0.012 OUR AVERAGE**0.216±0.010±0.031 DICKSON 16 CLAS  $\gamma p \rightarrow f_1(1285)p$ 0.166±0.01 ±0.008 BARBERIS 98C OMEG 450  $p p \rightarrow p_f f_1(1285)p_s$ 0.42 ±0.15 GURTU 79 HBC 4.2  $K^- p$ 0.5 ±0.2 <sup>1</sup> CORDEN 78 OMEG 12-15  $\pi^- p$ 0.20 ±0.08 <sup>2</sup> DEFOIX 72 HBC 0.7  $\bar{p} p \rightarrow 7\pi$ 0.16 ±0.08 CAMPBELL 69 DBC 2.7  $\pi^+ d$ <sup>1</sup> CORDEN 78 assumes low-mass  $\eta\pi\pi$  region is dominantly  $1^{++}$ . See BARBERIS 98C and MANAK 00A for discussion.<sup>2</sup>  $K\bar{K}$  system characterized by the  $I = 1$  threshold enhancement. (See under  $a_0(980)$ ).NODE=M008R2  
NODE=M008R2

OCCUR=2

NODE=M008R2;LINKAGE=CD

NODE=M008R2;LINKAGE=K

 $\Gamma(K\bar{K}^*(892))/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

not seen NACASCH 78 HBC 0.7,0.76  $\bar{p} p \rightarrow K\bar{K}3\pi$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

seen <sup>1</sup> ACHARD 07 L3 183-209  $e^+e^- \rightarrow e^+e^-K_S^0 K^\pm \pi^\mp$ <sup>1</sup> A clear signal of  $19.8 \pm 4.4$  events observed at high  $Q^2$ .NODE=M008R5  
NODE=M008R5

NODE=M008R5;LINKAGE=CH

 $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE (%) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-----------|------|-------------|------|---------|
|-----------|------|-------------|------|---------|

**0.30±0.055±0.074** 2.3k <sup>1</sup> DOROFEEV 11 VES  $\pi^- N \rightarrow \pi^- f_1(1285)N$ <sup>1</sup> Value obtained selecting the region corresponding to  $f_0(980)$  in the  $\pi^+\pi^-$  mass spectrum. The systematic error includes the uncertainty on the partial width  $f_1 \rightarrow \eta\pi\pi$  obtained from PDG 10 data.NODE=M008R01  
NODE=M008R01

NODE=M008R01;LINKAGE=DO

 $\Gamma(\rho^\pm\pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE (%) | CL% | DOCUMENT ID | TECN | COMMENT |
|-----------|-----|-------------|------|---------|
|-----------|-----|-------------|------|---------|

<0.31 95 DOROFEEV 11 VES  $\pi^- N \rightarrow \pi^- f_1(1285)N$ NODE=M008R03  
NODE=M008R03 $\Gamma(\gamma\rho^0)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

**6.1±1.0 OUR FIT** Error includes scale factor of 1.7.

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.8±0.7±0.6 <sup>1</sup> AMELIN 95 VES 37  $\pi^- N \rightarrow \pi^- \pi^+ \pi^- \gamma N$ <5 95 BITYUKOV 91B SPEC 32  $\pi^- p \rightarrow \pi^+ \pi^- \gamma n$ <sup>1</sup> Not an independent measurement.NODE=M008R15  
NODE=M008R15

NODE=M008R15;LINKAGE=A

 $\Gamma(\gamma\rho^0)/\Gamma(2\pi^+2\pi^-)$  $\Gamma_{15}/\Gamma_3 = \Gamma_{15}/\frac{1}{3}\Gamma_1$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.55±0.10 OUR FIT** Error includes scale factor of 1.5.**0.45±0.18** <sup>1</sup> COFFMAN 90 MRK3  $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$ <sup>1</sup> Using  $B(J/\psi \rightarrow \gamma f_1(1285) \rightarrow \gamma\gamma\rho^0) = 0.25 \times 10^{-4}$  and  $B(J/\psi \rightarrow \gamma f_1(1285) \rightarrow \gamma 2\pi^+ 2\pi^-) = 0.55 \times 10^{-4}$  given by MIR 88.NODE=M008R13  
NODE=M008R13

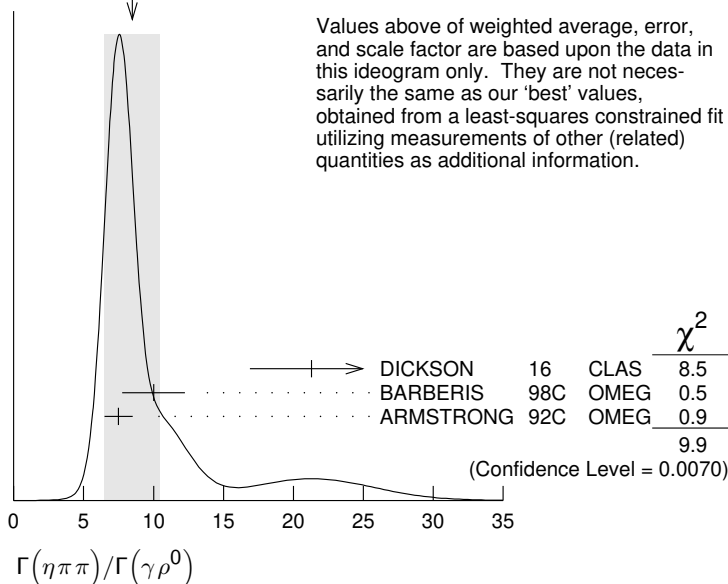
NODE=M008R13;LINKAGE=E

$\Gamma(\eta\pi\pi)/\Gamma(\gamma\rho^0)$  $\Gamma_8/\Gamma_{15} = (\Gamma_9 + \Gamma_{10})/\Gamma_{15}$ 

| VALUE                      | DOCUMENT ID                                                 | TECN | COMMENT                                                        |
|----------------------------|-------------------------------------------------------------|------|----------------------------------------------------------------|
| <b>8.6±1.6 OUR FIT</b>     | Error includes scale factor of 1.9.                         |      |                                                                |
| <b>8.5±2.0 OUR AVERAGE</b> | Error includes scale factor of 2.2. See the ideogram below. |      |                                                                |
| 21.3±4.4                   | DICKSON                                                     | 16   | CLAS $\gamma\rho \rightarrow f_1(1285)\rho$                    |
| 10.0±1.0±2.0               | BARBERIS                                                    | 98C  | OMEG 450 $pp \rightarrow p_f f_1(1285)p_s$                     |
| 7.5±1.0                    | <sup>1</sup> ARMSTRONG                                      | 92C  | OMEG 300 $pp \rightarrow pp\pi^+\pi^-\gamma, pp\eta\pi^+\pi^-$ |

<sup>1</sup> Published value multiplied by 1.5.NODE=M008R16  
NODE=M008R16

NODE=M008R16;LINKAGE=B

WEIGHTED AVERAGE  
8.5±2.0 (Error scaled by 2.2) $\Gamma(\gamma\rho^0)/\Gamma(K\bar{K}\pi)$  $\Gamma_{15}/\Gamma_{11}$ 

| VALUE                                                                         | CL% | DOCUMENT ID          | TECN | COMMENT                                          |
|-------------------------------------------------------------------------------|-----|----------------------|------|--------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |                      |      |                                                  |
| >0.035                                                                        | 90  | <sup>1</sup> COFFMAN | 90   | MRK3 $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$ |

<sup>1</sup> Using  $B(J/\psi \rightarrow \gamma f_1(1285) \rightarrow \gamma\gamma\rho^0) = 0.25 \times 10^{-4}$  and  $B(J/\psi \rightarrow \gamma f_1(1285) \rightarrow \gamma K\bar{K}\pi) < 0.72 \times 10^{-3}$ .

NODE=M008R12  
NODE=M008R12

NODE=M008R12;LINKAGE=F

 $\Gamma(\phi\gamma)/\Gamma(K\bar{K}\pi)$  $\Gamma_{16}/\Gamma_{11}$ 

| VALUE (units $10^{-2}$ )                                                      | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                                                 |
|-------------------------------------------------------------------------------|-----|------|-------------|------|---------------------------------------------------------|
| <b>0.82±0.21±0.20</b>                                                         |     | 19   | BITYUKOV    | 88   | SPEC 32.5 $\pi^- p \rightarrow K^+ K^- \pi^0 n$         |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |      |             |      |                                                         |
| <0.50                                                                         | 95  |      | BARBERIS    | 98C  | OMEG 450 $pp \rightarrow p_f f_1(1285)p_s$              |
| <0.93                                                                         | 95  |      | AMELIN      | 95   | VES 37 $\pi^- N \rightarrow \pi^- \pi^+ \pi^- \gamma N$ |

NODE=M008R9  
NODE=M008R9 $\Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID          | TECN | COMMENT                                 |
|----------------------------------|-----|----------------------|------|-----------------------------------------|
| <b>&lt;9.4 × 10<sup>-9</sup></b> | 90  | <sup>1</sup> ACHASOV | 20   | SND $e^+e^- \rightarrow \eta\pi^0\pi^0$ |

<sup>1</sup> ACHASOV 20 reports two candidate events corresponding to a significance of 2.5  $\sigma$  and the branching fraction of  $(5.1^{+3.7}_{-2.7}) \times 10^{-9}$ .

NODE=M008R00  
NODE=M008R00  
OCCUR=2

NODE=M008R00;LINKAGE=B

 $f_1(1285)$  REFERENCES

NODE=M008

|          |      |                |                            |                     |             |
|----------|------|----------------|----------------------------|---------------------|-------------|
| ACHASOV  | 20   | PL B800 135074 | M.N. Achasov <i>et al.</i> | (SND Collab.)       | REFID=60144 |
| ABLIKIM  | 19BA | PR D100 092003 | M. Ablikim <i>et al.</i>   | (BESIII Collab.)    | REFID=60024 |
| DICKSON  | 16   | PR C93 065202  | R. Dickson <i>et al.</i>   | (JLab CLAS Collab.) | REFID=57487 |
| ABLIKIM  | 15P  | PR D92 012007  | M. Ablikim <i>et al.</i>   | (BESIII Collab.)    | REFID=56781 |
| AAIJ     | 14Y  | PRL 112 091802 | R. Aaij <i>et al.</i>      | (LHCb Collab.)      | REFID=55837 |
| LEES     | 12X  | PR D86 092010  | J.P. Lees <i>et al.</i>    | (BABAR Collab.)     | REFID=54714 |
| ABLIKIM  | 11J  | PRL 107 182001 | M. Ablikim <i>et al.</i>   | (BESIII Collab.)    | REFID=53931 |
| DOROFEEV | 11   | EPJ A47 68     | V. Dorofeev <i>et al.</i>  | (SERP, MIP)         | REFID=16755 |
| PDG      | 10   | JP G37 075021  | K. Nakamura <i>et al.</i>  | (PDG Collab.)       | REFID=53229 |
| ACHARD   | 07   | JHEP 0703 018  | P. Achard <i>et al.</i>    | (L3 Collab.)        | REFID=51698 |
| AUBERT   | 07AU | PR D76 092005  | B. Aubert <i>et al.</i>    | (BABAR Collab.)     | REFID=52049 |
| BAI      | 04J  | PL B594 47     | J.Z. Bai <i>et al.</i>     | (BES Collab.)       | REFID=50167 |

|                             |     |                       |                                      |                                 |             |
|-----------------------------|-----|-----------------------|--------------------------------------|---------------------------------|-------------|
| ABDALLAH                    | 03H | PL B569 129           | J. Abdallah <i>et al.</i>            | (DELPHI Collab.)                | REFID=49548 |
| ACHARD                      | 02B | PL B526 269           | P. Achard <i>et al.</i>              | (L3 Collab.)                    | REFID=48574 |
| ACCIARRI                    | 01G | PL B501 1             | M. Acciarri <i>et al.</i>            | (L3 Collab.)                    | REFID=48319 |
| ADAMS                       | 01B | PL B516 264           | G.S. Adams <i>et al.</i>             | (BNL E852 Collab.)              | REFID=49649 |
| BARBERIS                    | 00C | PL B471 440           | D. Barberis <i>et al.</i>            | (WA 102 Collab.)                | REFID=47959 |
| MANAK                       | 00A | PR D62 012003         | J.J. Manak <i>et al.</i>             | (BNL E852 Collab.)              | REFID=47989 |
| SOSA                        | 99  | PRL 83 913            | M. Sosa <i>et al.</i>                |                                 | REFID=46937 |
| BARBERIS                    | 98C | PL B440 225           | D. Barberis <i>et al.</i>            | (WA 102 Collab.)                | REFID=46346 |
| ALDE                        | 97B | PAN 60 386            | D. Alde <i>et al.</i>                | (GAMS Collab.)                  | REFID=45396 |
| Translated from YAF 60 458. |     |                       |                                      |                                 |             |
| BARBERIS                    | 97B | PL B413 217           | D. Barberis <i>et al.</i>            | (WA 102 Collab.)                | REFID=45758 |
| BARBERIS                    | 97C | PL B413 225           | D. Barberis <i>et al.</i>            | (WA 102 Collab.)                | REFID=45759 |
| AMELIN                      | 95  | ZPHY C66 71           | D.V. Amelin <i>et al.</i>            | (VES Collab.)                   | REFID=44376 |
| ANTINORI                    | 95  | PL B353 589           | F. Antinori <i>et al.</i>            | (ATHU, BARI, BIRM+)             | REFID=44437 |
| ABATZIS                     | 94  | PL B324 509           | S. Abatzis <i>et al.</i>             | (ATHU, BARI, BIRM+)             | REFID=44090 |
| LEE                         | 94  | PL B323 227           | J.H. Lee <i>et al.</i>               | (BNL, IND, KYUN, MASD+)         | REFID=44092 |
| ARMSTRONG                   | 93C | PL B307 394           | T.A. Armstrong <i>et al.</i>         | (FNAL, FERR, GENO+)             | REFID=43587 |
| ARMSTRONG                   | 92C | ZPHY C54 371          | T.A. Armstrong <i>et al.</i>         | (ATHU, BARI, BIRM+)             | REFID=42097 |
| BOLTON                      | 92  | PL B278 495           | T. Bolton <i>et al.</i>              | (Mark III Collab.)              | REFID=42175 |
| BITYUKOV                    | 91B | SJNP 54 318           | S.I. Bitukov <i>et al.</i>           | (SERP)                          | REFID=41864 |
| Translated from YAF 54 529. |     |                       |                                      |                                 |             |
| FUKUI                       | 91C | PL B267 293           | S. Fukui <i>et al.</i>               | (SUGI, NAGO, KEK, KYOT+)        | REFID=41748 |
| COFFMAN                     | 90  | PR D41 1410           | D.M. Coffman <i>et al.</i>           | (Mark III Collab.)              | REFID=41350 |
| ARMSTRONG                   | 89  | PL B221 216           | T.A. Armstrong <i>et al.</i>         | (CERN, CDEF, BIRM+)             | REFID=40729 |
| ARMSTRONG                   | 89E | PL B228 536           | T.A. Armstrong, M. Benayoun          | (ATHU, BARI, BIRM+)             | REFID=41011 |
| ARMSTRONG                   | 89G | ZPHY C43 55           | T.A. Armstrong <i>et al.</i>         | (CERN, BIRM, BARI+)             | REFID=40930 |
| RATH                        | 89  | PR D40 693            | M.G. Rath <i>et al.</i>              | (NDAM, BRAN, BNL, CUNY+)        | REFID=40924 |
| AIHARA                      | 88B | PL B209 107           | H. Aihara <i>et al.</i>              | (TPC-2 $\gamma$ Collab.)        | REFID=40572 |
| BIRMAN                      | 88  | PRL 61 1557           | A. Birman <i>et al.</i>              | (BNL, FSU, IND, MASD) JP        | REFID=40568 |
| BITYUKOV                    | 88  | PL B203 327           | S.I. Bitukov <i>et al.</i>           | (SERP)                          | REFID=40569 |
| MIR                         | 88  | Photon-Photon 88, 126 | R. Mir                               | (Mark III Collab.)              | REFID=41574 |
| Conference                  |     |                       |                                      |                                 |             |
| ALDE                        | 87  | PL B198 286           | D.M. Alde <i>et al.</i>              | (LANL, BRUX, SERP, LAPP)        | REFID=40221 |
| BECKER                      | 87  | PRL 59 186            | J.J. Becker <i>et al.</i>            | (Mark III Collab.)              | REFID=40015 |
| GIDAL                       | 87  | PRL 59 2012           | G. Gidal <i>et al.</i>               | (LBL, SLAC, HARV)               | REFID=40223 |
| ANDO                        | 86  | PRL 57 1296           | A. Ando <i>et al.</i>                | (KEK, KYOT, NIRS, SAGA+) IJP    | REFID=20891 |
| REEVES                      | 86  | PR D34 1960           | D.F. Reeves <i>et al.</i>            | (FLOR, BNL, IND+) JP            | REFID=20936 |
| CHUNG                       | 85  | PRL 55 779            | S.U. Chung <i>et al.</i>             | (BNL, FLOR, IND+) JP            | REFID=20934 |
| ARMSTRONG                   | 84  | PL 146B 273           | T.A. Armstrong <i>et al.</i>         | (ATHU, BARI, BIRM+) JP          | REFID=20929 |
| BITYUKOV                    | 84B | PL 144B 133           | S.I. Bitukov <i>et al.</i>           | (SERP)                          | REFID=20468 |
| CHAUVAT                     | 84  | PL 148B 382           | P. Chauvat <i>et al.</i>             | (CERN, CLER, UCLA+)             | REFID=20932 |
| TORNQVIST                   | 82B | NP B203 268           | N.A. Tornqvist                       | (HELS)                          | REFID=20573 |
| EVANGELIS...                | 81  | NP B178 197           | C. Evangelista <i>et al.</i>         | (BARI, BONN, CERN+)             | REFID=20462 |
| BROMBERG                    | 80  | PR D22 1513           | C.M. Bromberg <i>et al.</i>          | (CIT, FNAL, ILLC+)              | REFID=20922 |
| DIONISI                     | 80  | NP B169 1             | C. Dionisi <i>et al.</i>             | (CERN, MADR, CDEF+)             | REFID=20924 |
| GURTU                       | 79  | NP B151 181           | A. Gurtu <i>et al.</i>               | (CERN, ZEEM, NIJM, OXF)         | REFID=20456 |
| STANTON                     | 79  | PRL 42 346            | N.R. Stanton <i>et al.</i>           | (OSU, CARL, MCGI+) JP           | REFID=20887 |
| CORDEN                      | 78  | NP B144 253           | M.J. Corden <i>et al.</i>            | (BIRM, RHEL, TELA+) JP          | REFID=20452 |
| NACASCH                     | 78  | NP B135 203           | R. Nacasch <i>et al.</i>             | (PARIS, MADR, CERN)             | REFID=20919 |
| GRASSLER                    | 77  | NP B121 189           | H. Grassler <i>et al.</i>            | (AACH3, BERL, BONN+)            | REFID=20447 |
| DEFOIX                      | 72  | NP B44 125            | C. Defoix <i>et al.</i>              | (CDEF, CERN)                    | REFID=20435 |
| DUBOC                       | 72  | NP B46 429            | J. Duboc <i>et al.</i>               | (PARIS, LIVP)                   | REFID=20339 |
| THUN                        | 72  | PRL 28 1733           | R. Thun <i>et al.</i>                | (STON, NEAS)                    | REFID=20911 |
| BARDADIN-...                | 71  | PR D4 2711            | M. Bardadin-Otwinowska <i>et al.</i> | (WARS)                          | REFID=20196 |
| BOESEBECK                   | 71  | PL 34B 659            | K. Boesebeck                         | (AACH, BERL, BONN, CERN, CRAC+) | REFID=20905 |
| CAMPBELL                    | 69  | PRL 22 1204           | J.H. Campbell <i>et al.</i>          | (PURD)                          | REFID=20419 |
| LORSTAD                     | 69  | NP B14 63             | B. Lorstad <i>et al.</i>             | (CDEF, CERN) JP                 | REFID=20901 |
| D'ANDLAU                    | 68  | NP B5 693             | C. d'Andlau <i>et al.</i>            | (CDEF, CERN, IRAD+) IJP         | REFID=20897 |
| DAHL                        | 67  | PR 163 1377           | O.I. Dahl <i>et al.</i>              | (LRL) IJP                       | REFID=20321 |

**$\eta(1295)$** 

$$I^G(J^{PC}) = 0^+(0^{-+})$$

See the review on "Pseudoscalar and pseudovector mesons in the 1400 MeV region."

NODE=M037

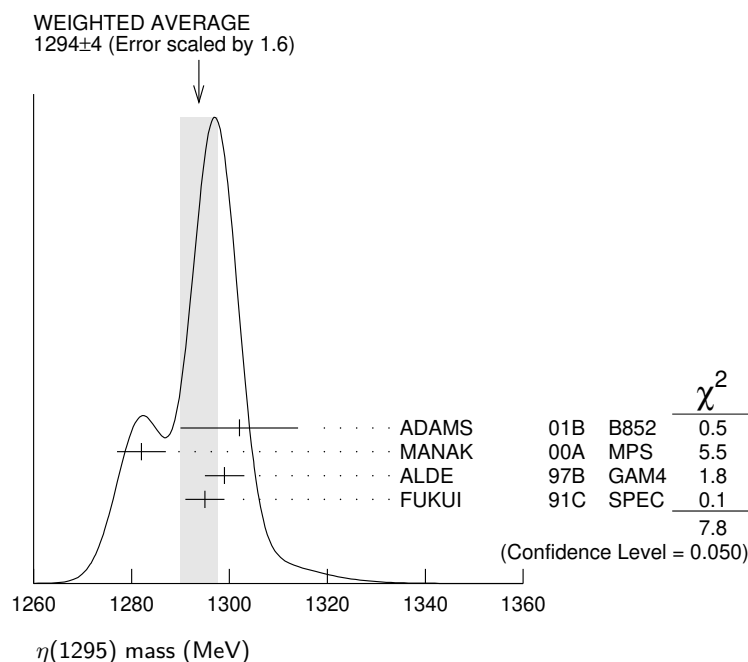
NODE=M037

NODE=M037M

NODE=M037M

 **$\eta(1295)$  MASS**

| VALUE (MeV)                                                                   | EVTs                                                        | DOCUMENT ID           | TECN     | COMMENT                                       |
|-------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------|----------|-----------------------------------------------|
| <b>1294±4 OUR AVERAGE</b>                                                     | Error includes scale factor of 1.6. See the ideogram below. |                       |          |                                               |
| 1302±9±8                                                                      | 20k                                                         | ADAMS                 | 01B B852 | 18 GeV $\pi^- p \rightarrow K^+ K^- \pi^0 n$  |
| 1282±5                                                                        | 9082                                                        | MANAK                 | 00A MPS  | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$   |
| 1299±4                                                                        | 2100                                                        | ALDE                  | 97B GAM4 | 100 $\pi^- p \rightarrow \eta \pi^0 \pi^0 n$  |
| 1295±4                                                                        |                                                             | FUKUI                 | 91C SPEC | 8.95 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                             |                       |          |                                               |
| 1264±8                                                                        |                                                             | <sup>1</sup> AUGUSTIN | 90 DM2   | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$  |
| ~ 1275                                                                        |                                                             | STANTON               | 79 CNTR  | 8.4 $\pi^- p \rightarrow n \eta 2\pi$         |



<sup>1</sup> PWA analysis of AUGUSTIN 92 assigns  $0^{-+}$  quantum numbers to this state rather than  $1^{++}$  as before.

NODE=M037M;LINKAGE=AG

 **$\eta(1295)$  WIDTH**

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID           | TECN     | COMMENT                                       |
|-------------------------------------------------------------------------------|------|-----------------------|----------|-----------------------------------------------|
| <b>55± 5 OUR AVERAGE</b>                                                      |      |                       |          |                                               |
| 57±23±21                                                                      | 20k  | ADAMS                 | 01B B852 | 18 GeV $\pi^- p \rightarrow K^+ K^- \pi^0 n$  |
| 66±13                                                                         | 9082 | MANAK                 | 00A MPS  | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$   |
| 53± 6                                                                         |      | FUKUI                 | 91C SPEC | 8.95 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |          |                                               |
| <40                                                                           | 2100 | ALDE                  | 97B GAM4 | 100 $\pi^- p \rightarrow \eta \pi^0 \pi^0 n$  |
| 44±20                                                                         |      | <sup>2</sup> AUGUSTIN | 90 DM2   | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$  |
| ~ 70                                                                          |      | STANTON               | 79 CNTR  | 8.4 $\pi^- p \rightarrow n \eta 2\pi$         |

<sup>2</sup> PWA analysis of AUGUSTIN 92 assigns  $0^{-+}$  quantum numbers to this state rather than  $1^{++}$  as before.

NODE=M037W

NODE=M037W

NODE=M037W;LINKAGE=AG

**$\eta(1295)$  DECAY MODES**

NODE=M037215;NODE=M037

| Mode                                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------------|--------------------------------|
| $\Gamma_1$ $\eta\pi^+\pi^-$               | seen                           |
| $\Gamma_2$ $a_0(980)\pi$                  | seen                           |
| $\Gamma_3$ $\gamma\gamma$                 |                                |
| $\Gamma_4$ $\eta\pi^0\pi^0$               | seen                           |
| $\Gamma_5$ $\eta(\pi\pi)_{S\text{-wave}}$ | seen                           |
| $\Gamma_6$ $\sigma\eta$                   |                                |
| $\Gamma_7$ $K\bar{K}\pi$                  |                                |

DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=3  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=6  
 DESIG=7

 **$\eta(1295) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

NODE=M037220

| $\Gamma(\eta\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$    |     |             |         |                                                                | $\Gamma_1\Gamma_3/\Gamma$ |
|-------------------------------------------------------------------------------|-----|-------------|---------|----------------------------------------------------------------|---------------------------|
| VALUE (keV)                                                                   | CL% | DOCUMENT ID | TECN    | COMMENT                                                        |                           |
| <0.066                                                                        | 95  | ACCIARRI    | 01G L3  | $183\text{--}202\ e^+e^- \rightarrow e^+\ e^-\ \eta\pi^+\pi^-$ |                           |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |             |         |                                                                |                           |
| <0.6                                                                          | 90  | AIHARA      | 88C TPC | $e^+e^- \rightarrow e^+\ e^-\ \eta\pi^+\pi^-$                  |                           |
| <0.3                                                                          |     | ANTREASYAN  | 87 CBAL | $e^+e^- \rightarrow e^+\ e^-\ \eta\pi\pi$                      |                           |

NODE=M037G2  
 NODE=M037G2

| $\Gamma(K\bar{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$       |     |             |      |         | $\Gamma_7\Gamma_3/\Gamma$                                                         |
|-------------------------------------------------------------------------------|-----|-------------|------|---------|-----------------------------------------------------------------------------------|
| VALUE (keV)                                                                   | CL% | DOCUMENT ID | TECN | COMMENT |                                                                                   |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |             |      |         |                                                                                   |
| <0.014                                                                        | 90  | 3,4 AHOHE   | 05   | CLE2    | $10.6 \frac{e^+e^- \rightarrow e^+e^-K_S^0K^\pm\pi^\mp}{e^+e^-K_S^0K^\pm\pi^\mp}$ |

NODE=M037G3  
 NODE=M037G3

<sup>3</sup> Using  $\eta(1295)$  mass and width 1294 MeV and 55 MeV, respectively.<sup>4</sup> Assuming three-body phase-space decay to  $K_S^0K^\pm\pi^\mp$ .

NODE=M037G3;LINKAGE=AH  
 NODE=M037G3;LINKAGE=B3

 **$\eta(1295)$  BRANCHING RATIOS**

NODE=M037225

| $\Gamma(a_0(980)\pi)/\Gamma_{\text{total}}$                                   | $\Gamma_2/\Gamma$ |      |         |                                                        |
|-------------------------------------------------------------------------------|-------------------|------|---------|--------------------------------------------------------|
| VALUE                                                                         | DOCUMENT ID       | TECN | COMMENT |                                                        |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                   |      |         |                                                        |
| not seen                                                                      | BERTIN            | 97   | OBLX    | 0.0 $\bar{p}p \rightarrow K^\pm(K^0)\pi^\mp\pi^+\pi^-$ |
| seen                                                                          | BIRMAN            | 88   | MPS     | 8 $\pi^-p \rightarrow K^+\bar{K}^0\pi^-\eta$           |
| large                                                                         | ANDO              | 86   | SPEC    | 8 $\pi^-p \rightarrow \eta\pi^+\pi^-n$                 |
| large                                                                         | STANTON           | 79   | CNTR    | 8.4 $\pi^-p \rightarrow n\eta 2\pi$                    |

NODE=M037R1  
 NODE=M037R1

| $\Gamma(a_0(980)\pi)/\Gamma(\eta\pi^0\pi^0)$ | $\Gamma_2/\Gamma_4$ |          |                                          |
|----------------------------------------------|---------------------|----------|------------------------------------------|
| VALUE                                        | DOCUMENT ID         | TECN     | COMMENT                                  |
| <b>0.65±0.10</b>                             | <sup>5</sup> ALDE   | 97B GAM4 | 100 $\pi^-p \rightarrow \eta\pi^0\pi^0n$ |

NODE=M037R2  
 NODE=M037R2

<sup>5</sup> Assuming that  $a_0(980)$  decays only to  $\eta\pi$ .

NODE=M037R2;LINKAGE=A

| $\Gamma(\eta(\pi\pi)_{S\text{-wave}})/\Gamma(\eta\pi^0\pi^0)$ | $\Gamma_5/\Gamma_4$ |          |                                          |
|---------------------------------------------------------------|---------------------|----------|------------------------------------------|
| VALUE                                                         | DOCUMENT ID         | TECN     | COMMENT                                  |
| <b>0.35±0.10</b>                                              | ALDE                | 97B GAM4 | 100 $\pi^-p \rightarrow \eta\pi^0\pi^0n$ |

NODE=M037R4  
 NODE=M037R4

| $\Gamma(a_0(980)\pi)/\Gamma(\sigma\eta)$ |      |             |      |         | $\Gamma_2/\Gamma_6$                     |
|------------------------------------------|------|-------------|------|---------|-----------------------------------------|
| VALUE                                    | EVTS | DOCUMENT ID | TECN | COMMENT |                                         |
| <b>0.48±0.22</b>                         | 9082 | MANAK       | 00A  | MPS     | 18 $\pi^-p \rightarrow \eta\pi^+\pi^-n$ |

NODE=M037R5  
 NODE=M037R5

 **$\eta(1295)$  REFERENCES**

NODE=M037

|                             |     |               |                             |                              |
|-----------------------------|-----|---------------|-----------------------------|------------------------------|
| AHOHE                       | 05  | PR D71 072001 | R. Ahohe <i>et al.</i>      | (CLEO Collab.)               |
| ACCIARRI                    | 01G | PL B501 1     | M. Acciarri <i>et al.</i>   | (L3 Collab.)                 |
| ADAMS                       | 01B | PL B516 264   | G.S. Adams <i>et al.</i>    | (BNL E852 Collab.)           |
| MANAK                       | 00A | PR D62 012003 | J.J. Manak <i>et al.</i>    | (BNL E852 Collab.)           |
| ALDE                        | 97B | PAN 60 386    | D. Alde <i>et al.</i>       | (GAMS Collab.)               |
| Translated from YAF 60 458. |     |               |                             |                              |
| BERTIN                      | 97  | PL B400 226   | A. Bertin <i>et al.</i>     | (OBELIX Collab.)             |
| AUGUSTIN                    | 92  | PR D46 1951   | J.E. Augustin, G. Cosme     | (DM2 Collab.)                |
| FUKUI                       | 91C | PL B267 293   | S. Fukui <i>et al.</i>      | (SUGI, NAGO, KEK, KYOT+)     |
| AUGUSTIN                    | 90  | PR D42 10     | J.E. Augustin <i>et al.</i> | (DM2 Collab.)                |
| AIHARA                      | 88C | PR D38 1      | H. Aihara <i>et al.</i>     | (TPC-2γ Collab.)             |
| BIRMAN                      | 88  | PRL 61 1557   | A. Birman <i>et al.</i>     | (BNL, FSU, IND, MASD) JP     |
| ANTREASYAN                  | 87  | PR D36 2633   | D. Antreasyan <i>et al.</i> | (Crystal Ball Collab.)       |
| ANDO                        | 86  | PRL 57 1296   | A. Ando <i>et al.</i>       | (KEK, KYOT, NIRS, SAGA+) IJP |
| STANTON                     | 79  | PRL 42 346    | N.R. Stanton <i>et al.</i>  | (OSU, CARL, MCGI+) JP        |

REFID=50764  
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 REFID=41352  
 REFID=40564  
 REFID=40568  
 REFID=40008  
 REFID=20891  
 REFID=20887



$\pi(1300)$ 

$$I^G(J^{PC}) = 1^-(0^-+)$$

NODE=M058

 $\pi(1300)$  MASS

NODE=M058M

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**1300±100 OUR ESTIMATE**

NODE=M058M

→ UNCHECKED ←

- • • We do not use the following data for averages, fits, limits, etc. • • •

|             |     |                         |     |      |                                                |
|-------------|-----|-------------------------|-----|------|------------------------------------------------|
| 1128± 26±70 |     | DARGENT                 | 17  | RVUE | $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$      |
| 1345± 8±10  | 18k | <sup>1</sup> SCHEGELSKY | 06  | RVUE | $\gamma\gamma \rightarrow \pi^+ \pi^- \pi^0$   |
| 1200± 40    | 90k | SALVINI                 | 04  | OBLX | $\bar{p}p \rightarrow 2\pi^+ 2\pi^-$           |
| 1343± 15±24 |     | CHUNG                   | 02  | B852 | $18.3 \pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |
| 1375± 40    |     | ABELE                   | 01  | CBAR | $0.0 \bar{p}d \rightarrow \pi^- 4\pi^0 p$      |
| 1275± 15    |     | BERTIN                  | 97D | OBLX | $0.05 \bar{p}p \rightarrow 2\pi^+ 2\pi^-$      |
| ~ 1114      |     | ABELE                   | 96  | CBAR | $0.0 \bar{p}p \rightarrow 5\pi^0$              |
| 1190± 30    |     | ZIELINSKI               | 84  | SPEC | $200 \pi^+ Z \rightarrow Z 3\pi$               |
| 1240± 30    |     | BELLINI                 | 82  | SPEC | $40 \pi^- A \rightarrow A 3\pi$                |
| 1273± 50    |     | <sup>2</sup> AARON      | 81  | RVUE |                                                |
| 1342± 20    |     | BONESINI                | 81  | OMEG | $12 \pi^- p \rightarrow p 3\pi$                |
| ~ 1400      |     | DAUM                    | 81B | SPEC | $63,94 \pi^- p$                                |

<sup>1</sup> From analysis of L3 data at 183–209 GeV.<sup>2</sup> Uses multichannel Aitchison-Bowler model (BOWLER 75). Uses data from DAUM 80 and DANKOWYCH 81.

NODE=M058M;LINKAGE=SC

NODE=M058M;LINKAGE=E

 $\pi(1300)$  WIDTH

NODE=M058W

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**200 to 600 OUR ESTIMATE**

NODE=M058W

→ UNCHECKED ←

- • • We do not use the following data for averages, fits, limits, etc. • • •

|            |     |                         |     |      |                                                |
|------------|-----|-------------------------|-----|------|------------------------------------------------|
| 314± 39±66 |     | DARGENT                 | 17  | RVUE | $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$      |
| 260± 20±30 | 18k | <sup>3</sup> SCHEGELSKY | 06  | RVUE | $\gamma\gamma \rightarrow \pi^+ \pi^- \pi^0$   |
| 470±120    | 90k | SALVINI                 | 04  | OBLX | $\bar{p}p \rightarrow 2\pi^+ 2\pi^-$           |
| 449± 39±47 |     | CHUNG                   | 02  | B852 | $18.3 \pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |
| 268± 50    |     | ABELE                   | 01  | CBAR | $0.0 \bar{p}d \rightarrow \pi^- 4\pi^0 p$      |
| 218±100    |     | BERTIN                  | 97D | OBLX | $0.05 \bar{p}p \rightarrow 2\pi^+ 2\pi^-$      |
| ~ 340      |     | ABELE                   | 96  | CBAR | $0.0 \bar{p}p \rightarrow 5\pi^0$              |
| 440± 80    |     | ZIELINSKI               | 84  | SPEC | $200 \pi^+ Z \rightarrow Z 3\pi$               |
| 360±120    |     | BELLINI                 | 82  | SPEC | $40 \pi^- A \rightarrow A 3\pi$                |
| 580±100    |     | <sup>4</sup> AARON      | 81  | RVUE |                                                |
| 220± 70    |     | BONESINI                | 81  | OMEG | $12 \pi^- p \rightarrow p 3\pi$                |
| ~ 600      |     | DAUM                    | 81B | SPEC | $63,94 \pi^- p$                                |

<sup>3</sup> From analysis of L3 data at 183–209 GeV.<sup>4</sup> Uses multichannel Aitchison-Bowler model (BOWLER 75). Uses data from DAUM 80 and DANKOWYCH 81.

NODE=M058W;LINKAGE=SC

NODE=M058W;LINKAGE=E

 $\pi(1300)$  DECAY MODES

NODE=M058215;NODE=M058

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1$ $\rho\pi$            | seen                           |
| $\Gamma_2$ $\pi(\pi\pi)S$ -wave | seen                           |
| $\Gamma_3$ $\gamma\gamma$       |                                |

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4

 $\pi(1300)$   $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$ 

NODE=M058218

 $\Gamma(\rho\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_1\Gamma_3/\Gamma$ 

| VALUE (keV) | CL% | DOCUMENT ID | TECN | COMMENT |
|-------------|-----|-------------|------|---------|
|-------------|-----|-------------|------|---------|

**<0.085** 90 ACCIARRI 97T L3  $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$ 

- • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                         |     |      |                                              |
|-------|----|-------------------------|-----|------|----------------------------------------------|
| <0.8  | 95 | <sup>5</sup> SCHEGELSKY | 06  | RVUE | $\gamma\gamma \rightarrow \pi^+ \pi^- \pi^0$ |
| <0.54 | 90 | ALBRECHT                | 97B | ARG  | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$   |

<sup>5</sup> From analysis of L3 data at 183–209 GeV.

NODE=M058G1

NODE=M058G1

NODE=M058G1;LINKAGE=SC

$\pi(1300)$  BRANCHING RATIOS

NODE=M058220

 $\Gamma(\pi\pi)_{S\text{-wave}}/\Gamma(\rho\pi)$  $\Gamma_2/\Gamma_1$ 

| VALUE                                                                         | CL% | EVTs | DOCUMENT ID        | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|-----|------|--------------------|------|------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                    |      |                                                |
| 2.2 $\pm$ 0.4                                                                 |     | 90k  | SALVINI            | 04   | OBLX $\bar{p}p \rightarrow 2\pi^+ 2\pi^-$      |
| seen                                                                          |     |      | CHUNG              | 02   | B852 $18.3 \pi^- p \rightarrow \pi^+ 2\pi^- p$ |
| <0.15                                                                         | 90  |      | ABELE              | 01   | CBAR $0.0 \bar{p}d \rightarrow \pi^- 4\pi^0 p$ |
| 2.12                                                                          |     |      | <sup>6</sup> AARON | 81   | RVUE                                           |

<sup>6</sup> Uses multichannel Aitchison-Bowler model (BOWLER 75). Uses data from DAUM 80 and DANKOWYCH 81.

NODE=M058R1  
NODE=M058R1

NODE=M058R1;LINKAGE=E

 $\pi(1300)$  REFERENCES

NODE=M058

|              |     |               |                               |                           |
|--------------|-----|---------------|-------------------------------|---------------------------|
| DARGENT      | 17  | JHEP 1705 143 | P. d'Argent <i>et al.</i>     | (HEID, BRIS)              |
| SCHEGELSKY   | 06  | EPJ A27 199   | V.A. Schegelsky <i>et al.</i> |                           |
| SALVINI      | 04  | EPJ C35 21    | P. Salvini <i>et al.</i>      | (OBELIX Collab.)          |
| CHUNG        | 02  | PR D65 072001 | S.U. Chung <i>et al.</i>      | (BNL E852 Collab.)        |
| ABELE        | 01  | EPJ C19 667   | A. Abele <i>et al.</i>        | (Crystal Barrel Collab.)  |
| ACCIARRI     | 97T | PL B413 147   | M. Acciarri <i>et al.</i>     | (L3 Collab.)              |
| ALBRECHT     | 97B | ZPHY C74 469  | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)           |
| BERTIN       | 97D | PL B414 220   | A. Bertin <i>et al.</i>       | (OBELIX Collab.)          |
| ABELE        | 96  | PL B380 453   | A. Abele <i>et al.</i>        | (Crystal Barrel Collab.)  |
| ZIELINSKI    | 84  | PR D30 1855   | M. Zielinski <i>et al.</i>    | (ROCH, MINN, FNAL)        |
| BELLINI      | 82  | PRL 48 1697   | G. Bellini <i>et al.</i>      | (MILA, BGNA, JINR)        |
| AARON        | 81  | PR D24 1207   | R.A. Aaron, R.S. Longacre     | (NEAS, BNL)               |
| BONESINI     | 81  | PL 103B 75    | M. Bonesini <i>et al.</i>     | (MILA, LIVP, DARE+)       |
| DANKOWYCH... | 81  | PRL 46 580    | J.A. Dankowycz <i>et al.</i>  | (TNT0, BNL, CARL+)        |
| DAUM         | 81B | NP B182 269   | C. Daum <i>et al.</i>         | (AMST, CERN, CRAC, MPIM+) |
| DAUM         | 80  | PL 89B 281    | C. Daum <i>et al.</i>         | (AMST, CERN, CRAC, MPIM+) |
| BOWLER       | 75  | NP B97 227    | M.G. Bowler <i>et al.</i>     | (OXFTP, DARE)             |

REFID=58121  
REFID=51186  
REFID=53226  
REFID=48837  
REFID=48334  
REFID=45761  
REFID=45418  
REFID=45763  
REFID=45011  
REFID=20881  
REFID=21134  
REFID=20870  
REFID=21130  
REFID=20572  
REFID=20872  
REFID=20868  
REFID=20571

NODE=M012

 $a_2(1320)$ 

$$I^G(J^{PC}) = 1^-(2^{++})$$

 $a_2(1320)$  MASS

NODE=M012M0

VALUE (MeV)

DOCUMENT ID

**1318.2 $\pm$ 0.6 OUR AVERAGE** Includes data from the 4 datablocks that follow this one.  
Error includes scale factor of 1.2. [1316.9  $\pm$  0.9 MeV OUR 2020 AVERAGE Scale factor = 1.9]

NODE=M012M0  
NEW

 $3\pi$  MODE

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

NODE=M012M1  
NODE=M012M1

**1318.6 $\pm$  1.3 OUR AVERAGE** Error includes scale factor of 1.4. See the ideogram below.

|                            |       |                       |     |           |                                                 |
|----------------------------|-------|-----------------------|-----|-----------|-------------------------------------------------|
| 1314.5 $^{+4.0}_{-3.3}$    | 46M   | <sup>1</sup> AGHASYAN | 18B | COMP      | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$   |
| 1326 $\pm$ 2 $\pm$ 2       |       | CHUNG                 | 02  | B852      | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$  |
| 1317 $\pm$ 3               |       | BARBERIS              | 98B |           | 450 $p p \rightarrow p_f \pi^+ \pi^- \pi^0 p_s$ |
| 1323 $\pm$ 4 $\pm$ 3       |       | ACCIARRI              | 97T | L3        | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
| 1320 $\pm$ 7               |       | ALBRECHT              | 97B | ARG       | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
| 1311.3 $\pm$ 1.6 $\pm$ 3.0 | 72.4k | AMELIN                | 96  | VES       | 36 $\pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$    |
| 1310 $\pm$ 5               |       | ARMSTRONG             | 90  | OMEG 0    | 300.0 $p p \rightarrow p p \pi^+ \pi^- \pi^0$   |
| 1323.8 $\pm$ 2.3           | 4022  | AUGUSTIN              | 89  | DM2 $\pm$ | $J/\psi \rightarrow \rho^\pm a_2^\mp$           |
| 1320.6 $\pm$ 3.1           | 3562  | AUGUSTIN              | 89  | DM2 0     | $J/\psi \rightarrow \rho^0 a_2^0$               |
| 1317 $\pm$ 2               | 25k   | <sup>2</sup> DAUM     | 80C | SPEC $-$  | 63,94 $\pi^- p \rightarrow 3\pi p$              |
| 1320 $\pm$ 10              | 1097  | <sup>2</sup> BALTAY   | 78B | HBC $+0$  | 15 $\pi^+ p \rightarrow p 4\pi$                 |
| 1306 $\pm$ 8               |       | FERRERSORIA           | 78  | OMEG $-$  | 9 $\pi^- p \rightarrow p 3\pi$                  |
| 1318 $\pm$ 7               | 1.6k  | <sup>2</sup> EMMS     | 75  | DBC 0     | 4 $\pi^+ n \rightarrow p(3\pi)^0$               |
| 1315 $\pm$ 5               |       | <sup>2</sup> ANTIPOV  | 73C | CNTR $-$  | 25,40 $\pi^- p \rightarrow p \eta \pi^-$        |
| 1306 $\pm$ 9               | 1580  | CHALOUPKA             | 73  | HBC $-$   | 3.9 $\pi^- p$                                   |

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |              |      |                           |     |      |                                                  |         |
|-----------|--------------|------|---------------------------|-----|------|--------------------------------------------------|---------|
| 1321 ± 1  | $^{+0}_{-7}$ | 420k | <sup>3</sup> ALEKSEEV     | 10  | COMP | $190 \pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$ |         |
| 1300 ± 2  | ± 4          | 18k  | <sup>4</sup> SCHEGELSKY   | 06  | RVUE | 0 $\gamma\gamma \rightarrow \pi^+ \pi^- \pi^0$   |         |
| 1305 ± 14 |              |      | CONDO                     | 93  | SHF  | $\gamma p \rightarrow n \pi^+ \pi^+ \pi^-$       |         |
| 1310 ± 2  |              |      | <sup>2</sup> EVANGELIS... | 81  | OMEG | — $12 \pi^- p \rightarrow 3\pi p$                |         |
| 1343 ± 11 |              | 490  | BALTAY                    | 78B | HBC  | 0 $15 \pi^+ p \rightarrow \Delta 3\pi$           | OCCUR=2 |
| 1309 ± 5  |              | 5k   | BINNIE                    | 71  | MMS  | — $\pi^- p$ near $a_2$ thresh-<br>old            | OCCUR=2 |
| 1299 ± 6  |              | 28k  | BOWEN                     | 71  | MMS  | — $5 \pi^- p$                                    |         |
| 1300 ± 6  |              | 24k  | BOWEN                     | 71  | MMS  | + $5 \pi^+ p$                                    | OCCUR=2 |
| 1309 ± 4  |              | 17k  | BOWEN                     | 71  | MMS  | — $7 \pi^- p$                                    | OCCUR=3 |
| 1306 ± 4  |              | 941  | ALSTON-...                | 70  | HBC  | + $7.0 \pi^+ p \rightarrow 3\pi p$               |         |

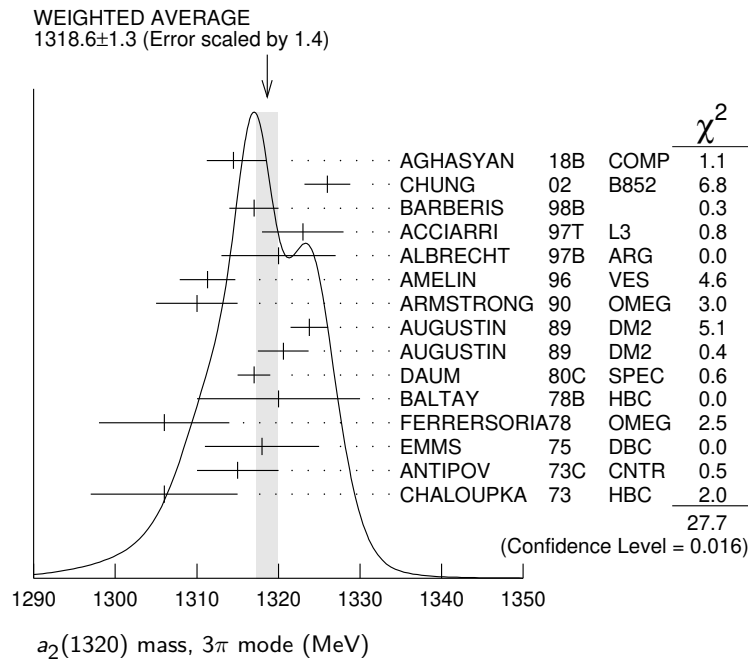
<sup>1</sup> Statistical error negligible.

<sup>2</sup> From a fit to  $J^P = 2^+ \rho\pi$  partial wave.

<sup>3</sup> Superseded by AGHASYAN 2018B.

<sup>4</sup> From analysis of L3 data at 183–209 GeV.

NODE=M012M1;LINKAGE=D  
NODE=M012M1;LINKAGE=P  
NODE=M012M1;LINKAGE=C  
NODE=M012M1;LINKAGE=SC



## K $\bar{K}$ MODE

VALUE (MeV) EVTS DOCUMENT ID TECN CHG COMMENT

The data in this block is included in the average printed for a previous datablock.

### 1318.1± 0.7 OUR AVERAGE

|          |       |                        |     |      |   |                                        |         |
|----------|-------|------------------------|-----|------|---|----------------------------------------|---------|
| 1319 ± 5 | 4700  | <sup>1,2</sup> CLELAND | 82B | SPEC | + | $50 \pi^+ p \rightarrow K_S^0 K^+ p$   | OCCUR=2 |
| 1324 ± 6 | 5200  | <sup>1,2</sup> CLELAND | 82B | SPEC | — | $50 \pi^- p \rightarrow K_S^0 K^- p$   | OCCUR=3 |
| 1320 ± 2 | 4000  | CHABAUD                | 80  | SPEC | — | $17 \pi^- A \rightarrow K_S^0 K^- A$   |         |
| 1312 ± 4 | 11000 | CHABAUD                | 78  | SPEC | — | $9.8 \pi^- p \rightarrow K^- K_S^0 p$  |         |
| 1316 ± 2 | 4730  | CHABAUD                | 78  | SPEC | — | $18.8 \pi^- p \rightarrow K^- K_S^0 p$ | OCCUR=2 |
| 1318 ± 1 |       | <sup>1,3</sup> MARTIN  | 78D | SPEC | — | $10 \pi^- p \rightarrow K_S^0 K^- p$   |         |
| 1320 ± 2 | 2724  | MARGULIE               | 76  | SPEC | — | $23 \pi^- p \rightarrow K^- K_S^0 p$   |         |
| 1313 ± 4 | 730   | FOLEY                  | 72  | CNTR | — | $20.3 \pi^- p \rightarrow K^- K_S^0 p$ |         |
| 1319 ± 3 | 1500  | <sup>3</sup> GRAYER    | 71  | ASPK | — | $17.2 \pi^- p \rightarrow K^- K_S^0 p$ |         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |      |                         |     |      |   |                                        |  |
|-----------|------|-------------------------|-----|------|---|----------------------------------------|--|
| 1304 ± 10 | 870  | <sup>4</sup> SCHEGELSKY | 06A | RVUE | 0 | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |  |
| 1330 ± 11 | 1000 | <sup>1,2</sup> CLELAND  | 82B | SPEC | + | $30 \pi^+ p \rightarrow K_S^0 K^+ p$   |  |
| 1324 ± 5  | 350  | HYAMS                   | 78  | ASPK | + | $12.7 \pi^+ p \rightarrow K^+ K_S^0 p$ |  |

<sup>1</sup> From a fit to  $J^P = 2^+$  partial wave.

<sup>2</sup> Number of events evaluated by us.

<sup>3</sup> Systematic error in mass scale subtracted.

<sup>4</sup> From analysis of L3 data at 91 and 183–209 GeV.

NODE=M012M2;LINKAGE=P  
NODE=M012M2;LINKAGE=W  
NODE=M012M2;LINKAGE=S  
NODE=M012M2;LINKAGE=SC

**$\eta\pi$  MODE**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

**1317.7 $\pm$  1.4 OUR AVERAGE**[1312.2  $\pm$  2.8 MeV OUR 2020 AVERAGE Scale factor = 2.6]

|                                                                               |      |                         |     |        |                                                                             |
|-------------------------------------------------------------------------------|------|-------------------------|-----|--------|-----------------------------------------------------------------------------|
| 1308 ± 9                                                                      |      | BARBERIS                | 00H |        | 450 $p\bar{p} \rightarrow p_f \eta \pi^0 p_s$                               |
| 1316 ± 9                                                                      |      | BARBERIS                | 00H |        | 450 $p\bar{p} \rightarrow \Delta_f^{++} \eta \pi^- p_s$                     |
| 1317 ± 1 ± 2                                                                  |      | THOMPSON                | 97  | MPS    | 18 $\pi^- p \rightarrow \eta \pi^- p$                                       |
| 1315 ± 5 ± 2                                                                  |      | <sup>1</sup> AMSLER     | 94D | CBAR   | 0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$                                 |
| 1325.1 ± 5.1                                                                  |      | AOYAGI                  | 93  | BKEI   | $\pi^- p \rightarrow \eta \pi^- p$                                          |
| 1317.7 ± 1.4 ± 2.0                                                            |      | BELADIDZE               | 93  | VES    | 37 $\pi^- N \rightarrow \eta \pi^- N$                                       |
| 1323 ± 8                                                                      | 1000 | <sup>2</sup> KEY        | 73  | OSPK – | 6 $\pi^- p \rightarrow p \pi^- \eta$                                        |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                         |     |        |                                                                             |
| 1312.5 ± 0.7 ± 2.6                                                            |      | <sup>3</sup> ALBRECHT   | 20  | RVUE   | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| 1306.0 ± 0.8 ± 1.3                                                            |      | <sup>4</sup> RODAS      | 19  | JPAC   | 191 $\pi^- p \rightarrow \eta^{(I)} \pi^-$                                  |
| 1307 ± 1 ± 6                                                                  |      | <sup>5</sup> JACKURA    | 18  | JPAC   | $\pi^- p \rightarrow \eta \pi^- p$                                          |
| 1315 ± 12                                                                     |      | <sup>6</sup> ADOLPH     | 15  | COMP   | 191 $\pi^- p \rightarrow \eta^{(I)} \pi^-$                                  |
| 1309 ± 4                                                                      |      | ANISOVICH               | 09  | RVUE   | $\bar{p}p, \pi N$                                                           |
| 1324 ± 5                                                                      |      | ARMSTRONG               | 93C | E760 0 | $\bar{p}p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$                  |
| 1336.2 ± 1.7                                                                  | 2561 | DELFO SSE               | 81  | SPEC + | $\pi^\pm p \rightarrow p \pi^\pm \eta$                                      |
| 1330.7 ± 2.4                                                                  | 1653 | DELFO SSE               | 81  | SPEC – | $\pi^\pm p \rightarrow p \pi^\pm \eta$                                      |
| 1324 ± 8                                                                      | 6200 | <sup>2,7</sup> CONFORTO | 73  | OSPK – | 6 $\pi^- p \rightarrow p \text{MM}^-$                                       |

<sup>1</sup> The systematic error of 2 MeV corresponds to the spread of solutions.<sup>2</sup> Error includes 5 MeV systematic mass-scale error.<sup>3</sup> T-matrix pole with 2 poles, 2 channels ( $\pi^0 \eta$  and  $K\bar{K}$ ).<sup>4</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15 data. The mass is extracted from the T-matrix pole.<sup>5</sup> Superseded by RODAS 19.<sup>6</sup> ADOLPH 15 value is derived from a Breit-Wigner fit with mass-dependent width taking the  $\eta\pi$  and  $\rho\pi$  channels into account.<sup>7</sup> Missing mass with enriched MMS =  $\eta\pi^-$ ,  $\eta = 2\gamma$ . **$\eta'\pi$  MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

The data in this block is included in the average printed for a previous datablock.

**1322  $\pm$  7 OUR AVERAGE**

|                           |  |           |    |      |                                        |
|---------------------------|--|-----------|----|------|----------------------------------------|
| 1318 $\pm$ 8 $^{+3}_{-5}$ |  | IVANOV    | 01 | B852 | 18 $\pi^- p \rightarrow \eta' \pi^- p$ |
| 1327.0 $\pm$ 10.7         |  | BELADIDZE | 93 | VES  | 37 $\pi^- N \rightarrow \eta' \pi^- N$ |

 **$a_2(1320)$  WIDTH** **$3\pi$  MODE**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

**105.0 $^{+1.7}_{-1.9}$  OUR AVERAGE**

|                           |       |                       |     |      |                                                         |
|---------------------------|-------|-----------------------|-----|------|---------------------------------------------------------|
| 106.6 $^{+3.4}_{-7.0}$    | 46M   | <sup>1</sup> AGHASYAN | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$           |
| 108 $\pm$ 3 $\pm$ 15      |       | CHUNG                 | 02  | B852 | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$          |
| 120 $\pm$ 10              |       | BARBERIS              | 98B |      | 450 $p\bar{p} \rightarrow p_f \pi^+ \pi^- \pi^0 p_s$    |
| 105 $\pm$ 10 $\pm$ 11     |       | ACCIARRI              | 97T | L3   | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$         |
| 120 $\pm$ 10              |       | ALBRECHT              | 97B | ARG  | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$         |
| 103.0 $\pm$ 6.0 $\pm$ 3.3 | 72.4k | AMELIN                | 96  | VES  | 36 $\pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$            |
| 120 $\pm$ 10              |       | ARMSTRONG             | 90  | OMEG | 0 $300.0 p\bar{p} \rightarrow p \rho \pi^+ \pi^- \pi^0$ |
| 107.0 $\pm$ 9.7           | 4022  | AUGUSTIN              | 89  | DM2  | $\pm$ $J/\psi \rightarrow \rho^\pm a_2^\mp$             |

NODE=M012M3  
NODE=M012M3

NEW

OCCUR=2

OCCUR=2

NODE=M012M3;LINKAGE=DD  
NODE=M012M3;LINKAGE=E  
NODE=M012M3;LINKAGE=D  
NODE=M012M3;LINKAGE=CNODE=M012M3;LINKAGE=B  
NODE=M012M3;LINKAGE=A

NODE=M012M3;LINKAGE=M

NODE=M012M4  
NODE=M012M4

NODE=M012210

NODE=M012W1  
NODE=M012W1

|              |      |                           |     |      |    |                                             |         |
|--------------|------|---------------------------|-----|------|----|---------------------------------------------|---------|
| 118.5 ± 12.5 | 3562 | AUGUSTIN                  | 89  | DM2  | 0  | $J/\psi \rightarrow \rho^0 a_2^0$           | OCCUR=2 |
| 97 ± 5       |      | <sup>2</sup> EVANGELIS... | 81  | OMEG | —  | $12 \pi^- p \rightarrow 3\pi p$             |         |
| 96 ± 9       | 25k  | <sup>2</sup> DAUM         | 80c | SPEC | —  | $63,94 \pi^- p \rightarrow 3\pi p$          |         |
| 110 ± 15     | 1097 | <sup>2</sup> BALTAY       | 78B | HBC  | +0 | $15 \pi^+ p \rightarrow p 4\pi$             |         |
| 112 ± 18     | 1.6k | <sup>2</sup> EMMS         | 75  | DBC  | 0  | $4 \pi^+ n \rightarrow p(3\pi)^0$           |         |
| 122 ± 14     | 1.2k | <sup>2,3</sup> WAGNER     | 75  | HBC  | 0  | $7 \pi^+ p \rightarrow \Delta^{++}(3\pi)^0$ |         |
| 115 ± 15     |      | <sup>2</sup> ANTIPOV      | 73c | CNTR | —  | $25,40 \pi^- p \rightarrow p \eta \pi^-$    |         |
| 99 ± 15      | 1580 | CHALOUKKA                 | 73  | HBC  | —  | $3.9 \pi^- p$                               |         |
| 105 ± 5      | 28k  | BOWEN                     | 71  | MMS  | —  | $5 \pi^- p$                                 |         |
| 99 ± 5       | 24k  | BOWEN                     | 71  | MMS  | +  | $5 \pi^+ p$                                 | OCCUR=2 |
| 103 ± 5      | 17k  | BOWEN                     | 71  | MMS  | —  | $7 \pi^- p$                                 | OCCUR=3 |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |      |                         |     |      |   |                                                  |         |
|-----------------------|------|-------------------------|-----|------|---|--------------------------------------------------|---------|
| 110 ± 2 $^{+2}_{-15}$ | 420k | <sup>4</sup> ALEKSEEV   | 10  | COMP |   | $190 \pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$ |         |
| 117 ± 6 ± 20          | 18k  | <sup>5</sup> SCHEGELSKY | 06  | RVUE | 0 | $\gamma\gamma \rightarrow \pi^+ \pi^- \pi^0$     |         |
| 120 ± 40              |      | CONDO                   | 93  | SHF  |   | $\gamma p \rightarrow n \pi^+ \pi^+ \pi^-$       |         |
| 115 ± 14              | 490  | BALTAY                  | 78B | HBC  | 0 | $15 \pi^+ p \rightarrow \Delta 3\pi$             | OCCUR=2 |
| 72 ± 16               | 5k   | BINNIE                  | 71  | MMS  | — | $\pi^- p$ near $a_2$ thresh-<br>old              | OCCUR=2 |
| 79 ± 12               | 941  | ALSTON-...              | 70  | HBC  | + | $7.0 \pi^+ p \rightarrow 3\pi p$                 |         |

<sup>1</sup> Statistical error negligible.

<sup>2</sup> From a fit to  $J^P = 2^+ \rho\pi$  partial wave.

<sup>3</sup> Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

<sup>4</sup> Superseded by AGHASYAN 2018B.

<sup>5</sup> From analysis of L3 data at 183–209 GeV.

NODE=M012W1;LINKAGE=C  
NODE=M012W1;LINKAGE=P  
NODE=M012W1;LINKAGE=S  
NODE=M012W1;LINKAGE=E  
NODE=M012W1;LINKAGE=SC

## $K\bar{K}$ AND $\eta\pi$ MODES

VALUE (MeV) DOCUMENT ID

### 107 ± 5 OUR ESTIMATE

**110.4 ± 1.7 OUR AVERAGE** Includes data from the 2 datablocks that follow this one.  
[112.5 ± 1.2 MeV OUR 2020 AVERAGE]

NODE=M012W0  
NODE=M012W0  
→ UNCHECKED ←  
NEW

## $K\bar{K}$ MODE

VALUE (MeV) EVTS DOCUMENT ID TECN CHG COMMENT

The data in this block is included in the average printed for a previous datablock.

NODE=M012W2  
NODE=M012W2

### 109.8 ± 2.4 OUR AVERAGE

|          |       |                        |     |      |   |                                        |         |
|----------|-------|------------------------|-----|------|---|----------------------------------------|---------|
| 112 ± 20 | 4700  | <sup>1,2</sup> CLELAND | 82B | SPEC | + | $50 \pi^+ p \rightarrow K_S^0 K^+ p$   | OCCUR=2 |
| 120 ± 25 | 5200  | <sup>1,2</sup> CLELAND | 82B | SPEC | — | $50 \pi^- p \rightarrow K_S^0 K^- p$   | OCCUR=3 |
| 106 ± 4  | 4000  | CHABAUD                | 80  | SPEC | — | $17 \pi^- A \rightarrow K_S^0 K^- A$   |         |
| 126 ± 11 | 11000 | CHABAUD                | 78  | SPEC | — | $9.8 \pi^- p \rightarrow K^- K_S^0 p$  |         |
| 101 ± 8  | 4730  | CHABAUD                | 78  | SPEC | — | $18.8 \pi^- p \rightarrow K^- K_S^0 p$ | OCCUR=2 |
| 113 ± 4  |       | <sup>1,3</sup> MARTIN  | 78D | SPEC | — | $10 \pi^- p \rightarrow K_S^0 K^- p$   |         |
| 105 ± 8  | 2724  | <sup>3</sup> MARGULIE  | 76  | SPEC | — | $23 \pi^- p \rightarrow K^- K_S^0 p$   |         |
| 113 ± 19 | 730   | FOLEY                  | 72  | CNTR | — | $20.3 \pi^- p \rightarrow K^- K_S^0 p$ |         |
| 123 ± 13 | 1500  | <sup>3</sup> GRAYER    | 71  | ASPK | — | $17.2 \pi^- p \rightarrow K^- K_S^0 p$ |         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |      |                         |     |      |   |                                        |  |
|----------|------|-------------------------|-----|------|---|----------------------------------------|--|
| 120 ± 15 | 870  | <sup>4</sup> SCHEGELSKY | 06A | RVUE | 0 | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |  |
| 121 ± 51 | 1000 | <sup>1,2</sup> CLELAND  | 82B | SPEC | + | $30 \pi^+ p \rightarrow K_S^0 K^+ p$   |  |
| 110 ± 18 | 350  | HYAMS                   | 78  | ASPK | + | $12.7 \pi^+ p \rightarrow K^+ K_S^0 p$ |  |

<sup>1</sup> From a fit to  $J^P = 2^+$  partial wave.

<sup>2</sup> Number of events evaluated by us.

<sup>3</sup> Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

<sup>4</sup> From analysis of L3 data at 91 and 183–209 GeV.

NODE=M012W2;LINKAGE=P  
NODE=M012W2;LINKAGE=W  
NODE=M012W2;LINKAGE=S  
NODE=M012W2;LINKAGE=SC

**$\eta\pi$  MODE**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

**111.1± 2.4 OUR AVERAGE**

[113.4 ± 1.3 MeV OUR 2020 AVERAGE]

|                                                                               |                       |     |        |                                                                             |
|-------------------------------------------------------------------------------|-----------------------|-----|--------|-----------------------------------------------------------------------------|
| 115 ±20                                                                       | BARBERIS              | 00H |        | 450 $pp \rightarrow p_f \eta \pi^0 p_s$                                     |
| 112 ±14                                                                       | BARBERIS              | 00H |        | 450 $pp \rightarrow \Delta_f^{++} \eta \pi^- p_s$                           |
| 112 ± 3 ±2                                                                    | <sup>1</sup> AMSLER   | 94D | CBAR   | 0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$                                 |
| 103 ± 6 ±3                                                                    | BELADIDZE             | 93  | VES    | 37 $\pi^- N \rightarrow \eta \pi^- N$                                       |
| 112.2± 5.7 2561                                                               | DELFOSSSE             | 81  | SPEC + | $\pi^\pm p \rightarrow p \pi^\pm \eta$                                      |
| 116.6± 7.7 1653                                                               | DELFOSSSE             | 81  | SPEC - | $\pi^\pm p \rightarrow p \pi^\pm \eta$                                      |
| 108 ± 9 1000                                                                  | KEY                   | 73  | OSPK - | 6 $\pi^- p \rightarrow p \pi^- \eta$                                        |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                       |     |        |                                                                             |
| 106.9± 1.2±3.7                                                                | <sup>2</sup> ALBRECHT | 20  | RVUE   | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| 114.4± 1.6±0.0                                                                | <sup>3</sup> RODAS    | 19  | JPAC   | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$                           |
| 112 ± 1 ±8                                                                    | <sup>4</sup> JACKURA  | 18  | JPAC   | $\pi^- p \rightarrow \eta \pi^- p$                                          |
| 119 ±14                                                                       | <sup>5</sup> ADOLPH   | 15  | COMP   | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$                           |
| 110 ± 4                                                                       | ANISOVICH             | 09  | RVUE   | $\bar{p}p, \pi N$                                                           |
| 127 ± 2 ±2                                                                    | <sup>6</sup> THOMPSON | 97  | MPS    | 18 $\pi^- p \rightarrow \eta \pi^- p$                                       |
| 118 ±10                                                                       | ARMSTRONG             | 93C | E760 0 | $\bar{p}p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$                  |
| 104 ± 9 6200                                                                  | <sup>7</sup> CONFORTO | 73  | OSPK - | 6 $\pi^- p \rightarrow p \pi^- \eta$                                        |

<sup>1</sup> The systematic error of 2 MeV corresponds to the spread of solutions.

<sup>2</sup> T-matrix pole with 2 poles, 2 channels ( $\pi^0 \eta$  and  $K\bar{K}$ ).

<sup>3</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15 data. The width is extracted from the T-matrix pole.

<sup>4</sup> Superseded by RODAS 19.

<sup>5</sup> ADOLPH 15 value is derived from a Breit-Wigner fit with mass-dependent width taking the  $\eta\pi$  and  $\rho\pi$  channels into account.

<sup>6</sup> Resolution is not unfolded.

<sup>7</sup> Missing mass with enriched MMS =  $\eta\pi^-$ ,  $\eta = 2\gamma$ .

NODE=M012W3  
NODE=M012W3

NEW

OCCUR=2

OCCUR=2

NODE=M012W3;LINKAGE=DD  
NODE=M012W3;LINKAGE=F  
NODE=M012W3;LINKAGE=E

NODE=M012W3;LINKAGE=C  
NODE=M012W3;LINKAGE=B

NODE=M012W3;LINKAGE=A  
NODE=M012W3;LINKAGE=M

 **$\eta'\pi$  MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**119±25 OUR AVERAGE**

|           |           |    |      |                                        |
|-----------|-----------|----|------|----------------------------------------|
| 140±35±20 | IVANOV    | 01 | B852 | 18 $\pi^- p \rightarrow \eta' \pi^- p$ |
| 106±32    | BELADIDZE | 93 | VES  | 37 $\pi^- N \rightarrow \eta' \pi^- N$ |

NODE=M012W4  
NODE=M012W4

 **$a_2(1320)$  DECAY MODES**

| Mode                         | Fraction ( $\Gamma_i/\Gamma$ )   | Scale factor/<br>Confidence level |
|------------------------------|----------------------------------|-----------------------------------|
| $\Gamma_1$ $3\pi$            | (70.1 ±2.7 ) %                   | S=1.2                             |
| $\Gamma_2$ $\rho(770)\pi$    |                                  |                                   |
| $\Gamma_3$ $f_2(1270)\pi$    |                                  |                                   |
| $\Gamma_4$ $\rho(1450)\pi$   |                                  |                                   |
| $\Gamma_5$ $\eta\pi$         | (14.5 ±1.2 ) %                   |                                   |
| $\Gamma_6$ $\omega\pi\pi$    | (10.6 ±3.2 ) %                   | S=1.3                             |
| $\Gamma_7$ $K\bar{K}$        | ( 4.9 ±0.8 ) %                   |                                   |
| $\Gamma_8$ $\eta'(958)\pi$   | ( 5.5 ±0.9 ) × 10 <sup>-3</sup>  |                                   |
| $\Gamma_9$ $\pi^\pm\gamma$   | ( 2.91±0.27 ) × 10 <sup>-3</sup> |                                   |
| $\Gamma_{10}$ $\gamma\gamma$ | ( 9.4 ±0.7 ) × 10 <sup>-6</sup>  |                                   |
| $\Gamma_{11}$ $e^+e^-$       | < 5 × 10 <sup>-9</sup>           | CL=90%                            |

NODE=M012215;NODE=M012

DESIG=1  
DESIG=11  
DESIG=12  
DESIG=13  
DESIG=3  
DESIG=4  
DESIG=2  
DESIG=8  
DESIG=7  
DESIG=9  
DESIG=10

## CONSTRAINED FIT INFORMATION

An overall fit to 5 branching ratios uses 18 measurements and one constraint to determine 4 parameters. The overall fit has a  $\chi^2 = 9.3$  for 15 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|       |       |       |       |
|-------|-------|-------|-------|
| $x_5$ | 10    |       |       |
| $x_6$ | -89   | -46   |       |
| $x_7$ | -1    | -2    | -24   |
|       | $x_1$ | $x_5$ | $x_6$ |

### $a_2(1320)$ PARTIAL WIDTHS

#### $\Gamma(\eta\pi)$

$\Gamma_5$

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |     |                             |      |   |                                        |
|----------------|-----|-----------------------------|------|---|----------------------------------------|
| $18.5 \pm 3.0$ | 870 | <sup>1</sup> SCHEGELSKY 06A | RVUE | 0 | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |
|----------------|-----|-----------------------------|------|---|----------------------------------------|

<sup>1</sup> From analysis of L3 data at 91 and 183–209 GeV, using  $\Gamma(a_2(1320) \rightarrow \gamma\gamma) = 0.91$  keV and SU(3) relations.

NODE=M012220

NODE=M012W6  
NODE=M012W6

NODE=M012W6;LINKAGE=SC

#### $\Gamma(K\bar{K})$

$\Gamma_7$

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                     |     |                             |      |   |                                        |
|---------------------|-----|-----------------------------|------|---|----------------------------------------|
| $7.0^{+2.0}_{-1.5}$ | 870 | <sup>1</sup> SCHEGELSKY 06A | RVUE | 0 | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |
|---------------------|-----|-----------------------------|------|---|----------------------------------------|

<sup>1</sup> From analysis of L3 data at 91 and 183–209 GeV, using  $\Gamma(a_2(1320) \rightarrow \gamma\gamma) = 0.91$  keV and SU(3) relations.

NODE=M012W5  
NODE=M012W5

NODE=M012W5;LINKAGE=SC

#### $\Gamma(\pi^\pm\gamma)$

$\Gamma_9$

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

**311 ± 25 OUR AVERAGE**

|                    |  |                     |    |      |                                                                  |
|--------------------|--|---------------------|----|------|------------------------------------------------------------------|
| $358 \pm 6 \pm 42$ |  | <sup>1</sup> ADOLPH | 14 | COMP | – 190 $\pi^- \text{Pb} \rightarrow \pi^+ \pi^- \pi^- \text{Pb}'$ |
|--------------------|--|---------------------|----|------|------------------------------------------------------------------|

|                     |      |              |      |  |                                               |
|---------------------|------|--------------|------|--|-----------------------------------------------|
| $284 \pm 25 \pm 25$ | 7.1k | MOLCHANOV 01 | SELX |  | 600 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$ |
|---------------------|------|--------------|------|--|-----------------------------------------------|

|              |  |             |      |   |               |
|--------------|--|-------------|------|---|---------------|
| $295 \pm 60$ |  | CIHANGIR 82 | SPEC | + | 200 $\pi^+ A$ |
|--------------|--|-------------|------|---|---------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |  |                  |    |      |                  |
|---------------|--|------------------|----|------|------------------|
| $461 \pm 110$ |  | <sup>2</sup> MAY | 77 | SPEC | ± 9.7 $\gamma A$ |
|---------------|--|------------------|----|------|------------------|

<sup>1</sup> Primakoff reaction using  $a_2(1320) \rightarrow 3\pi$  branching ratio of 70.1%.

<sup>2</sup> Assuming one-pion exchange.

NODE=M012W7  
NODE=M012W7

NODE=M012W7;LINKAGE=AD  
NODE=M012W;LINKAGE=M2

#### $\Gamma(\gamma\gamma)$

$\Gamma_{10}$

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

**1.00 ± 0.06 OUR AVERAGE**

|                          |  |          |     |    |                                                 |
|--------------------------|--|----------|-----|----|-------------------------------------------------|
| $0.98 \pm 0.05 \pm 0.09$ |  | ACCIARRI | 97T | L3 | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
|--------------------------|--|----------|-----|----|-------------------------------------------------|

|                          |  |          |     |     |                                                 |
|--------------------------|--|----------|-----|-----|-------------------------------------------------|
| $0.96 \pm 0.03 \pm 0.13$ |  | ALBRECHT | 97B | ARG | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
|--------------------------|--|----------|-----|-----|-------------------------------------------------|

|                          |    |      |    |     |                                                 |
|--------------------------|----|------|----|-----|-------------------------------------------------|
| $1.26 \pm 0.26 \pm 0.18$ | 36 | BARU | 90 | MD1 | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
|--------------------------|----|------|----|-----|-------------------------------------------------|

|                          |     |         |     |      |                                                   |
|--------------------------|-----|---------|-----|------|---------------------------------------------------|
| $1.00 \pm 0.07 \pm 0.15$ | 415 | BEHREND | 90C | CELL | 0 $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
|--------------------------|-----|---------|-----|------|---------------------------------------------------|

|                          |  |        |    |      |                                                 |
|--------------------------|--|--------|----|------|-------------------------------------------------|
| $1.03 \pm 0.13 \pm 0.21$ |  | BUTLER | 90 | MRK2 | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \pi^0$ |
|--------------------------|--|--------|----|------|-------------------------------------------------|

|                          |    |      |    |      |                                          |
|--------------------------|----|------|----|------|------------------------------------------|
| $1.01 \pm 0.14 \pm 0.22$ | 85 | OEST | 90 | JADE | $e^+ e^- \rightarrow e^+ e^- \pi^0 \eta$ |
|--------------------------|----|------|----|------|------------------------------------------|

|                          |    |                      |    |      |                                      |
|--------------------------|----|----------------------|----|------|--------------------------------------|
| $0.90 \pm 0.27 \pm 0.15$ | 56 | <sup>1</sup> ALTHOFF | 86 | TASS | 0 $e^+ e^- \rightarrow e^+ e^- 3\pi$ |
|--------------------------|----|----------------------|----|------|--------------------------------------|

|                          |  |                         |    |      |                                            |
|--------------------------|--|-------------------------|----|------|--------------------------------------------|
| $1.14 \pm 0.20 \pm 0.26$ |  | <sup>2</sup> ANTREASYAN | 86 | CBAL | 0 $e^+ e^- \rightarrow e^+ e^- \pi^0 \eta$ |
|--------------------------|--|-------------------------|----|------|--------------------------------------------|

|                          |  |        |     |      |                                      |
|--------------------------|--|--------|-----|------|--------------------------------------|
| $1.06 \pm 0.18 \pm 0.19$ |  | BERGER | 84C | PLUT | 0 $e^+ e^- \rightarrow e^+ e^- 3\pi$ |
|--------------------------|--|--------|-----|------|--------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                 |    |                      |     |      |                                      |
|---------------------------------|----|----------------------|-----|------|--------------------------------------|
| $0.81 \pm 0.19^{+0.42}_{-0.11}$ | 35 | <sup>1</sup> BEHREND | 82C | CELL | 0 $e^+ e^- \rightarrow e^+ e^- 3\pi$ |
|---------------------------------|----|----------------------|-----|------|--------------------------------------|

|                          |    |                      |     |      |                                            |
|--------------------------|----|----------------------|-----|------|--------------------------------------------|
| $0.77 \pm 0.18 \pm 0.27$ | 22 | <sup>2</sup> EDWARDS | 82F | CBAL | 0 $e^+ e^- \rightarrow e^+ e^- \pi^0 \eta$ |
|--------------------------|----|----------------------|-----|------|--------------------------------------------|

<sup>1</sup> From  $\rho\pi$  decay mode.

<sup>2</sup> From  $\eta\pi^0$  decay mode.

NODE=M012W9  
NODE=M012W9

NODE=M012W;LINKAGE=F  
NODE=M012W;LINKAGE=G

$\Gamma(e^+e^-)$  $\Gamma_{11}$ 

| VALUE (eV)                                                                    | CL% | DOCUMENT ID | TECN    | COMMENT                         |
|-------------------------------------------------------------------------------|-----|-------------|---------|---------------------------------|
| <b>&lt; 0.56</b>                                                              | 90  | ACHASOV     | 00K SND | $e^+e^- \rightarrow \pi^0\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |         |                                 |
| <25                                                                           | 90  | VOROBYEV    | 88 ND   | $e^+e^- \rightarrow \pi^0\eta$  |

NODE=M012W10  
 NODE=M012W10

 $a_2(1320) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$ 

NODE=M012223

 $\Gamma(3\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_1\Gamma_{10}/\Gamma$ 

| VALUE (keV)    | EVTS | DOCUMENT ID                | TECN | COMMENT                                    |
|----------------|------|----------------------------|------|--------------------------------------------|
| 0.65±0.02±0.02 | 18k  | <sup>1</sup> SCHEGELSKY 06 | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$ |

NODE=M012G2  
 NODE=M012G2

<sup>1</sup> From analysis of L3 data at 183–209 GeV.

NODE=M012G2;LINKAGE=SC

 $\Gamma(\eta\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_5\Gamma_{10}/\Gamma$ 

| VALUE (keV)                               | DOCUMENT ID                  | TECN | COMMENT                              |
|-------------------------------------------|------------------------------|------|--------------------------------------|
| 0.145 <sup>+0.097</sup> <sub>-0.034</sub> | <sup>1</sup> UEHARA 09A BELL |      | $e^+e^- \rightarrow e^+e^-\eta\pi^0$ |

NODE=M012G01  
 NODE=M012G01

<sup>1</sup> From the  $D_2$ -wave. The fraction of the  $D_0$ -wave is 3.4<sup>+2.3</sup><sub>-1.1</sub>%.

NODE=M012G01;LINKAGE=UE

 $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_7\Gamma_{10}/\Gamma$ 

| VALUE (keV)                                                                   | DOCUMENT ID                   | TECN | COMMENT                           |
|-------------------------------------------------------------------------------|-------------------------------|------|-----------------------------------|
| <b>0.126±0.007±0.028</b>                                                      | <sup>1</sup> ALBRECHT 90G ARG |      | $e^+e^- \rightarrow e^+e^-K^+K^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                               |      |                                   |
| 0.081±0.006±0.027                                                             | <sup>2</sup> ALBRECHT 90G ARG |      | $e^+e^- \rightarrow e^+e^-K^+K^-$ |

NODE=M012G1  
 NODE=M012G1

<sup>1</sup> Using an incoherent background.<sup>2</sup> Using a coherent background.

OCCUR=2

NODE=M012G1;LINKAGE=A  
 NODE=M012G1;LINKAGE=B

 $a_2(1320) \text{ BRANCHING RATIOS}$ 

NODE=M012225

 $[\Gamma(f_2(1270)\pi) + \Gamma(\rho(1450)\pi)]/\Gamma(\rho(770)\pi)$  $(\Gamma_3+\Gamma_4)/\Gamma_2$ 

| VALUE           | CL% | DOCUMENT ID | TECN    | CHG | COMMENT       |
|-----------------|-----|-------------|---------|-----|---------------|
| <b>&lt;0.12</b> | 90  | ABRAMOVI... | 70B HBC | —   | 3.93 $\pi^-p$ |

NODE=M012R9  
 NODE=M012R9

 $\Gamma(\rho(770)\pi)/\Gamma(f_2(1270)\pi)$  $\Gamma_2/\Gamma_3$ 

| VALUE                                     | EVTS | DOCUMENT ID                    | TECN                                         | COMMENT |
|-------------------------------------------|------|--------------------------------|----------------------------------------------|---------|
| <b>16.5<sup>+1.2</sup><sub>-2.4</sub></b> | 46M  | <sup>1</sup> AGHASYAN 18B COMP | 190 $\pi^-p \rightarrow \pi^- \pi^+ \pi^- p$ |         |

NODE=M012R00  
 NODE=M012R00

<sup>1</sup> Statistical error negligible.

NODE=M012R00;LINKAGE=A

 $\Gamma(\eta\pi)/\Gamma(3\pi)$  $\Gamma_5/\Gamma_1$ 

| VALUE                          | EVTS | DOCUMENT ID   | TECN | CHG | COMMENT       |
|--------------------------------|------|---------------|------|-----|---------------|
| <b>0.207±0.018 OUR FIT</b>     |      |               |      |     |               |
| <b>0.213±0.020 OUR AVERAGE</b> |      |               |      |     |               |
| 0.18 ±0.05                     |      | FORINO 76     | HBC  |     | 11 $\pi^-p$   |
| 0.22 ±0.05                     | 52   | ANTIPOV 73    | CNTR | —   | 40 $\pi^-p$   |
| 0.211±0.044                    | 149  | CHALOUPKA 73  | HBC  | —   | 3.9 $\pi^-p$  |
| 0.246±0.042                    | 167  | ALSTON-... 71 | HBC  | +   | 7.0 $\pi^+p$  |
| 0.25 ±0.09                     | 15   | BOECKMANN 70  | HBC  | +   | 5.0 $\pi^+p$  |
| 0.23 ±0.08                     | 22   | ASCOLI 68     | HBC  | —   | 5 $\pi^-p$    |
| 0.12 ±0.08                     |      | CHUNG 68      | HBC  | —   | 3.2 $\pi^-p$  |
| 0.22 ±0.09                     |      | CONTE 67      | HBC  | —   | 11.0 $\pi^-p$ |

NODE=M012R3  
 NODE=M012R3

 $\Gamma(\omega\pi\pi)/\Gamma(3\pi)$  $\Gamma_6/\Gamma_1$ 

| VALUE                                                                         | EVTS                                                        | DOCUMENT ID               | TECN | CHG | COMMENT           |
|-------------------------------------------------------------------------------|-------------------------------------------------------------|---------------------------|------|-----|-------------------|
| <b>0.15±0.05 OUR FIT</b>                                                      | Error includes scale factor of 1.3.                         |                           |      |     |                   |
| <b>0.15±0.05 OUR AVERAGE</b>                                                  | Error includes scale factor of 1.3. See the ideogram below. |                           |      |     |                   |
| 0.28±0.09                                                                     | 60                                                          | DIAZ 74                   | DBC  | 0   | 6 $\pi^+n$        |
| 0.18±0.08                                                                     |                                                             | <sup>1</sup> KARSHON 74   | HBC  |     | Avg. of above two |
| 0.10±0.05                                                                     | 279                                                         | <sup>2</sup> CHALOUPKA 73 | HBC  | —   | 3.9 $\pi^-p$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                             |                           |      |     |                   |
| 0.29±0.08                                                                     | 140                                                         | <sup>1</sup> KARSHON 74   | HBC  | 0   | 4.9 $\pi^+p$      |
| 0.10±0.04                                                                     | 60                                                          | <sup>1</sup> KARSHON 74   | HBC  | +   | 4.9 $\pi^+p$      |
| 0.19±0.08                                                                     |                                                             | DEFOIX 73                 | HBC  | 0   | 0.7 $\bar{p}p$    |

NODE=M012R12  
 NODE=M012R12

OCCUR=3

OCCUR=2

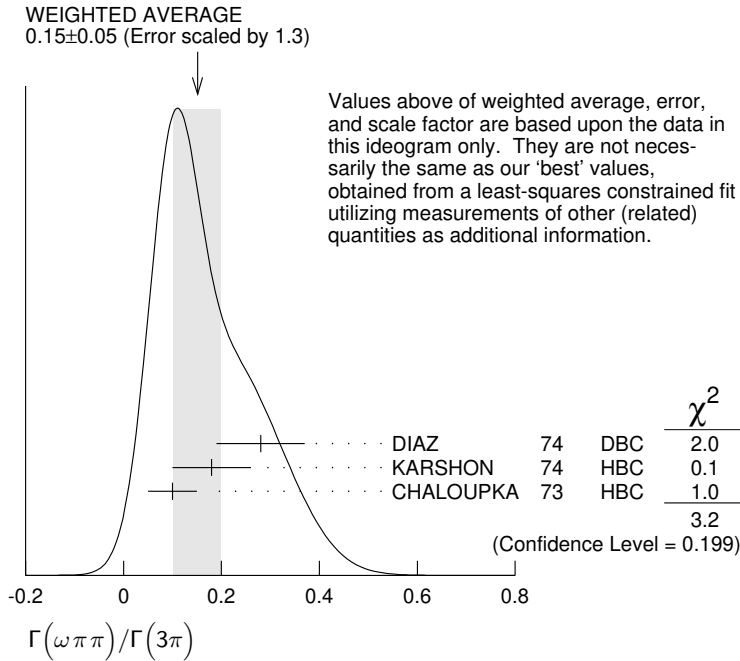


<sup>1</sup>KARSHON 74 suggest an additional  $I = 0$  state strongly coupled to  $\omega\pi\pi$  which could explain discrepancies in branching ratios and masses. We use a central value and a systematic spread.

<sup>2</sup>Decays to  $b_1(1040)\pi$ ,  $b_1 \rightarrow \omega\pi$ . Error increased to account for possible systematic errors of complicated analysis.

NODE=M012R12;LINKAGE=K

NODE=M012R12;LINKAGE=01

 $\Gamma(K\bar{K})/\Gamma(3\pi)$  $\Gamma_7/\Gamma_1$ 

| VALUE                                                                         | EVTS | DOCUMENT ID                 | TECN | CHG | COMMENT                                      |
|-------------------------------------------------------------------------------|------|-----------------------------|------|-----|----------------------------------------------|
| <b>0.070±0.012 OUR FIT</b>                                                    |      |                             |      |     |                                              |
| <b>0.078±0.017</b>                                                            |      | CHABAUD 78                  | RVUE |     |                                              |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                             |      |     |                                              |
| 0.011±0.003                                                                   |      | <sup>1</sup> BERTIN 98B     | OBLX |     | 0.0 $\bar{p}p \rightarrow K^\pm K_s \pi^\mp$ |
| 0.056±0.014                                                                   | 50   | <sup>2</sup> CHALOUPKA 73   | HBC  | -   | 3.9 $\pi^- p$                                |
| 0.097±0.018                                                                   | 113  | <sup>2</sup> ALSTON-... 71  | HBC  | +   | 7.0 $\pi^+ p$                                |
| 0.06 ±0.03                                                                    |      | <sup>2</sup> ABRAMOV... 70B | HBC  | -   | 3.93 $\pi^- p$                               |
| 0.054±0.022                                                                   |      | <sup>2</sup> CHUNG 68       | HBC  | -   | 3.2 $\pi^- p$                                |

<sup>1</sup> Using 4 $\pi$  data from BERTIN 97D.

<sup>2</sup> Included in CHABAUD 78 review.

NODE=M012R1  
NODE=M012R1 $\Gamma(K\bar{K})/\Gamma(\eta\pi)$  $\Gamma_7/\Gamma_5$ 

| VALUE                                                                         | DOCUMENT ID              | TECN | COMMENT                                                                              |
|-------------------------------------------------------------------------------|--------------------------|------|--------------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |                                                                                      |
| 0.352±0.011±0.175                                                             | <sup>1</sup> ALBRECHT 20 | RVUE | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$ ,<br>$\pi^0 \eta \eta$ , $\pi^0 K^+ K^-$ |
| 0.08 ±0.02                                                                    | <sup>2</sup> BERTIN 98B  | OBLX | 0.0 $\bar{p}p \rightarrow K^\pm K_s \pi^\mp$                                         |

<sup>1</sup> Residues from T-matrix pole with 2 poles, 2 channels ( $\pi^0 \eta$  and  $K\bar{K}$ ).

<sup>2</sup> Using  $\eta\pi\pi$  data from AMSLER 94D.

NODE=M012R1;LINKAGE=BE  
NODE=M012R1;LINKAGE=CNODE=M012R14  
NODE=M012R14 $\Gamma(\eta\pi)/[\Gamma(3\pi) + \Gamma(\eta\pi) + \Gamma(K\bar{K})]$  $\Gamma_5/(\Gamma_1+\Gamma_5+\Gamma_7)$ 

| VALUE                          | EVTS | DOCUMENT ID | TECN | CHG | COMMENT        |
|--------------------------------|------|-------------|------|-----|----------------|
| <b>0.162±0.012 OUR FIT</b>     |      |             |      |     |                |
| <b>0.140±0.028 OUR AVERAGE</b> |      |             |      |     |                |
| 0.13 ±0.04                     |      | ESPIGAT 72  | HBC  | ±   | 0.0 $\bar{p}p$ |
| 0.15 ±0.04                     | 34   | BARNHAM 71  | HBC  | +   | 3.7 $\pi^+ p$  |

NODE=M012R2  
NODE=M012R2 $\Gamma(K\bar{K})/[\Gamma(3\pi) + \Gamma(\eta\pi) + \Gamma(K\bar{K})]$  $\Gamma_7/(\Gamma_1+\Gamma_5+\Gamma_7)$ 

| VALUE                                                                         | EVTS | DOCUMENT ID             | TECN | CHG | COMMENT        |
|-------------------------------------------------------------------------------|------|-------------------------|------|-----|----------------|
| <b>0.054±0.009 OUR FIT</b>                                                    |      |                         |      |     |                |
| <b>0.048±0.012 OUR AVERAGE</b>                                                |      |                         |      |     |                |
| 0.05 ±0.02                                                                    |      | TOET 73                 | HBC  | +   | 5 $\pi^+ p$    |
| 0.09 ±0.04                                                                    |      | TOET 73                 | HBC  | 0   | 5 $\pi^+ p$    |
| 0.03 ±0.02                                                                    | 8    | <sup>1</sup> DAMERI 72  | HBC  | -   | 11 $\pi^- p$   |
| 0.06 ±0.03                                                                    | 17   | BARNHAM 71              | HBC  | +   | 3.7 $\pi^+ p$  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                         |      |     |                |
| 0.020±0.004                                                                   |      | <sup>2</sup> ESPIGAT 72 | HBC  | ±   | 0.0 $\bar{p}p$ |

NODE=M012R8  
NODE=M012R8

OCCUR=2

<sup>1</sup> Montanet agrees. Vlada.<sup>2</sup> Not averaged because of discrepancy between masses from  $K\bar{K}$  and  $\rho\pi$  modes.

NODE=M012R8;LINKAGE=01

NODE=M012R8;LINKAGE=A

 $\Gamma(\eta'(958)\pi)/\Gamma_{\text{total}}$   $\Gamma_8/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID            | TECN | CHG  | COMMENT                                    |
|-------------------------------------------------------------------------------|-----|------------------------|------|------|--------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |                        |      |      |                                            |
| <0.006                                                                        | 95  | ALDE                   | 92B  | GAM2 | $38,100 \pi^- p \rightarrow \eta' \pi^0 n$ |
| <0.02                                                                         | 97  | BARNHAM                | 71   | HBC  | $+ 3.7 \pi^+ p$                            |
| $0.004 \pm 0.004$                                                             |     | <sup>1</sup> BOESEBECK | 68   | HBC  | $+ 8 \pi^+ p$                              |

<sup>1</sup> No longer valid since  $\Gamma(K\bar{K})/\Gamma(3\pi)$  value has changed (MORRISON 71).NODE=M012R4  
NODE=M012R4

NODE=M012R4;LINKAGE=B

 $\Gamma(\eta'(958)\pi)/\Gamma(3\pi)$   $\Gamma_8/\Gamma_1$ 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | CHG | COMMENT               |
|-------------------------------------------------------------------------------|-----|-------------|------|-----|-----------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |             |      |     |                       |
| <0.011                                                                        | 90  | EISENSTEIN  | 73   | HBC | $- 5 \pi^- p$         |
| <0.04                                                                         |     | ALSTON-...  | 71   | HBC | $+ 7.0 \pi^+ p$       |
| $0.04 \begin{smallmatrix} +0.03 \\ -0.04 \end{smallmatrix}$                   |     | BOECKMANN   | 70   | HBC | $0 \quad 5.0 \pi^+ p$ |

NODE=M012R5  
NODE=M012R5 $\Gamma(\eta'(958)\pi)/\Gamma(\eta\pi)$   $\Gamma_8/\Gamma_5$ 

| VALUE                            | DOCUMENT ID            | TECN | COMMENT                                                |
|----------------------------------|------------------------|------|--------------------------------------------------------|
| <b>0.038 ± 0.005 OUR AVERAGE</b> |                        |      |                                                        |
| $0.05 \pm 0.02$                  | ADOLPH                 | 15   | COMP $191 \pi^- p \rightarrow \eta^{(\prime)} \pi^- p$ |
| $0.032 \pm 0.009$                | ABELE                  | 97C  | CBAR $0.0 \bar{p} p \rightarrow \pi^0 \pi^0 \eta'$     |
| $0.047 \pm 0.010 \pm 0.004$      | <sup>1</sup> BELADIDZE | 93   | VES $37 \pi^- N \rightarrow a_2^- N$                   |
| $0.034 \pm 0.008 \pm 0.005$      | BELADIDZE              | 92   | VES $36 \pi^- C \rightarrow a_2^- C$                   |

<sup>1</sup> Using  $B(\eta' \rightarrow \pi^+ \pi^- \eta) = 0.441$ ,  $B(\eta \rightarrow \gamma\gamma) = 0.389$  and  $B(\eta \rightarrow \pi^+ \pi^- \pi^0) = 0.236$ .NODE=M012R13  
NODE=M012R13

NODE=M012R13;LINKAGE=A

 $\Gamma(\pi^\pm \gamma)/\Gamma_{\text{total}}$   $\Gamma_9/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID            | TECN | COMMENT                       |
|-------------------------------------------------------------------------------|------------------------|------|-------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                        |      |                               |
| $0.005 \begin{smallmatrix} +0.005 \\ -0.003 \end{smallmatrix}$                | <sup>1</sup> EISENBERG | 72   | HBC $4.3, 5.25, 7.5 \gamma p$ |

<sup>1</sup> Pion-exchange model used in this estimation.NODE=M012R11  
NODE=M012R11

NODE=M012R11;LINKAGE=R

 $\Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{11}/\Gamma$ 

| VALUE (units $10^{-9}$ )                                                      | CL% | DOCUMENT ID | TECN | COMMENT                               |
|-------------------------------------------------------------------------------|-----|-------------|------|---------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |             |      |                                       |
| <6                                                                            | 90  | ACHASOV     | 00K  | SND $e^+ e^- \rightarrow \pi^0 \pi^0$ |

NODE=M012R15  
NODE=M012R15 $a_2(1320)$  REFERENCES

|            |     |                |                                        |                            |
|------------|-----|----------------|----------------------------------------|----------------------------|
| ALBRECHT   | 20  | EPJ C80 453    | M. Albrecht <i>et al.</i>              | (Crystal Barrel Collab.)   |
| RODAS      | 19  | PRL 122 042002 | A. Rodas <i>et al.</i>                 | (JPAC Collab.)             |
| AGHASYAN   | 18B | PR D98 092003  | M. Aghasyan <i>et al.</i>              | (COMPASS Collab.)          |
| JACKURA    | 18  | PL B779 464    | A. Jackura <i>et al.</i>               | (JPAC and COMPASS Collab.) |
| ADOLPH     | 15  | PL B740 303    | M. Adolph <i>et al.</i>                | (COMPASS Collab.)          |
| ADOLPH     | 14  | EPJ A50 79     | C. Adolph <i>et al.</i>                | (COMPASS Collab.)          |
| ALEKSEEV   | 10  | PRL 104 241803 | M.G. Alekseev <i>et al.</i>            | (COMPASS Collab.)          |
| ANISOVICH  | 09  | IJMP A24 2481  | V.V. Anisovich, A.V. Sarantsev         |                            |
| UEHARA     | 09A | PR D80 032001  | S. Uehara <i>et al.</i>                | (BELLE Collab.)            |
| SCHEGELSKY | 06  | EPJ A27 199    | V.A. Schegelsky <i>et al.</i>          |                            |
| SCHEGELSKY | 06A | EPJ A27 207    | V.A. Schegelsky <i>et al.</i>          |                            |
| CHUNG      | 02  | PR D65 072001  | S.U. Chung <i>et al.</i>               | (BNL E852 Collab.)         |
| IVANOV     | 01  | PRL 86 3977    | E.I. Ivanov <i>et al.</i>              | (BNL E852 Collab.)         |
| MOLCHANOV  | 01  | PL B521 171    | V.V. Molchanov <i>et al.</i>           | (FNAL SELEX Collab.)       |
| ACHASOV    | 00K | PL B492 8      | M.N. Achasov <i>et al.</i>             | (Novosibirsk SND Collab.)  |
| BARBERIS   | 00H | PL B488 225    | D. Barberis <i>et al.</i>              | (WA 102 Collab.)           |
| BARBERIS   | 98B | PL B422 399    | D. Barberis <i>et al.</i>              | (WA 102 Collab.)           |
| BERTIN     | 98B | PL B434 180    | A. Bertin <i>et al.</i>                | (OBELIX Collab.)           |
| ABELE      | 97C | PL B404 179    | A. Abele <i>et al.</i>                 | (Crystal Barrel Collab.)   |
| ACCIARRI   | 97T | PL B413 147    | M. Acciarri <i>et al.</i>              | (L3 Collab.)               |
| ALBRECHT   | 97B | ZPHY C74 469   | H. Albrecht <i>et al.</i>              | (ARGUS Collab.)            |
| THOMPSON   | 97  | PRL 79 1630    | D.R. Thompson <i>et al.</i>            | (BNL E852 Collab.)         |
| AMELIN     | 96  | ZPHY C70 71    | D.V. Amelin <i>et al.</i>              | (SERP, TBIL)               |
| AMSLER     | 94D | PL B333 277    | C. Amsler <i>et al.</i>                | (Crystal Barrel Collab.)   |
| AOYAGI     | 93  | PL B314 246    | H. Aoyagi <i>et al.</i>                | (BKEI Collab.)             |
| ARMSTRONG  | 93C | PL B307 394    | T.A. Armstrong <i>et al.</i>           | (FNAL, FERR, GENO+)        |
| BELADIDZE  | 93  | PL B313 276    | G.M. Beladidze <i>et al.</i>           | (VES Collab.)              |
| CONDO      | 93  | PR D48 3045    | G.T. Condo <i>et al.</i>               | (SLAC Hybrid Collab.)      |
| ALDE       | 92B | ZPHY C54 549   | D.M. Alde <i>et al.</i>                | (SERP, BELG, LANL, LAPP+)  |
| BELADIDZE  | 92  | ZPHY C54 235   | G.M. Beladidze <i>et al.</i>           | (VES Collab.)              |
| ALBRECHT   | 90G | ZPHY C48 183   | H. Albrecht <i>et al.</i>              | (ARGUS Collab.)            |
| ARMSTRONG  | 90  | ZPHY C48 213   | T.A. Armstrong, M. Benayoun, W. Beusch | (WA76 Coll.)               |
| BARU       | 90  | ZPHY C48 581   | S.E. Baru <i>et al.</i>                | (MD-1 Collab.)             |

NODE=M012

REFID=60439  
REFID=59554  
REFID=59471  
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REFID=43598  
REFID=43600  
REFID=41852  
REFID=42171  
REFID=41374  
REFID=41375  
REFID=41366

|              |     |                            |                                  |                           |             |
|--------------|-----|----------------------------|----------------------------------|---------------------------|-------------|
| BEHREND      | 90C | ZPHY C46 583               | H.J. Behrend <i>et al.</i>       | (CELLO Collab.)           | REFID=41356 |
| BUTLER       | 90  | PR D42 1368                | F. Butler <i>et al.</i>          | (Mark II Collab.)         | REFID=41363 |
| OEST         | 90  | ZPHY C47 343               | T. Oest <i>et al.</i>            | (JADE Collab.)            | REFID=41358 |
| AUGUSTIN     | 89  | NP B320 1                  | J.E. Augustin, G. Cosme          | (DM2 Collab.)             | REFID=41004 |
| VOROBYEV     | 88  | SJNP 48 273                | P.V. Vorobiev <i>et al.</i>      | (NOVO)                    | REFID=41023 |
| ALTHOFF      | 86  | Translated from YAF 48 436 | M. Althoff <i>et al.</i>         | (TASSO Collab.)           | REFID=21287 |
| ANTREASIAN   | 86  | ZPHY C31 537               | D. Antreasian <i>et al.</i>      | (Crystal Ball Collab.)    | REFID=20469 |
| BERGER       | 84C | PR D33 1847                | C. Berger <i>et al.</i>          | (PLUTO Collab.)           | REFID=21286 |
| BEHREND      | 82C | PL 149B 427                | H.J. Behrend <i>et al.</i>       | (CELLO Collab.)           | REFID=20303 |
| Also         |     | PL 114B 378                | H.J. Behrend <i>et al.</i>       | (CELLO Collab.)           | REFID=20302 |
| CIHANGIR     | 82  | PL 125B 518 (erratum)      | S. Cihangir <i>et al.</i>        | (FNAL, MINN, ROCH)        | REFID=21280 |
| CLELAND      | 82B | PL 117B 123                | W.E. Cleland <i>et al.</i>       | (DURH, GEVA, LAUS+)       | REFID=21281 |
| EDWARDS      | 82F | NP B208 228                | C. Edwards <i>et al.</i>         | (CIT, HARV, PRIN+)        | REFID=20747 |
| DELFOSSSE    | 81  | PL 110B 82                 | A. Delfosse <i>et al.</i>        | (GEVA, LAUS)              | REFID=21277 |
| EVANGELIS... | 81  | NP B183 349                | C. Evangelista <i>et al.</i>     | (BARI, BONN, CERN+)       | REFID=20462 |
| CHABAUD      | 80  | NP B178 197                | V. Chabaud <i>et al.</i>         | (CERN, MPIM, AMST)        | REFID=21274 |
| DAUM         | 80C | NP B175 189                | C. Daum <i>et al.</i>            | (AMST, CERN, CRAC, MPIM+) | REFID=21275 |
| BALTAY       | 78B | PL 89B 276                 | C. Baltay <i>et al.</i>          | (COLU, BING)              | REFID=21265 |
| CHABAUD      | 78  | PR D17 62                  | V. Chabaud <i>et al.</i>         | (CERN, MPIM)              | REFID=21267 |
| FERRERSORIA  | 78  | NP B145 349                | A. Ferrer Soria <i>et al.</i>    | (ORSAY, CERN, CDEF+)      | REFID=21270 |
| HYAMS        | 78  | PL 74B 287                 | B.D. Hyams <i>et al.</i>         | (CERN, MPIM, ATEN)        | REFID=21271 |
| MARTIN       | 78D | NP B146 303                | A.D. Martin <i>et al.</i>        | (DURH, GEVA)              | REFID=21272 |
| MAY          | 77  | PL 74B 417                 | E.N. May <i>et al.</i>           | (ROCH, CORN)              | REFID=20450 |
| FORINO       | 76  | PR D16 1983                | A. Forino <i>et al.</i>          | (BGNA, FIRZ, GENO, MILA+) | REFID=21259 |
| MARGULIE     | 76  | NC 35A 465                 | M. Margulies <i>et al.</i>       | (BNL, CUNY)               | REFID=21261 |
| EMMS         | 75  | PR D14 667                 | M.J. Emms <i>et al.</i>          | (BIRM, DURH, RHEL) JP     | REFID=21254 |
| WAGNER       | 75  | PL 58B 117                 | F. Wagner, M. Tabak, D.M. Chew   | (LBL) JP                  | REFID=20843 |
| DIAZ         | 74  | PL 58B 201                 | J. Diaz <i>et al.</i>            | (CASE, CMU)               | REFID=21248 |
| KARSHON      | 74  | PRL 32 260                 | U. Karshon <i>et al.</i>         | (REHO)                    | REFID=21249 |
| ANTIPOV      | 73  | PRL 32 852                 | Y.M. Antipov <i>et al.</i>       | (CERN, SERP) JP           | REFID=21238 |
| ANTIPOV      | 73C | NP B63 175                 | Y.M. Antipov <i>et al.</i>       | (CERN, SERP) JP           | REFID=20817 |
| CHALOUPKA    | 73  | NP B63 153                 | V. Chaloupka <i>et al.</i>       | (CERN)                    | REFID=21242 |
| CONFORTO     | 73  | PL 44B 211                 | G. Conforto <i>et al.</i>        | (EFI, FNAL, TNTO+)        | REFID=21243 |
| DEFOIX       | 73  | PL 45B 154                 | C. Defoix <i>et al.</i>          | (CDEF)                    | REFID=21244 |
| EISENSTEIN   | 73  | PL 43B 141                 | L. Eisenstein <i>et al.</i>      | (ILL)                     | REFID=21245 |
| KEY          | 73  | PR D7 278                  | A.W. Key <i>et al.</i>           | (TNTO, EFI, FNAL, WISC)   | REFID=21246 |
| TOET         | 73  | PRL 30 503                 | D.Z. Toet <i>et al.</i>          | (NIJM, BONN, DURH, TORI)  | REFID=20714 |
| DAMERI       | 72  | NP B63 248                 | M. Dameri <i>et al.</i>          | (GENO, MILA, SACL)        | REFID=20338 |
| EISENBERG    | 72  | NC 9A 1                    | Y. Eisenberg <i>et al.</i>       | (REHO, SLAC, TELA)        | REFID=20098 |
| ESPIGAT      | 72  | PR D5 15                   | P. Espigat <i>et al.</i>         | (CERN, CDEF)              | REFID=21232 |
| FOLEY        | 72  | NP B36 93                  | K.J. Foley <i>et al.</i>         | (BNL, CUNY)               | REFID=21233 |
| ALSTON-...   | 71  | PR D6 747                  | M. Alston-Garnjost <i>et al.</i> | (LRL)                     | REFID=21214 |
| BARNHAM      | 71  | PL 34B 156                 | K.W.J. Barnham <i>et al.</i>     | (LBL)                     | REFID=21215 |
| BINNIE       | 71  | PRL 26 1494                | D.M. Binnie <i>et al.</i>        | (LOIC, SHMP)              | REFID=21217 |
| BOWEN        | 71  | PL 36B 257                 | D.R. Bowen <i>et al.</i>         | (NEAS, STON)              | REFID=21219 |
| GRAYER       | 71  | PRL 26 1663                | G. Grayer <i>et al.</i>          | (CERN, MPIM)              | REFID=21223 |
| ABRAMOVI...  | 70B | PL 34B 333                 | M. Abramovich <i>et al.</i>      | (CERN) JP                 | REFID=21195 |
| ALSTON-...   | 70  | NP B23 466                 | M. Alston-Garnjost <i>et al.</i> | (LRL)                     | REFID=21196 |
| BOECKMANN    | 70  | PL 33B 607                 | K. Boeckmann <i>et al.</i>       | (BONN, DURH, NIJM+)       | REFID=21202 |
| ASCOLI       | 68  | NP B16 221                 | G. Ascoli <i>et al.</i>          | (ILL) JP                  | REFID=21171 |
| BOESEBECK    | 68  | PRL 20 1321                | K. Boesebeck <i>et al.</i>       | (AACH, BERL, CERN)        | REFID=20585 |
| CHUNG        | 68  | NP B4 501                  | S.U. Chung <i>et al.</i>         | (LRL)                     | REFID=20059 |
| CONTE        | 67  | PR 165 1491                | F. Conte <i>et al.</i>           | (GENO, HAMB, MILA, SACL)  | REFID=21166 |
|              | 67  | NC 51A 175                 |                                  |                           |             |

**$f_0(1370)$** 

$$J^{PC} = 0^{++}$$

See the review on "Scalar Mesons below 2 GeV" and a note on "Non- $q\bar{q}$  Candidates" in PDG 06, Journal of Physics **G33** 1 (2006).

NODE=M147

NODE=M147

 **$f_0(1370)$  T-MATRIX POLE POSITION**

Note that  $\Gamma \approx 2 \operatorname{Im}(\sqrt{s_{\text{pole}}})$ .

NODE=M147PP

NODE=M147PP

NODE=M147PP

→ UNCHECKED ←

| VALUE (MeV)                                                                   | DOCUMENT ID               | TECN | COMMENT                                                                               |
|-------------------------------------------------------------------------------|---------------------------|------|---------------------------------------------------------------------------------------|
| <b>(1200–1500)–<math>i(150\text{--}250)</math> OUR ESTIMATE</b>               |                           |      |                                                                                       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                           |      |                                                                                       |
| $(1280.6 \pm 1.6 \pm 47.4)$<br>$-i(205.2 \pm 1.7 \pm 20.7)$                   | <sup>1</sup> ALBRECHT     | 20   | RVUE $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta,$<br>$\pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| $(1290 \pm 50) - i(170^{+20}_{-40})$                                          | <sup>2</sup> ANISOVICH    | 09   | RVUE $0.0 \bar{p}p, \pi N$                                                            |
| $(1373 \pm 15) - i(137 \pm 10)$                                               | <sup>3</sup> BARGIOTTI    | 03   | OBLX $\bar{p}p$                                                                       |
| $(1302 \pm 17) - i(166 \pm 18)$                                               | <sup>4</sup> BARBERIS     | 00C  | 450 $pp \rightarrow p_f 4\pi p_s$                                                     |
| $(1312 \pm 25 \pm 10) - i(109 \pm 22 \pm 15)$                                 | BARBERIS                  | 99D  | OMEG $450 pp \rightarrow K^+ K^-,$<br>$\pi^+ \pi^-$                                   |
| $(1406 \pm 19) - i(80 \pm 6)$                                                 | <sup>5</sup> KAMINSKI     | 99   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, \sigma\sigma$                              |
| $(1300 \pm 20) - i(120 \pm 20)$                                               | ANISOVICH                 | 98B  | RVUE Compilation                                                                      |
| $(1290 \pm 15) - i(145 \pm 15)$                                               | BARBERIS                  | 97B  | OMEG $450 pp \rightarrow$<br>$pp2(\pi^+ \pi^-)$                                       |
| $(1548 \pm 40) - i(560 \pm 40)$                                               | BERTIN                    | 97C  | OBLX $0.0 \bar{p}p \rightarrow \pi^+ \pi^- \pi^0$                                     |
| $(1380 \pm 40) - i(180 \pm 25)$                                               | ABELE                     | 96B  | CBAR $0.0 \bar{p}p \rightarrow \pi^0 K_L^0 K_L^0$                                     |
| $(1300 \pm 15) - i(115 \pm 8)$                                                | BUGG                      | 96   | RVUE                                                                                  |
| $(1330 \pm 50) - i(150 \pm 40)$                                               | <sup>6</sup> AMSLER       | 95B  | CBAR $\bar{p}p \rightarrow 3\pi^0$                                                    |
| $(1360 \pm 35) - i(150\text{--}300)$                                          | <sup>6</sup> AMSLER       | 95C  | CBAR $\bar{p}p \rightarrow \pi^0 \eta \eta$                                           |
| $(1390 \pm 30) - i(190 \pm 40)$                                               | <sup>7</sup> AMSLER       | 95D  | CBAR $\bar{p}p \rightarrow 3\pi^0, \pi^0 \eta \eta,$<br>$\pi^0 \pi^0 \eta$            |
| $1346 - i249$                                                                 | <sup>8,9</sup> JANSSEN    | 95   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                            |
| $1214 - i168$                                                                 | <sup>9,10</sup> TORNQVIST | 95   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi,$<br>$\eta\pi$                        |
| $1364 - i139$                                                                 | AMSLER                    | 94D  | CBAR $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$                                          |
| $(1365^{+20}_{-55}) - i(134 \pm 35)$                                          | ANISOVICH                 | 94   | CBAR $\bar{p}p \rightarrow 3\pi^0, \pi^0 \eta \eta$                                   |
| $(1340 \pm 40) - i(127^{+30}_{-20})$                                          | <sup>11</sup> BUGG        | 94   | RVUE $\bar{p}p \rightarrow 3\pi^0, \eta \eta \pi^0,$<br>$\eta \pi^0 \pi^0$            |
| $(1430 \pm 5) - i(73 \pm 13)$                                                 | <sup>12</sup> KAMINSKI    | 94   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                            |
| $1420 - i220$                                                                 | <sup>13</sup> AU          | 87   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}$                                            |

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=2

<sup>1</sup> T-matrix pole, 5 poles, 5 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ), and BINON 84c ( $\eta\eta'$ ).

<sup>2</sup> Another pole is found at  $(1510 \pm 130) - i(800^{+100}_{-150})$  MeV.

<sup>3</sup> Coupled channel analysis of  $\pi^+ \pi^- \pi^0, K^+ K^- \pi^0$ , and  $K^\pm K_S^0 \pi^\mp$ .

<sup>4</sup> Average between  $\pi^+ \pi^- 2\pi^0$  and  $2(\pi^+ \pi^-)$ .

<sup>5</sup> T-matrix pole on sheet — — —.

<sup>6</sup> Supersedes ANISOVICH 94.

<sup>7</sup> Coupled-channel analysis of  $\bar{p}p \rightarrow 3\pi^0, \pi^0 \eta \eta$ , and  $\pi^0 \pi^0 \eta$  on sheet IV. Demonstrates explicitly that  $f_0(500)$  and  $f_0(1370)$  are two different poles.

<sup>8</sup> Analysis of data from FALVARD 88.

<sup>9</sup> The pole is on Sheet III. Demonstrates explicitly that  $f_0(500)$  and  $f_0(1370)$  are two different poles.

<sup>10</sup> Uses data from BEIER 72B, OCHS 73, HYAMS 73, GRAYER 74, ROSSELET 77, CASON 83, ASTON 88, and ARMSTRONG 91B. Coupled channel analysis with flavor symmetry and all light two-pseudoscalars systems.

<sup>11</sup> Reanalysis of ANISOVICH 94 data.

<sup>12</sup> T-matrix pole on sheet III.

<sup>13</sup> Analysis of data from OCHS 73, GRAYER 74, BECKER 79, and CASON 83.

NODE=M147PP;LINKAGE=E

NODE=M147PP;LINKAGE=AO

NODE=M147PP;LINKAGE=BG

NODE=M147PP;LINKAGE=PC

NODE=M147PP;LINKAGE=TK

NODE=M147PP;LINKAGE=K

NODE=M147PP;LINKAGE=A

NODE=M147PP;LINKAGE=C

NODE=M147PP;LINKAGE=DD

NODE=M147PP;LINKAGE=BB

NODE=M147PP;LINKAGE=C1

NODE=M147PP;LINKAGE=KM

NODE=M147PP;LINKAGE=H

 **$f_0(1370)$  BREIT-WIGNER MASS OR K-MATRIX POLE PARAMETER**

NODE=M147205

| VALUE (MeV)                      | DOCUMENT ID |
|----------------------------------|-------------|
| <b>1200 to 1500 OUR ESTIMATE</b> |             |

NODE=M147M  
→ UNCHECKED ←

**$\pi\pi$  MODE**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                 | TECN | COMMENT                                              |
|-------------------------------------------------------------------------------|------|-----------------------------|------|------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                             |      |                                                      |
| $1400 \pm 40$                                                                 |      | <sup>1</sup> AUBERT 09L     | BABR | $B^\pm \rightarrow \pi^\pm \pi^\pm \pi^\mp$          |
| $1470^{+6+72}_{-7-255}$                                                       |      | <sup>2</sup> UEHARA 08A     | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$       |
| $1259 \pm 55$                                                                 | 2.6k | BONVICINI 07                | CLEO | $D^+ \rightarrow \pi^- \pi^+ \pi^+$                  |
| $1309 \pm 1 \pm 15$                                                           |      | <sup>3</sup> BUGG 07A       | RVUE | $0.0 p \bar{p} \rightarrow 3\pi^0$                   |
| $1449 \pm 13$                                                                 | 4.3k | <sup>4</sup> GARMASH 06     | BELL | $B^+ \rightarrow K^+ \pi^+ \pi^-$                    |
| $1350 \pm 50$                                                                 |      | ABLIKIM 05                  | BES2 | $J/\psi \rightarrow \phi \pi^+ \pi^-$                |
| $1265 \pm 30^{+20}_{-35}$                                                     |      | ABLIKIM 05Q                 | BES2 | $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$    |
| $1434 \pm 18 \pm 9$                                                           | 848  | AITALA 01A                  | E791 | $D_s^+ \rightarrow \pi^- \pi^+ \pi^+$                |
| $1308 \pm 10$                                                                 |      | BARBERIS 99B                | OMEG | $450 p p \rightarrow p_s p_f \pi^+ \pi^-$            |
| $1315 \pm 50$                                                                 |      | BELLAZZINI 99               | GAM4 | $450 p p \rightarrow p p \pi^0 \pi^0$                |
| $1315 \pm 30$                                                                 |      | ALDE 98                     | GAM4 | $100 \pi^- p \rightarrow \pi^0 \pi^0 n$              |
| $1280 \pm 55$                                                                 |      | BERTIN 98                   | OBLX | $0.05-0.405 \bar{n} p \rightarrow \pi^+ \pi^+ \pi^-$ |
| 1186                                                                          |      | <sup>5,6</sup> TORNQVIST 95 | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$ |
| $1472 \pm 12$                                                                 |      | ARMSTRONG 91                | OMEG | $300 p p \rightarrow p p \pi\pi, p p K\bar{K}$       |
| $1275 \pm 20$                                                                 |      | BREAKSTONE 90               | SFM  | $62 p p \rightarrow p p \pi^+ \pi^-$                 |
| $1420 \pm 20$                                                                 |      | AKESSON 86                  | SPEC | $63 p p \rightarrow p p \pi^+ \pi^-$                 |
| 1256                                                                          |      | FROGGATT 77                 | RVUE | $\pi^+ \pi^-$ channel                                |

<sup>1</sup> Breit-Wigner mass.<sup>2</sup> Breit-Wigner mass. May also be the  $f_0(1500)$ .<sup>3</sup> Reanalysis of ABELE 96C data.<sup>4</sup> Also observed by GARMASH 07 in  $B^0 \rightarrow K_S^0 \pi^+ \pi^-$  decays. Supersedes GARMASH 05.<sup>5</sup> Uses data from BEIER 72B, OCHS 73, HYAMS 73, GRAYER 74, ROSSELET 77, CA-SON 83, ASTON 88, and ARMSTRONG 91B. Coupled channel analysis with flavor symmetry and all light two-pseudoscalars systems.<sup>6</sup> Also observed by ASNER 00 in  $\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$  decaysNODE=M147M1  
NODE=M147M1NODE=M147M1;LINKAGE=BW  
NODE=M147M1;LINKAGE=UE  
NODE=M147M1;LINKAGE=BU  
NODE=M147M1;LINKAGE=GR  
NODE=M147M1;LINKAGE=BB

NODE=M147M1;LINKAGE=FF

 **$K\bar{K}$  MODE**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID             | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|------|-------------------------|------|------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                         |      |                                                |
| $1422 \pm 15 \pm 28$                                                          |      | <sup>1</sup> AAIJ 19H   | LHCB | $p p \rightarrow D^\pm X$                      |
| $1360 \pm 31 \pm 28$                                                          | 430  | <sup>2,3</sup> DOBBS 15 |      | $J/\psi \rightarrow \gamma K^+ K^-$            |
| $1350 \pm 48 \pm 15$                                                          | 168  | <sup>2,3</sup> DOBBS 15 |      | $\psi(2S) \rightarrow \gamma K^+ K^-$          |
| $1440 \pm 6$                                                                  |      | VLADIMIRSK...06         | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$         |
| $1391 \pm 10$                                                                 |      | TIKHOMIROV 03           | SPEC | $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| $1440 \pm 50$                                                                 |      | BOLONKIN 88             | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$         |
| $1463 \pm 9$                                                                  |      | ETKIN 82B               | MPS  | $23 \pi^- p \rightarrow n 2 K_S^0$             |
| $1425 \pm 15$                                                                 |      | WICKLUND 80             | SPEC | $6 \pi N \rightarrow K^+ K^- N$                |
| $\sim 1300$                                                                   |      | POLYCHRO... 79          | STRC | $7 \pi^- p \rightarrow n 2 K_S^0$              |

<sup>1</sup> From the  $D^\pm \rightarrow K^\pm K^+ K^-$  Dalitz plot fit with the isobar model A.<sup>2</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>3</sup> From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 346$  MeV.NODE=M147M2  
NODE=M147M2

OCCUR=4

OCCUR=2

NODE=M147M2;LINKAGE=F  
NODE=M147M2;LINKAGE=A  
NODE=M147M2;LINKAGE=B **$4\pi$  MODE  $2(\pi\pi)_S + \rho\rho$** 

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID             | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|------|-------------------------|------|------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                         |      |                                                |
| $1395 \pm 40$                                                                 |      | ABELE 01                | CBAR | $0.0 \bar{p} d \rightarrow \pi^- 4\pi^0 p$     |
| $1374 \pm 38$                                                                 |      | AMSLER 94               | CBAR | $0.0 \bar{p} p \rightarrow \pi^+ \pi^- 3\pi^0$ |
| $1345 \pm 12$                                                                 |      | ADAMO 93                | OBLX | $\bar{n} p \rightarrow 3\pi^+ 2\pi^-$          |
| $1386 \pm 30$                                                                 |      | GASPERO 93              | DBC  | $0.0 \bar{p} n \rightarrow 2\pi^+ 3\pi^-$      |
| $\sim 1410$                                                                   | 5751 | <sup>1</sup> BETTINI 66 | DBC  | $0.0 \bar{p} n \rightarrow 2\pi^+ 3\pi^-$      |

<sup>1</sup>  $\rho\rho$  dominant.NODE=M147M3  
NODE=M147M3

NODE=M147M3;LINKAGE=BE

 **$\eta\eta$  MODE**

| VALUE (MeV)                                                                   | DOCUMENT ID             | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|-------------------------|------|---------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                         |      |                                             |
| $1262^{+51+82}_{-78-103}$                                                     | <sup>1</sup> UEHARA 10A | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \eta\eta$ |
| 1430                                                                          | AMSLER 92               | CBAR | $0.0 \bar{p} p \rightarrow \pi^0 \eta\eta$  |
| $1220 \pm 40$                                                                 | ALDE 86D                | GAM4 | $100 \pi^- p \rightarrow n 2\eta$           |

<sup>1</sup> Breit-Wigner mass. May also be the  $f_0(1500)$ .NODE=M147M4  
NODE=M147M4

NODE=M147M4;LINKAGE=UE

**COUPLED CHANNEL MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                |                        |     |                               |
|--------------------------------|------------------------|-----|-------------------------------|
| $1330.2^{+5.9}_{-6.5} \pm 5.1$ | <sup>1</sup> AAIJ      | 19H | LHCB $pp \rightarrow D^\pm X$ |
| $1306 \pm 20$                  | <sup>2</sup> ANISOVICH | 03  | RVUE                          |

<sup>1</sup> From the  $D^\pm \rightarrow K^\pm K^+ K^-$  Dalitz plot fit with the Triple-M amplitude in the multi-meson model of AOUE 18.

<sup>2</sup> K-matrix pole from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K \bar{K} n$ ,  $\pi^+ \pi^- \rightarrow \pi^+ \pi^-$ ,  $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \eta \eta$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^0$ ,  $K^+ K_S^0 \pi^-$  at rest,  $\bar{p} n \rightarrow \pi^- \pi^- \pi^+$ ,  $K_S^0 K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^-$  at rest.

NODE=M147M5  
NODE=M147M5

NODE=M147M5;LINKAGE=A

NODE=M147M;LINKAGE=KM

 **$f_0(1370)$  BREIT-WIGNER WIDTH**

| VALUE (MeV) | DOCUMENT ID |
|-------------|-------------|
|-------------|-------------|

**200 to 500 OUR ESTIMATE**

NODE=M147210

NODE=M147W  
→ UNCHECKED ←

 **$\pi\pi$  MODE**

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                            |      |                          |     |                                                           |
|----------------------------|------|--------------------------|-----|-----------------------------------------------------------|
| $300 \pm 80$               |      | <sup>1</sup> AUBERT      | 09L | BABR $B^\pm \rightarrow \pi^\pm \pi^\pm \pi^\mp$          |
| $90^{+2+50}_{-1-22}$       |      | <sup>2</sup> UEHARA      | 08A | BELL $10.6 e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$       |
| $298 \pm 21$               | 2.6k | BONVICINI                | 07  | CLEO $D^+ \rightarrow \pi^- \pi^+ \pi^+$                  |
| $126 \pm 25$               | 4286 | <sup>3</sup> GARMASH     | 06  | BELL $B^+ \rightarrow K^+ \pi^+ \pi^-$                    |
| $265 \pm 40$               |      | ABLIKIM                  | 05  | BES2 $J/\psi \rightarrow \phi \pi^+ \pi^-$                |
| $350 \pm 100^{+105}_{-60}$ |      | ABLIKIM                  | 05Q | BES2 $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$    |
| $173 \pm 32 \pm 6$         | 848  | AITALA                   | 01A | E791 $D_s^+ \rightarrow \pi^- \pi^+ \pi^+$                |
| $222 \pm 20$               |      | BARBERIS                 | 99B | OMEG $450 pp \rightarrow p_S p_f \pi^+ \pi^-$             |
| $255 \pm 60$               |      | BELLAZZINI               | 99  | GAM4 $450 pp \rightarrow pp \pi^0 \pi^0$                  |
| $190 \pm 50$               |      | ALDE                     | 98  | GAM4 $100 \pi^- p \rightarrow \pi^0 \pi^0 n$              |
| $323 \pm 13$               |      | BERTIN                   | 98  | OBLX $0.05-0.405 \bar{n} p \rightarrow \pi^+ \pi^+ \pi^-$ |
| 350                        |      | <sup>4,5</sup> TORNQVIST | 95  | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi, \eta\pi$ |
| $195 \pm 33$               |      | ARMSTRONG                | 91  | OMEG $300 pp \rightarrow pp \pi\pi, pp K\bar{K}$          |
| $285 \pm 60$               |      | BREAKSTONE               | 90  | SFM $62 pp \rightarrow pp \pi^+ \pi^-$                    |
| $460 \pm 50$               |      | AKESSON                  | 86  | SPEC $63 pp \rightarrow pp \pi^+ \pi^-$                   |
| $\sim 400$                 |      | <sup>6</sup> FROGGATT    | 77  | RVUE $\pi^+ \pi^-$ channel                                |

<sup>1</sup> The systematic errors are not reported.

<sup>2</sup> Breit-Wigner width. May also be the  $f_0(1500)$ .

<sup>3</sup> Also observed by GARMASH 07 in  $B^0 \rightarrow K_S^0 \pi^+ \pi^-$  decays. Supersedes GARMASH 05.

<sup>4</sup> Uses data from BEIER 72B, OCHS 73, HYAMS 73, GRAYER 74, ROSSELET 77, CA-SON 83, ASTON 88, and ARMSTRONG 91B. Coupled channel analysis with flavor symmetry and all light two-pseudoscalars systems.

<sup>5</sup> Also observed by ASNER 00 in  $\tau^- \rightarrow \pi^- \pi^0 \pi^0 \nu_\tau$  decays

<sup>6</sup> Width defined as distance between 45 and 135° phase shift.

NODE=M147W1;LINKAGE=NS

NODE=M147W1;LINKAGE=UE

NODE=M147W1;LINKAGE=GR

NODE=M147W1;LINKAGE=BB

NODE=M147W1;LINKAGE=FF

NODE=M147W1;LINKAGE=E

 **$K\bar{K}$  MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                     |                   |     |                                                     |
|---------------------|-------------------|-----|-----------------------------------------------------|
| $324 \pm 38 \pm 42$ | <sup>1</sup> AAIJ | 19H | LHCB $pp \rightarrow D^\pm X$                       |
| $121 \pm 15$        | VLADIMIRSK...     | 06  | SPEC $40 \pi^- p \rightarrow K_S^0 K_S^0 n$         |
| $55 \pm 26$         | TIKHOMIROV        | 03  | SPEC $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| $250 \pm 80$        | BOLONKIN          | 88  | SPEC $40 \pi^- p \rightarrow K_S^0 K_S^0 n$         |
| $118^{+138}_{-16}$  | ETKIN             | 82B | MPS $23 \pi^- p \rightarrow n 2 K_S^0$              |
| $160 \pm 30$        | WICKLUND          | 80  | SPEC $6 \pi N \rightarrow K^+ K^- N$                |
| $\sim 150$          | POLYCHRO...       | 79  | STRC $7 \pi^- p \rightarrow n 2 K_S^0$              |

<sup>1</sup> From the  $D^\pm \rightarrow K^\pm K^+ K^-$  Dalitz plot fit with the isobar model A.

OCCUR=3

NODE=M147W2;LINKAGE=C

**4 $\pi$  MODE 2( $\pi\pi$ ) $_S$ + $\rho\rho$** 

| VALUE (MeV)                                                                   | EVS  | DOCUMENT ID          | TECN | COMMENT                                            |
|-------------------------------------------------------------------------------|------|----------------------|------|----------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |      |                                                    |
| 275 $\pm$ 55                                                                  |      | ABELE                | 01   | CBAR 0.0 $\bar{p}d \rightarrow \pi^- 4\pi^0 p$     |
| 375 $\pm$ 61                                                                  |      | AMSLER               | 94   | CBAR 0.0 $\bar{p}p \rightarrow \pi^+ \pi^- 3\pi^0$ |
| 398 $\pm$ 26                                                                  |      | ADAMO                | 93   | OBLX $\bar{n}p \rightarrow 3\pi^+ 2\pi^-$          |
| 310 $\pm$ 50                                                                  |      | GASPERO              | 93   | DBC 0.0 $\bar{p}n \rightarrow 2\pi^+ 3\pi^-$       |
| $\sim 90$                                                                     | 5751 | <sup>1</sup> BETTINI | 66   | DBC 0.0 $\bar{p}n \rightarrow 2\pi^+ 3\pi^-$       |

<sup>1</sup>  $\rho\rho$  dominant.NODE=M147W3  
NODE=M147W3

NODE=M147W3;LINKAGE=BE

 **$\eta\eta$  MODE**

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN | COMMENT                                          |
|-------------------------------------------------------------------------------|---------------------|------|--------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |      |                                                  |
| 484 $^{+246}_{-170}$ + 246<br>- 263                                           | <sup>1</sup> UEHARA | 10A  | BELL 10.6 $e^+ e^- \rightarrow e^+ e^- \eta\eta$ |
| 250                                                                           | AMSLER              | 92   | CBAR 0.0 $\bar{p}p \rightarrow \pi^0 \eta\eta$   |
| 320 $\pm$ 40                                                                  | ALDE                | 86D  | GAM4 100 $\pi^- p \rightarrow n 2\eta$           |

<sup>1</sup> Breit-Wigner width. May also be the  $f_0(1500)$ .NODE=M147W4  
NODE=M147W4

NODE=M147W4;LINKAGE=UE

**COUPLED CHANNEL MODE**

| VALUE (MeV)                                                                                                                                                                                                                                                                                                                                                                                                                                    | DOCUMENT ID            | TECN | COMMENT |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------|---------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                  |                        |      |         |
| 147 $^{+30}_{-50}$                                                                                                                                                                                                                                                                                                                                                                                                                             | <sup>1</sup> ANISOVICH | 03   | RVUE    |
| <sup>1</sup> K-matrix pole from combined analysis of $\pi^- p \rightarrow \pi^0 \pi^0 n$ , $\pi^- p \rightarrow K \bar{K} n$ , $\pi^+ \pi^- \rightarrow \pi^+ \pi^-$ , $\bar{p}p \rightarrow \pi^0 \pi^0 \pi^0$ , $\pi^0 \eta\eta$ , $\pi^0 \pi^0 \eta$ , $\pi^+ \pi^- \pi^0$ , $K^+ K^- \pi^0$ , $K_S^0 K_S^0 \pi^0$ , $K^+ K_S^0 \pi^-$ at rest, $\bar{p}n \rightarrow \pi^- \pi^- \pi^+$ , $K_S^0 K^- \pi^0$ , $K_S^0 K_S^0 \pi^-$ at rest. |                        |      |         |

NODE=M147W5  
NODE=M147W5

NODE=M147W;LINKAGE=KM

 **$f_0(1370)$  DECAY MODES**

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1$ $\pi\pi$             | seen                           |
| $\Gamma_2$ $4\pi$               | seen                           |
| $\Gamma_3$ $4\pi^0$             | seen                           |
| $\Gamma_4$ $2\pi^+ 2\pi^-$      | seen                           |
| $\Gamma_5$ $\pi^+ \pi^- 2\pi^0$ | seen                           |
| $\Gamma_6$ $\rho\rho$           | seen                           |
| $\Gamma_7$ $2(\pi\pi)_S$ -wave  | seen                           |
| $\Gamma_8$ $\pi(1300)\pi$       | seen                           |
| $\Gamma_9$ $a_1(1260)\pi$       | seen                           |
| $\Gamma_{10}$ $\eta\eta$        | seen                           |
| $\Gamma_{11}$ $K\bar{K}$        | seen                           |
| $\Gamma_{12}$ $K\bar{K} n\pi$   | not seen                       |
| $\Gamma_{13}$ $6\pi$            | not seen                       |
| $\Gamma_{14}$ $\omega\omega$    | not seen                       |
| $\Gamma_{15}$ $\gamma\gamma$    | seen                           |
| $\Gamma_{16}$ $e^+ e^-$         | not seen                       |

NODE=M147215;NODE=M147

DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=10;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=6;OUR EST;→ UNCHECKED ←  
 DESIG=14;OUR EST;→ UNCHECKED ←  
 DESIG=15;OUR EST;→ UNCHECKED ←  
 DESIG=16;OUR EVAL;→ UNCHECKED ←  
 DESIG=17;OUR EVAL;→ UNCHECKED ←  
 DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=11;OUR EST;→ UNCHECKED ←  
 DESIG=18;OUR EVAL;→ UNCHECKED ←  
 DESIG=19;OUR EVAL;→ UNCHECKED ←  
 DESIG=20;OUR EVAL;→ UNCHECKED ←  
 DESIG=12;OUR EST;→ UNCHECKED ←  
 DESIG=13;OUR EST;→ UNCHECKED ←

 **$f_0(1370)$  PARTIAL WIDTHS** **$\Gamma(\gamma\gamma)$** See  $\gamma\gamma$  widths under  $f_0(500)$  and MORGAN 90. **$\Gamma_{15}$** 

NODE=M147217

NODE=M147W11  
NODE=M147W11  
NODE=M147W11 **$\Gamma(e^+ e^-)$** 

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT                              |
|------------|-----|-------------|------|--------------------------------------|
| <20        | 90  | VOROBYEV    | 88   | ND $e^+ e^- \rightarrow \pi^0 \pi^0$ |

 **$\Gamma_{16}$** NODE=M147W12  
NODE=M147W12

$f_0(1370) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$ 

NODE=M147225

 $\Gamma(\eta\eta) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$  $\Gamma_{10} \Gamma_{15} / \Gamma$ 

| VALUE (eV) | DOCUMENT ID | TECN | COMMENT |
|------------|-------------|------|---------|
|------------|-------------|------|---------|

NODE=M147G01  
NODE=M147G01

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                            |                     |     |      |                                             |
|----------------------------|---------------------|-----|------|---------------------------------------------|
| $121^{+133+169}_{-53-106}$ | <sup>1</sup> UEHARA | 10A | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \eta\eta$ |
|----------------------------|---------------------|-----|------|---------------------------------------------|

<sup>1</sup> Including interference with the  $f'_2(1525)$  (parameters fixed to the values from the 2008 edition of this review, PDG 08) and  $f_2(1270)$ . May also be the  $f_0(1500)$ .

NODE=M147G01;LINKAGE=UE

 $f_0(1370) \text{ BRANCHING RATIOS}$ 

NODE=M147220

 $\Gamma(\pi\pi) / \Gamma_{\text{total}}$  $\Gamma_1 / \Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

NODE=M147R3  
NODE=M147R3

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |    |                     |    |                                                |
|-----------------|----|---------------------|----|------------------------------------------------|
| <0.10           | 95 | OCHS                | 13 | RVUE                                           |
| $0.26 \pm 0.09$ |    | BUGG                | 96 | RVUE                                           |
| <0.15           |    | <sup>1</sup> AMSLER | 94 | CBAR $\bar{p}p \rightarrow \pi^+ \pi^- 3\pi^0$ |
| <0.06           |    | GASPERO             | 93 | DBC $0.0 \bar{p}n \rightarrow \text{hadrons}$  |

<sup>1</sup> Using AMSLER 95B ( $3\pi^0$ ).

NODE=M147R3;LINKAGE=B

 $\Gamma(4\pi) / \Gamma_{\text{total}}$  $\Gamma_2 / \Gamma = (\Gamma_3 + \Gamma_4 + \Gamma_5) / \Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M147R4  
NODE=M147R4

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |         |    |                                               |
|-------|---------|----|-----------------------------------------------|
| >0.72 | GASPERO | 93 | DBC $0.0 \bar{p}n \rightarrow \text{hadrons}$ |
|-------|---------|----|-----------------------------------------------|

 $\Gamma(4\pi^0) / \Gamma(4\pi)$  $\Gamma_3 / \Gamma_2$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M147R12  
NODE=M147R12

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |                      |    |                                               |
|-------------------|----------------------|----|-----------------------------------------------|
| seen              | ABELE                | 96 | CBAR $0.0 \bar{p}p \rightarrow 5\pi^0$        |
| $0.068 \pm 0.005$ | <sup>1</sup> GASPERO | 93 | DBC $0.0 \bar{p}n \rightarrow \text{hadrons}$ |

<sup>1</sup> Model-dependent evaluation.

NODE=M147R12;LINKAGE=GA

 $\Gamma(2\pi^+ 2\pi^-) / \Gamma(4\pi)$  $\Gamma_4 / \Gamma_2 = \Gamma_4 / (\Gamma_3 + \Gamma_4 + \Gamma_5)$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M147R5  
NODE=M147R5

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |                      |    |                                              |
|-------------------|----------------------|----|----------------------------------------------|
| $0.420 \pm 0.014$ | <sup>1</sup> GASPERO | 93 | DBC $0.0 \bar{p}n \rightarrow 2\pi^+ 3\pi^-$ |
|-------------------|----------------------|----|----------------------------------------------|

<sup>1</sup> Model-dependent evaluation.

NODE=M147R5;LINKAGE=A

 $\Gamma(\pi^+ \pi^- 2\pi^0) / \Gamma(4\pi)$  $\Gamma_5 / \Gamma_2 = \Gamma_5 / (\Gamma_3 + \Gamma_4 + \Gamma_5)$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M147R6  
NODE=M147R6

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |                      |    |                                               |
|-------------------|----------------------|----|-----------------------------------------------|
| $0.512 \pm 0.019$ | <sup>1</sup> GASPERO | 93 | DBC $0.0 \bar{p}n \rightarrow \text{hadrons}$ |
|-------------------|----------------------|----|-----------------------------------------------|

<sup>1</sup> Model-dependent evaluation.

NODE=M147R6;LINKAGE=A

 $\Gamma(\rho\rho) / \Gamma(4\pi)$  $\Gamma_6 / \Gamma_2$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M147R17  
NODE=M147R17

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |       |     |                                        |
|-----------------|-------|-----|----------------------------------------|
| $0.26 \pm 0.07$ | ABELE | 01B | CBAR $0.0 \bar{p}d \rightarrow 5\pi p$ |
|-----------------|-------|-----|----------------------------------------|

 $\Gamma(2(\pi\pi)_{S\text{-wave}}) / \Gamma(\pi\pi)$  $\Gamma_7 / \Gamma_1$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M147R15  
NODE=M147R15

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |                    |    |                                                |
|---------------|--------------------|----|------------------------------------------------|
| $5.6 \pm 2.6$ | <sup>1</sup> ABELE | 01 | CBAR $0.0 \bar{p}d \rightarrow \pi^- 4\pi^0 p$ |
|---------------|--------------------|----|------------------------------------------------|

<sup>1</sup> From the combined data of ABELE 96 and ABELE 96C.

NODE=M147R;LINKAGE=KZ

 $\Gamma(2(\pi\pi)_{S\text{-wave}}) / \Gamma(4\pi)$  $\Gamma_7 / \Gamma_2$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M147R16  
NODE=M147R16

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |       |     |                                        |
|-----------------|-------|-----|----------------------------------------|
| $0.51 \pm 0.09$ | ABELE | 01B | CBAR $0.0 \bar{p}d \rightarrow 5\pi p$ |
|-----------------|-------|-----|----------------------------------------|



$\Gamma(\rho\rho)/\Gamma(2(\pi\pi)_{S\text{-wave}})$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|-------------|------|------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                                |
| large                                                                         | BARBERIS    | 00C  | $450\ p\bar{p} \rightarrow p_f 4\pi p_s$       |
| $1.6 \pm 0.2$                                                                 | AMSLER      | 94   | CBAR $\bar{p}p \rightarrow \pi^+ \pi^- 3\pi^0$ |
| $\sim 0.65$                                                                   | GASPERO     | 93   | DBC $0.0\ \bar{p}n \rightarrow \text{hadrons}$ |

 $\Gamma_6/\Gamma_7$ 

NODE=M147R10  
 NODE=M147R10

OCCUR=2

 $\Gamma(\pi(1300)\pi)/\Gamma(4\pi)$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                 |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                         |
| $0.17 \pm 0.06$                                                               | ABELE       | 01B  | CBAR $0.0\ \bar{p}d \rightarrow 5\pi p$ |

 $\Gamma_8/\Gamma_2$ 

NODE=M147R18  
 NODE=M147R18

 $\Gamma(a_1(1260)\pi)/\Gamma(4\pi)$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                 |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                         |
| $0.06 \pm 0.02$                                                               | ABELE       | 01B  | CBAR $0.0\ \bar{p}d \rightarrow 5\pi p$ |

 $\Gamma_9/\Gamma_2$ 

NODE=M147R19  
 NODE=M147R19

 $\Gamma(\eta\eta)/\Gamma(4\pi)$ 

| VALUE                                                                         | DOCUMENT ID            | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|------------------------|------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |                                               |
| $(28 \pm 11) \times 10^{-3}$                                                  | <sup>1</sup> ANISOVICH | 02D  | SPEC Combined fit                             |
| $(4.7 \pm 2.0) \times 10^{-3}$                                                | BARBERIS               | 00E  | $450\ p\bar{p} \rightarrow p_f \eta \eta p_s$ |

 $\Gamma_{10}/\Gamma_2 = \Gamma_{10}/(\Gamma_3 + \Gamma_4 + \Gamma_5)$ 

NODE=M147R14  
 NODE=M147R14

<sup>1</sup> From a combined K-matrix analysis of Crystal Barrel ( $0. \ p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ ), GAMS ( $\pi p \rightarrow \pi^0 \pi^0 n, \eta \eta n, \eta \eta' n$ ), and BNL ( $\pi p \rightarrow K \bar{K} n$ ) data.

NODE=M147R14;LINKAGE=CH

 $\Gamma(K\bar{K})/\Gamma_{\text{total}}$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------------------------------------------|-------------|------|---------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |         |
| $0.35 \pm 0.13$                                                               | BUGG        | 96   | RVUE    |

 $\Gamma_{11}/\Gamma$ 

NODE=M147R11  
 NODE=M147R11

 $\Gamma(K\bar{K})/\Gamma(\pi\pi)$ 

| VALUE                                                                         | DOCUMENT ID            | TECN | COMMENT                                                  |
|-------------------------------------------------------------------------------|------------------------|------|----------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |                                                          |
| $0.08 \pm 0.08$                                                               | ABLIKIM                | 05   | BES2 $J/\psi \rightarrow \phi \pi^+ \pi^-, \phi K^+ K^-$ |
| $0.91 \pm 0.20$                                                               | <sup>1</sup> BARGIOTTI | 03   | OBLX $\bar{p}p$                                          |
| $0.12 \pm 0.06$                                                               | <sup>2</sup> ANISOVICH | 02D  | SPEC Combined fit                                        |
| $0.46 \pm 0.15 \pm 0.11$                                                      | BARBERIS               | 99D  | OMEG $450\ p\bar{p} \rightarrow K^+ K^-, \pi^+ \pi^-$    |

 $\Gamma_{11}/\Gamma_1$ 

NODE=M147R13  
 NODE=M147R13

<sup>1</sup> Coupled channel analysis of  $\pi^+ \pi^- \pi^0, K^+ K^- \pi^0$ , and  $K_S^0 \pi^\mp$ .

<sup>2</sup> From a combined K-matrix analysis of Crystal Barrel ( $0. \ p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ ), GAMS ( $\pi p \rightarrow \pi^0 \pi^0 n, \eta \eta n, \eta \eta' n$ ), and BNL ( $\pi p \rightarrow K \bar{K} n$ ) data.

NODE=M147R;LINKAGE=BG  
 NODE=M147R;LINKAGE=CH

 $\Gamma(K\bar{K}n\pi)/\Gamma_{\text{total}}$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|-------------|------|------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                                |
| $< 0.03$                                                                      | GASPERO     | 93   | DBC $0.0\ \bar{p}n \rightarrow \text{hadrons}$ |

 $\Gamma_{12}/\Gamma$ 

NODE=M147R20  
 NODE=M147R20

 $\Gamma(6\pi)/\Gamma_{\text{total}}$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|-------------|------|------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                                |
| $< 0.22$                                                                      | GASPERO     | 93   | DBC $0.0\ \bar{p}n \rightarrow \text{hadrons}$ |

 $\Gamma_{13}/\Gamma$ 

NODE=M147R21  
 NODE=M147R21

 $\Gamma(\omega\omega)/\Gamma_{\text{total}}$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|-------------|------|------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                                |
| $< 0.13$                                                                      | GASPERO     | 93   | DBC $0.0\ \bar{p}n \rightarrow \text{hadrons}$ |

 $\Gamma_{14}/\Gamma$ 

NODE=M147R22  
 NODE=M147R22

**$\phi_0(1370)$  REFERENCES**

NODE=M147

|               |     |                              |                                       |                              |             |
|---------------|-----|------------------------------|---------------------------------------|------------------------------|-------------|
| ALBRECHT      | 20  | EPJ C80 453                  | M. Albrecht <i>et al.</i>             | (Crystal Barrel Collab.)     | REFID=60439 |
| AAIJ          | 19H | JHEP 1904 063                | R. Aaij <i>et al.</i>                 | (LHCb Collab.)               | REFID=59670 |
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| DOBBS         | 15  | PR D91 052006                | S. Dobbs <i>et al.</i>                | (NWES)                       | REFID=56805 |
| OCHS          | 13  | JP G40 043001                | W. Ochs                               |                              | REFID=55367 |
| UEHARA        | 10A | PR D82 114031                | S. Uehara <i>et al.</i>               | (BELLE Collab.)              | REFID=53641 |
| ANISOVICH     | 09  | IJMP A24 2481                | V.V. Anisovich, A.V. Sarantsev        |                              | REFID=52719 |
| AUBERT        | 09L | PR D79 072006                | B. Aubert <i>et al.</i>               | (BABAR Collab.)              | REFID=52723 |
| PDG           | 08  | PL B667 1                    | C. Amsler <i>et al.</i>               | (PDG Collab.)                | REFID=52166 |
| UEHARA        | 08A | PR D78 052004                | S. Uehara <i>et al.</i>               | (BELLE Collab.)              | REFID=52309 |
| BONVICINI     | 07  | PR D76 012001                | G. Bonvicini <i>et al.</i>            | (CLEO Collab.)               | REFID=51721 |
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| GARMASH       | 07  | PR D75 012006                | A. Garmash <i>et al.</i>              | (BELLE Collab.)              | REFID=51594 |
| GARMASH       | 06  | PRL 96 251803                | A. Garmash <i>et al.</i>              | (BELLE Collab.)              | REFID=51162 |
| PDG           | 06  | JP G33 1                     | W.-M. Yao <i>et al.</i>               | (PDG Collab.)                | REFID=51004 |
| VLADIMIRSK... | 06  | PAN 69 493                   | V.V. Vladimirovsky <i>et al.</i>      | (ITEP, Moscow)               | REFID=51191 |
|               |     | Translated from YAF 69 515.  |                                       |                              |             |
| ABLIKIM       | 05  | PL B607 243                  | M. Ablikim <i>et al.</i>              | (BES Collab.)                | REFID=50450 |
| ABLIKIM       | 05Q | PR D72 092002                | M. Ablikim <i>et al.</i>              | (BES Collab.)                | REFID=50958 |
| GARMASH       | 05  | PR D71 092003                | A. Garmash <i>et al.</i>              | (BELLE Collab.)              | REFID=50641 |
| ANISOVICH     | 03  | EPJ A16 229                  | V.V. Anisovich <i>et al.</i>          |                              | REFID=49401 |
| BARGIOTTI     | 03  | EPJ C26 371                  | M. Bargiotti <i>et al.</i>            | (OBELIX Collab.)             | REFID=49217 |
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| ANISOVICH     | 02D | PAN 65 1545                  | V.V. Anisovich <i>et al.</i>          |                              | REFID=48831 |
|               |     | Translated from YAF 65 1583. |                                       |                              |             |
| ABELE         | 01  | EPJ C19 667                  | A. Abele <i>et al.</i>                | (Crystal Barrel Collab.)     | REFID=48334 |
| ABELE         | 01B | EPJ C21 261                  | A. Abele <i>et al.</i>                | (Crystal Barrel Collab.)     | REFID=48356 |
| AITALA        | 01A | PRL 86 765                   | E.M. Aitala <i>et al.</i>             | (FNAL E791 Collab.)          | REFID=48004 |
| ASNER         | 00  | PR D61 012002                | D.M. Asner <i>et al.</i>              | (CLEO Collab.)               | REFID=47339 |
| BARBERIS      | 00C | PL B471 440                  | D. Barberis <i>et al.</i>             | (WA 102 Collab.)             | REFID=47959 |
| BARBERIS      | 00E | PL B479 59                   | D. Barberis <i>et al.</i>             | (WA 102 Collab.)             | REFID=47961 |
| BARBERIS      | 99B | PL B453 316                  | D. Barberis <i>et al.</i>             | (Omega Expt.)                | REFID=46922 |
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| BELLAZZINI    | 99  | PL B467 296                  | R. Bellazzini <i>et al.</i>           |                              | REFID=47400 |
| KAMINSKI      | 99  | EPJ C9 141                   | R. Kaminski, L. Lesniak, B. Loiseau   | (CRAC, PARIN)                | REFID=46927 |
| ALDE          | 98  | EPJ A3 361                   | D. Alde <i>et al.</i>                 | (GAM4 Collab.)               | REFID=46605 |
| Also          |     | PAN 62 405                   | D. Alde <i>et al.</i>                 | (GAMS Collab.)               | REFID=46914 |
|               |     | Translated from YAF 62 446.  |                                       |                              |             |
| ANISOVICH     | 98B | SPU 41 419                   | V.V. Anisovich <i>et al.</i>          |                              | REFID=46331 |
|               |     | Translated from UFN 168 481. |                                       |                              |             |
| BERTIN        | 98  | PR D57 55                    | A. Bertin <i>et al.</i>               | (OBELIX Collab.)             | REFID=45782 |
| BARBERIS      | 97B | PL B413 217                  | D. Barberis <i>et al.</i>             | (WA 102 Collab.)             | REFID=45758 |
| BERTIN        | 97C | PL B408 476                  | A. Bertin <i>et al.</i>               | (OBELIX Collab.)             | REFID=45701 |
| ABELE         | 96  | PL B380 453                  | A. Abele <i>et al.</i>                | (Crystal Barrel Collab.)     | REFID=45011 |
| ABELE         | 96B | PL B385 425                  | A. Abele <i>et al.</i>                | (Crystal Barrel Collab.)     | REFID=45038 |
| ABELE         | 96C | NP A609 562                  | A. Abele <i>et al.</i>                | (Crystal Barrel Collab.)     | REFID=45076 |
| BUGG          | 96  | NP B471 59                   | D.V. Bugg, A.V. Sarantsev, B.S. Zou   | (LOQM, PNPI)                 | REFID=45094 |
| AMSLER        | 95B | PL B342 433                  | C. Amsler <i>et al.</i>               | (Crystal Barrel Collab.)     | REFID=44377 |
| AMSLER        | 95C | PL B353 571                  | C. Amsler <i>et al.</i>               | (Crystal Barrel Collab.)     | REFID=44440 |
| AMSLER        | 95D | PL B355 425                  | C. Amsler <i>et al.</i>               | (Crystal Barrel Collab.)     | REFID=44441 |
| JANSSEN       | 95  | PR D52 2690                  | G. Janssen <i>et al.</i>              | (STON, ADLD, JULI)           | REFID=44508 |
| TORNQVIST     | 95  | ZPHY C68 647                 | N.A. Tornqvist                        | (HELS)                       | REFID=44529 |
| AMSLER        | 94  | PL B322 431                  | C. Amsler <i>et al.</i>               | (Crystal Barrel Collab.) JPC | REFID=43660 |
| AMSLER        | 94D | PL B333 277                  | C. Amsler <i>et al.</i>               | (Crystal Barrel Collab.)     | REFID=44093 |
| ANISOVICH     | 94  | PL B323 233                  | V.V. Anisovich <i>et al.</i>          | (Crystal Barrel Collab.) JPC | REFID=43659 |
| BUGG          | 94  | PR D50 4412                  | D.V. Bugg <i>et al.</i>               | (LOQM)                       | REFID=44078 |
| KAMINSKI      | 94  | PR D50 3145                  | R. Kaminski, L. Lesniak, J.P. Maillet | (CRAC+)                      | REFID=45771 |
| ADAMO         | 93  | NP A558 13C                  | A. Adamo <i>et al.</i>                | (OBELIX Collab.) JPC         | REFID=43657 |
| GASPERO       | 93  | NP A562 407                  | M. Gaspero                            | (ROMA)                       | REFID=43658 |
| AMSLER        | 92  | PL B291 347                  | C. Amsler <i>et al.</i>               | (Crystal Barrel Collab.)     | REFID=43169 |
| ARMSTRONG     | 91  | ZPHY C51 351                 | T.A. Armstrong <i>et al.</i>          | (ATHU, BARI, BIRM+)          | REFID=41744 |
| ARMSTRONG     | 91B | ZPHY C52 389                 | T.A. Armstrong <i>et al.</i>          | (ATHU, BARI, BIRM+)          | REFID=41862 |
| BREAKSTONE    | 90  | ZPHY C48 569                 | A.M. Breakstone <i>et al.</i>         | (ISU, BGNA, CERN+)           | REFID=41376 |
| MORGAN        | 90  | ZPHY C48 623                 | D. Morgan, M.R. Pennington            | (RAL, DURH)                  | REFID=41583 |
| ASTON         | 88  | NP B296 493                  | D. Aston <i>et al.</i>                | (SLAC, NAGO, CINC, INUS)     | REFID=40262 |
| BOLONKIN      | 88  | NP B309 426                  | B.V. Bolonkin <i>et al.</i>           | (ITEP, SERP)                 | REFID=40580 |
| FALVARD       | 88  | PR D38 2706                  | A. Falvard <i>et al.</i>              | (CLER, FRAS, LALO+)          | REFID=40576 |
| VOROBYEV      | 88  | SJNP 48 273                  | P.V. Vorobiev <i>et al.</i>           | (NOVO)                       | REFID=41023 |
|               |     | Translated from YAF 48 436.  |                                       |                              |             |
| AU            | 87  | PR D35 1633                  | K.L. Au, D. Morgan, M.R. Pennington   | (DURH, RAL)                  | REFID=40064 |
| AKESSON       | 86  | NP B264 154                  | T. Akesson <i>et al.</i>              | (Axial Field Spec. Collab.)  | REFID=21123 |
| ALDE          | 86D | NP B269 485                  | D.M. Alde <i>et al.</i>               | (BELG, LAPP, SERP, CERN+)    | REFID=20765 |
| LONGACRE      | 86  | PL B177 223                  | R.S. Longacre <i>et al.</i>           | (BNL, BRAN, CUNY+)           | REFID=20768 |
| BINON         | 84C | NC 80A 363                   | F.G. Binon <i>et al.</i>              | (BELG, LAPP, SERP+)          | REFID=21418 |
| BINON         | 83  | NC 78A 313                   | F.G. Binon <i>et al.</i>              | (BELG, LAPP, SERP+)          | REFID=20750 |
| CASON         | 83  | PR D28 1586                  | N.M. Cason <i>et al.</i>              | (NDAM, ANL)                  | REFID=20752 |
| ETKIN         | 82B | PR D25 1786                  | A. Etkin <i>et al.</i>                | (BNL, CUNY, TUFTS, VAND)     | REFID=20390 |
| WICKLUND      | 80  | PRL 45 1469                  | A.B. Wicklund <i>et al.</i>           | (ANL)                        | REFID=20383 |
| BECKER        | 79  | NP B151 46                   | H. Becker <i>et al.</i>               | (MPIM, CERN, ZEEM, CRAC)     | REFID=21084 |
| POLYCHRO...   | 79  | PR D19 1317                  | V.A. Polychronakos <i>et al.</i>      | (NDAM, ANL)                  | REFID=20378 |
| FROGGATT      | 77  | NP B129 89                   | C.D. Froggatt, J.L. Petersen          | (GLAS, NORD)                 | REFID=21072 |
| ROSSELET      | 77  | PR D15 574                   | L. Rosselet <i>et al.</i>             | (GEVA, SACL)                 | REFID=11004 |
| HYAMS         | 75  | NP B100 205                  | B.D. Hyams <i>et al.</i>              | (CERN, MPIM)                 | REFID=20355 |
| GRAYER        | 74  | NP B75 189                   | G. Grayer <i>et al.</i>               | (CERN, MPIM)                 | REFID=20113 |
| HYAMS         | 73  | NP B64 134                   | B.D. Hyams <i>et al.</i>              | (CERN, MPIM)                 | REFID=20107 |
| OCHS          | 73  | Thesis                       | W. Ochs                               | (MPIM, MUNI)                 | REFID=20349 |
| BEIER         | 72B | PRL 29 511                   | E.W. Beier <i>et al.</i>              | (PENN)                       | REFID=44530 |
| BETTINI       | 66  | NC 42A 695                   | A. Bettini <i>et al.</i>              | (PADO, PISA)                 | REFID=21361 |

**$\pi_1(1400)$** 

$$I^G(J^{PC}) = 1^-(1^-+)$$

See the review on "Non- $q\bar{q}$  Mesons" and a note in PDG 06, Journal of Physics **G33** 1 (2006).

NODE=M111

NODE=M111

NODE=M111M

NODE=M111M

 **$\pi_1(1400)$  MASS**

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID                                                 | TECN | CHG    | COMMENT                                      |
|-------------------------------------------------------------------------------|-------|-------------------------------------------------------------|------|--------|----------------------------------------------|
| <b>1354 ±25 OUR AVERAGE</b>                                                   |       | Error includes scale factor of 1.8. See the ideogram below. |      |        |                                              |
| 1257 ±20 ±25                                                                  | 23.5k | ADAMS                                                       | 07B  | B852   | $18 \pi^- p \rightarrow \eta \pi^0 n$        |
| 1384 ±20 ±35                                                                  | 90k   | SALVINI                                                     | 04   | OBLX   | $\bar{p} p \rightarrow 2\pi^+ 2\pi^-$        |
| 1360 ±25                                                                      |       | ABELE                                                       | 99   | CBAR   | $0.0 \bar{p} p \rightarrow \pi^0 \pi^0 \eta$ |
| 1400 ±20 ±20                                                                  |       | ABELE                                                       | 98B  | CBAR   | $0.0 \bar{p} n \rightarrow \pi^- \pi^0 \eta$ |
| 1370 ±16 $^{+50}_{-30}$                                                       |       | <sup>1</sup> THOMPSON                                       | 97   | MPS    | $18 \pi^- p \rightarrow \eta \pi^- p$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                                                             |      |        |                                              |
| 1404.7 ± 3.5 $^{+15.1}_{-17.7}$                                               |       | <sup>2</sup> ALBRECHT                                       | 20   | RVUE   | $0.9 \bar{p} p \rightarrow \pi^0 \pi^0 \eta$ |
| 1323.1 ± 4.6                                                                  |       | <sup>3</sup> AOYAGI                                         | 93   | BKEI   | $\pi^- p \rightarrow \eta \pi^- p$           |
| 1406 ±20                                                                      |       | <sup>4</sup> ALDE                                           | 88B  | GAM4 0 | $100 \pi^- p \rightarrow \eta \pi^0 n$       |

<sup>1</sup> Natural parity exchange, questioned by DZIERBA 03.

<sup>2</sup> T-matrix pole, 1 pole, 2 channels ( $\pi\eta$ ,  $\pi\eta'$  for unitarity).

<sup>3</sup> Unnatural parity exchange.

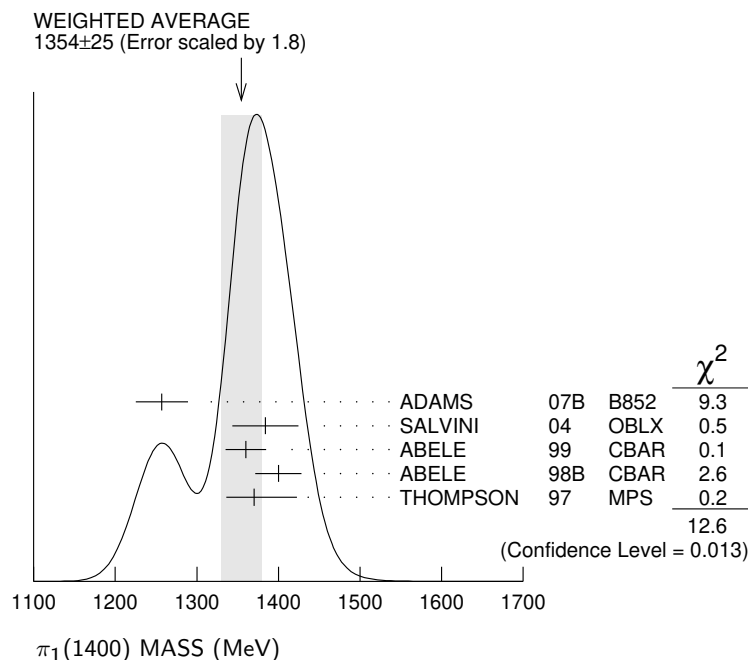
<sup>4</sup> Seen in the  $P_0$ -wave intensity of the  $\eta\pi^0$  system, unnatural parity exchange.

NODE=M111M;LINKAGE=B

NODE=M111M;LINKAGE=E

NODE=M111M;LINKAGE=C

NODE=M111M;LINKAGE=A

 **$\pi_1(1400)$  WIDTH**

NODE=M111W

NODE=M111W

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID           | TECN | CHG    | COMMENT                                      |
|-------------------------------------------------------------------------------|-------|-----------------------|------|--------|----------------------------------------------|
| <b>330 ±35 OUR AVERAGE</b>                                                    |       |                       |      |        |                                              |
| 354 ±64 ±58                                                                   | 23.5k | ADAMS                 | 07B  | B852   | $18 \pi^- p \rightarrow \eta \pi^0 n$        |
| 378 ±50 ±50                                                                   | 90k   | SALVINI               | 04   | OBLX   | $\bar{p} p \rightarrow 2\pi^+ 2\pi^-$        |
| 220 ±90                                                                       |       | ABELE                 | 99   | CBAR   | $0.0 \bar{p} p \rightarrow \pi^0 \pi^0 \eta$ |
| 310 ±50 $^{+50}_{-30}$                                                        |       | ABELE                 | 98B  | CBAR   | $0.0 \bar{p} n \rightarrow \pi^- \pi^0 \eta$ |
| 385 ±40 $^{+65}_{-105}$                                                       |       | <sup>1</sup> THOMPSON | 97   | MPS    | $18 \pi^- p \rightarrow \eta \pi^- p$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                       |      |        |                                              |
| 628.3 ±27.1 $^{+35.8}_{-138.2}$                                               |       | <sup>2</sup> ALBRECHT | 20   | RVUE   | $0.9 \bar{p} p \rightarrow \pi^0 \pi^0 \eta$ |
| 143.2 ±12.5                                                                   |       | <sup>3</sup> AOYAGI   | 93   | BKEI   | $\pi^- p \rightarrow \eta \pi^- p$           |
| 180 ±20                                                                       |       | <sup>4</sup> ALDE     | 88B  | GAM4 0 | $100 \pi^- p \rightarrow \eta \pi^0 n$       |

<sup>1</sup> Resolution is not unfolded, natural parity exchange, questioned by DZIERBA 03.

<sup>2</sup> T-matrix pole, 1 pole, 2 channels ( $\pi\eta$ ,  $\pi\eta'$  for unitarity).

<sup>3</sup> Unnatural parity exchange.

<sup>4</sup> Seen in the  $P_0$ -wave intensity of the  $\eta\pi^0$  system, unnatural parity exchange.

NODE=M111W;LINKAGE=QQ

NODE=M111W;LINKAGE=B

NODE=M111W;LINKAGE=C

NODE=M111W;LINKAGE=A

NODE=M111215;NODE=M111

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=4;OUR EST;→ UNCHECKED ←

DESIG=3

DESIG=5

NODE=M111220

NODE=M111R1

NODE=M111R1

NODE=M111R1;LINKAGE=C

NODE=M111R1;LINKAGE=B

NODE=M111R4

NODE=M111R4

NODE=M111R3

NODE=M111R3

NODE=M111R00

NODE=M111R00

NODE=M111

REFID=60439

REFID=59471

REFID=52048

REFID=51004

REFID=53226

REFID=49412

REFID=46602

REFID=45864

REFID=45584

REFID=44619

REFID=44078

REFID=43599

REFID=43598

REFID=41751

REFID=40558

REFID=22913

## $\pi_1(1400)$ DECAY MODES

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad \eta\pi^0$    | seen                           |
| $\Gamma_2 \quad \eta\pi^-$    | seen                           |
| $\Gamma_3 \quad \eta'\pi$     |                                |
| $\Gamma_4 \quad \rho(770)\pi$ | not seen                       |

## $\pi_1(1400)$ BRANCHING RATIOS

| $\Gamma(\eta\pi^0)/\Gamma_{\text{total}}$                                     |                   |      |        |                                       | $\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------|-------------------|------|--------|---------------------------------------|-------------------|
| VALUE                                                                         | DOCUMENT ID       | TECN | CHG    | COMMENT                               |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                   |      |        |                                       |                   |
| not seen                                                                      | PROKOSHKIN 95B    | GAM4 |        | $100 \pi^- p \rightarrow \eta\pi^0 n$ |                   |
| not seen                                                                      | <sup>1</sup> BUGG | 94   | RVUE   | $\bar{p}p \rightarrow \eta 2\pi^0$    |                   |
| not seen                                                                      | <sup>2</sup> APEL | 81   | NICE 0 | $40 \pi^- p \rightarrow \eta\pi^0 n$  |                   |

<sup>1</sup> Using Crystal Barrel data.

<sup>2</sup> A general fit allowing  $S$ ,  $D$ , and  $P$  waves (including  $m=0$ ) is not done because of limited statistics.

| $\Gamma(\eta\pi^-)/\Gamma_{\text{total}}$                                     |              |      |         |                                     | $\Gamma_2/\Gamma$ |
|-------------------------------------------------------------------------------|--------------|------|---------|-------------------------------------|-------------------|
| VALUE                                                                         | DOCUMENT ID  | TECN | COMMENT |                                     |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |      |         |                                     |                   |
| possibly seen                                                                 | BELADIDZE 93 | VES  |         | $37\pi^- N \rightarrow \eta\pi^- N$ |                   |

| $\Gamma(\eta'\pi)/\Gamma(\eta\pi^0)$                                          |     |              |      |                                     | $\Gamma_3/\Gamma_1$ |
|-------------------------------------------------------------------------------|-----|--------------|------|-------------------------------------|---------------------|
| VALUE                                                                         | CL% | DOCUMENT ID  | TECN | COMMENT                             |                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |              |      |                                     |                     |
| <0.80                                                                         | 95  | BOUTEMEUR 90 | GAM4 | $100 \pi^- p \rightarrow 4\gamma n$ |                     |

| $\Gamma(\rho(770)\pi)/\Gamma_{\text{total}}$ |              |      |         |                                           | $\Gamma_4/\Gamma$ |
|----------------------------------------------|--------------|------|---------|-------------------------------------------|-------------------|
| VALUE                                        | DOCUMENT ID  | TECN | COMMENT |                                           |                   |
| not seen                                     | AGHASYAN 18B | COMP | 190     | $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ |                   |

## $\pi_1(1400)$ REFERENCES

|            |     |                             |                                |                                |
|------------|-----|-----------------------------|--------------------------------|--------------------------------|
| ALBRECHT   | 20  | EPJ C80 453                 | M. Albrecht <i>et al.</i>      | (Crystal Barrel Collab.)       |
| AGHASYAN   | 18B | PR D98 092003               | M. Aghasyan <i>et al.</i>      | (COMPASS Collab.)              |
| ADAMS      | 07B | PL B657 27                  | G.S. Adams <i>et al.</i>       | (BNL E852 Collab.)             |
| PDG        | 06  | JP G33 1                    | W.-M. Yao <i>et al.</i>        | (PDG Collab.)                  |
| SALVINI    | 04  | EPJ C35 21                  | P. Salvini <i>et al.</i>       | (OBELIX Collab.)               |
| DZIERBA    | 03  | PR D67 094015               | A.R. Dzierba <i>et al.</i>     |                                |
| ABELE      | 99  | PL B446 349                 | A. Abele <i>et al.</i>         | (Crystal Barrel Collab.)       |
| ABELE      | 98B | PL B423 175                 | A. Abele <i>et al.</i>         | (Crystal Barrel Collab.)       |
| THOMPSON   | 97  | PRL 79 1630                 | D.R. Thompson <i>et al.</i>    | (BNL E852 Collab.)             |
| PROKOSHKIN | 95B | PAN 58 606                  | Y.D. Prokoshkin, S.A. Sadovsky | (SERP)                         |
|            |     | Translated from YAF 58 662. |                                |                                |
| BUGG       | 94  | PR D50 4412                 | D.V. Bugg <i>et al.</i>        | (LOQM)                         |
| AOYAGI     | 93  | PL B314 246                 | H. Aoyagi <i>et al.</i>        | (BKEI Collab.)                 |
| BELADIDZE  | 93  | PL B313 276                 | G.M. Beladidze <i>et al.</i>   | (VES Collab.)                  |
| BOUTEMEUR  | 90  | Hadron 89 Conf. p 119       | M. Boutemeur, M. Poulet        | (SERP, BELG, LANL+)            |
| ALDE       | 88B | PL B205 397                 | D.M. Alde <i>et al.</i>        | (SERP, BELG, LANL, LAPP) IGJPC |
| APEL       | 81  | NP B193 269                 | W.D. Apel <i>et al.</i>        | (SERP, CERN)                   |

**$\eta(1405)$** 

$$J^G(J^{PC}) = 0^+(0^{-+})$$

See also the  $\eta(1475)$ .

See the related review(s):

Pseudoscalar and Pseudovector Mesons in the 1400 MeV Region

NODE=M027

NODE=M027

 **$\eta(1405)$  MASS**

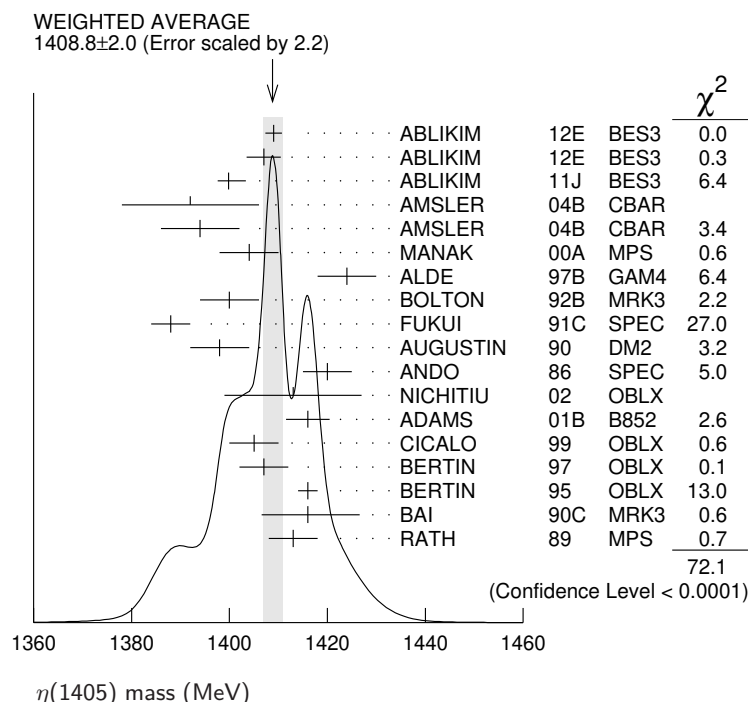
NODE=M027205

NODE=M027MX

VALUE (MeV)

DOCUMENT ID

**1408.8 $\pm$ 2.0 OUR AVERAGE** Includes data from the 2 datablocks that follow this one.  
Error includes scale factor of 2.2. See the ideogram below.

 **$\eta\pi\pi$  MODE**

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

COMMENT

The data in this block is included in the average printed for a previous datablock.

NODE=M027M1

NODE=M027M1

**1405.8 $\pm$  2.6 OUR AVERAGE** Error includes scale factor of 2.3. See the ideogram below.

|                                                                               |                |            |     |       |                                                   |
|-------------------------------------------------------------------------------|----------------|------------|-----|-------|---------------------------------------------------|
| 1409.0 $\pm$ 1.7                                                              | 743            | ABLIKIM    | 12E | BES3  | $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^0)$      |
| 1407.0 $\pm$ 3.5                                                              | 198            | ABLIKIM    | 12E | BES3  | $J/\psi \rightarrow \gamma(\pi^0\pi^0\pi^0)$      |
| 1399.8 $\pm$ 2.2 $^{+2.8}_{-0.1}$                                             | 1              | ABLIKIM    | 11J | BES3  | $J/\psi \rightarrow \omega(\eta\pi^+\pi^-)$       |
| 1392 $\pm$ 14                                                                 | 900 $\pm$ 375  | AMSLER     | 04B | CBAR  | $0 \bar{p}p \rightarrow \pi^+\pi^-\pi^+\pi^-\eta$ |
| 1394 $\pm$ 8                                                                  | 6.6 $\pm$ 2.0k | AMSLER     | 04B | CBAR  | $0 \bar{p}p \rightarrow \pi^+\pi^-\pi^0\pi^0\eta$ |
| 1404 $\pm$ 6                                                                  | 9082           | MANAK      | 00A | MPS   | $18 \pi^-p \rightarrow \eta\pi^+\pi^-n$           |
| 1424 $\pm$ 6                                                                  | 2200           | ALDE       | 97B | GAM4  | $100 \pi^-p \rightarrow \eta\pi^0\pi^0n$          |
| 1400 $\pm$ 6                                                                  |                | 2 BOLTON   | 92B | MRK3  | $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$         |
| 1388 $\pm$ 4                                                                  |                | FUKUI      | 91C | SPEC  | $8.95 \pi^-p \rightarrow \eta\pi^+\pi^-n$         |
| 1398 $\pm$ 6                                                                  | 261            | 3 AUGUSTIN | 90  | DM2   | $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$         |
| 1420 $\pm$ 5                                                                  |                | ANDO       | 86  | SPEC  | $8 \pi^-p \rightarrow \eta\pi^+\pi^-n$            |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                |            |     |       |                                                   |
| 1404.0 $\pm$ 11.0                                                             | 195            | ABLIKIM    | 19B | ABES3 | $e^+e^- \rightarrow \psi(2S)$                     |
| 1385 $\pm$ 7                                                                  |                | BAI        | 99  | BES   | $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$         |
| 1409 $\pm$ 3                                                                  | 4              | AMSLER     | 95F | CBAR  | $0 \bar{p}p \rightarrow \pi^+\pi^-\pi^0\pi^0\eta$ |

OCCUR=2

OCCUR=2

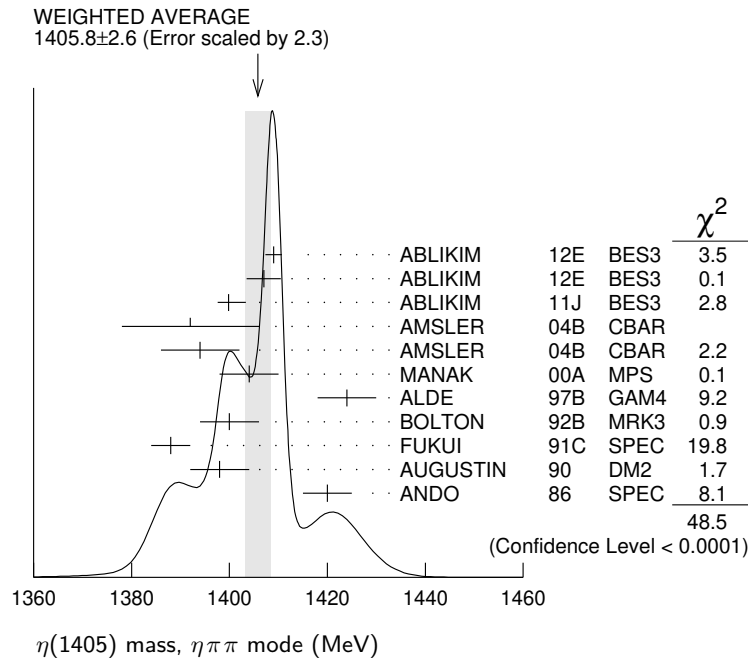
<sup>1</sup> The selected process is  $J/\psi \rightarrow \omega a_0(980)\pi$ .<sup>2</sup> From fit to the  $a_0(980)\pi 0^-+$  partial wave.<sup>3</sup> Best fit with a single Breit Wigner.<sup>4</sup> Superseded by AMSLER 04B.

NODE=M027M1;LINKAGE=BL

NODE=M027M1;LINKAGE=J1

NODE=M027M1;LINKAGE=A1

NODE=M027M1;LINKAGE=A



### $K\bar{K}\pi$ MODE ( $a_0(980)\pi$ or direct $K\bar{K}\pi$ )

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

The data in this block is included in the average printed for a previous datablock.

**1413.9± 1.7 OUR AVERAGE** Error includes scale factor of 1.1.

|                                                           |      |                       |          |                                                          |
|-----------------------------------------------------------|------|-----------------------|----------|----------------------------------------------------------|
| 1413 ± 14                                                 | 3651 | <sup>1</sup> NICHITIU | 02 OBLX  | 0 $\bar{p}p \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$       |
| 1416 ± 4 ± 2                                              | 20k  | ADAMS                 | 01B B852 | 18 GeV $\pi^- p \rightarrow K^+ K^- \pi^0 n$             |
| 1405 ± 5                                                  |      | <sup>2</sup> CICALO   | 99 OBLX  | 0 $\bar{p}p \rightarrow K^\pm K_S^0 \pi^\mp \pi^+ \pi^-$ |
| 1407 ± 5                                                  |      | <sup>2</sup> BERTIN   | 97 OBLX  | 0 $\bar{p}p \rightarrow K^\pm (K^0) \pi^\mp \pi^+ \pi^-$ |
| 1416 ± 2                                                  |      | <sup>2</sup> BERTIN   | 95 OBLX  | 0 $\bar{p}p \rightarrow K\bar{K}\pi\pi\pi$               |
| 1416 ± 8 $\begin{smallmatrix} +7 \\ -5 \end{smallmatrix}$ | 700  | <sup>3</sup> BAI      | 90C MRK3 | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$          |
| 1413 ± 5                                                  |      | <sup>3</sup> RATH     | 89 MPS   | 21.4 $\pi^- p \rightarrow n K_S^0 K_S^0 \pi^0$           |

NODE=M027M4  
NODE=M027M4

OCCUR=2

OCCUR=3

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |  |                       |        |                                         |
|----------|--|-----------------------|--------|-----------------------------------------|
| 1459 ± 5 |  | <sup>4</sup> AUGUSTIN | 92 DM2 | $J/\psi \rightarrow \gamma K\bar{K}\pi$ |
|----------|--|-----------------------|--------|-----------------------------------------|

<sup>1</sup> Decaying dominantly directly to  $K^+ K^- \pi^0$ .

<sup>2</sup> Decaying into  $(K\bar{K})_S \pi$ ,  $(K\pi)_S \bar{K}$ , and  $a_0(980)\pi$ .

<sup>3</sup> From fit to the  $a_0(980)\pi 0^-$  partial wave. Cannot rule out a  $a_0(980)\pi 1^+$  partial wave.

<sup>4</sup> Excluded from averaging because averaging would be meaningless.

NODE=M027M;LINKAGE=NC  
NODE=M027M4;LINKAGE=FX  
NODE=M027M4;LINKAGE=C2

NODE=M027M4;LINKAGE=AA

### $\pi\pi\gamma$ MODE

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

**1403±17 OUR AVERAGE** Error includes scale factor of 1.8.

|            |          |        |          |                                                       |
|------------|----------|--------|----------|-------------------------------------------------------|
| 1390±12    | 235 ± 91 | AMSLER | 04B CBAR | 0 $\bar{p}p \rightarrow \pi^+ \pi^- \pi^+ \pi^- \eta$ |
| 1424±10±11 | 547      | BAI    | 04J BES2 | $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$           |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |  |                         |         |                                               |
|---------|--|-------------------------|---------|-----------------------------------------------|
| 1401±18 |  | <sup>1,2</sup> AUGUSTIN | 90 DM2  | $J/\psi \rightarrow \pi^+ \pi^- \gamma\gamma$ |
| 1432± 8 |  | <sup>2</sup> COFFMAN    | 90 MRK3 | $J/\psi \rightarrow \pi^+ \pi^- 2\gamma$      |

OCCUR=4

<sup>1</sup> Best fit with a single Breit Wigner.

<sup>2</sup> This peak in the  $\gamma\rho$  channel may not be related to the  $\eta(1405)$ .

NODE=M027M2;LINKAGE=E  
NODE=M027M2;LINKAGE=X

### $4\pi$ MODE

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |      |                      |         |                                                 |
|---------|------|----------------------|---------|-------------------------------------------------|
| 1420±20 |      | BUGG                 | 95 MRK3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$ |
| 1489±12 | 3270 | <sup>1</sup> BISELLO | 89B DM2 | $J/\psi \rightarrow 4\pi\gamma$                 |

<sup>1</sup> Estimated by us from various fits.

NODE=M027M3  
NODE=M027M3

NODE=M027M3;LINKAGE=E

**$K\bar{K}\pi$  MODE (unresolved)**

| VALUE (MeV)                                                                   | EVTs         | DOCUMENT ID            | TECN     | COMMENT                                                   |
|-------------------------------------------------------------------------------|--------------|------------------------|----------|-----------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                        |          |                                                           |
| $1452.7 \pm 3.3$                                                              | 191          | <sup>1,2</sup> ABLIKIM | 13M BES3 | $\psi(2S) \rightarrow \omega K K \pi$                     |
| $1437.6 \pm 3.2$                                                              | $249 \pm 35$ | <sup>1,2</sup> ABLIKIM | 08E BES2 | $J/\psi \rightarrow \omega K_S^0 K^+ \pi^- + \text{c.c.}$ |
| $1445.9 \pm 5.7$                                                              | $62 \pm 18$  | <sup>1,2</sup> ABLIKIM | 08E BES2 | $J/\psi \rightarrow \omega K^+ K^- \pi^0$                 |
| $1442 \pm 10$                                                                 | 410          | <sup>1</sup> BAI       | 98C BES  | $J/\psi \rightarrow \gamma K^+ K^- \pi^0$                 |
| $1445 \pm 8$                                                                  | 693          | <sup>1</sup> AUGUSTIN  | 90 DM2   | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$           |
| $1433 \pm 8$                                                                  | 296          | <sup>1</sup> AUGUSTIN  | 90 DM2   | $J/\psi \rightarrow \gamma K^+ K^- \pi^0$                 |
| $1413 \pm 8$                                                                  | 500          | <sup>1</sup> DUCH      | 89 ASTE  | $\bar{p}p \rightarrow \pi^+ \pi^- K^\pm \pi^\mp K^0$      |
| $1453 \pm 7$                                                                  | 170          | <sup>1</sup> RATH      | 89 MPS   | $21.4 \pi^- p \rightarrow K_S^0 K_S^0 \pi^0 n$            |
| $1419 \pm 1$                                                                  | 8800         | <sup>1</sup> BIRMAN    | 88 MPS   | $8 \pi^- p \rightarrow K^+ \bar{K}^0 \pi^- n$             |
| $1424 \pm 3$                                                                  | 620          | <sup>1</sup> REEVES    | 86 SPEC  | $6.6 p\bar{p} \rightarrow K\bar{K}\pi X$                  |
| $1421 \pm 2$                                                                  |              | <sup>1</sup> CHUNG     | 85 SPEC  | $8 \pi^- p \rightarrow K\bar{K}\pi n$                     |
| $1440^{+20}_{-15}$                                                            | 174          | <sup>1</sup> EDWARDS   | 82E CBAL | $J/\psi \rightarrow \gamma K^+ K^- \pi^0$                 |
| $1440^{+10}_{-15}$                                                            |              | <sup>1</sup> SCHARRE   | 80 MRK2  | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$           |
| $1425 \pm 7$                                                                  | 800          | <sup>1,3</sup> BAILLON | 67 HBC   | $0 \bar{p}p \rightarrow K\bar{K}\pi\pi\pi$                |

<sup>1</sup> These experiments identify only one pseudoscalar in the 1400–1500 range. Data could also refer to  $\eta(1475)$ .

<sup>2</sup> Systematic uncertainty not evaluated.

<sup>3</sup> From best fit of  $0^-+$  partial wave, 50%  $K^*(892)K$ , 50%  $a_0(980)\pi$ .

NODE=M027M6  
NODE=M027M6

OCCUR=2

OCCUR=2

OCCUR=2

NODE=M027M;LINKAGE=NP

NODE=M027M;LINKAGE=NS  
NODE=M027M6;LINKAGE=H

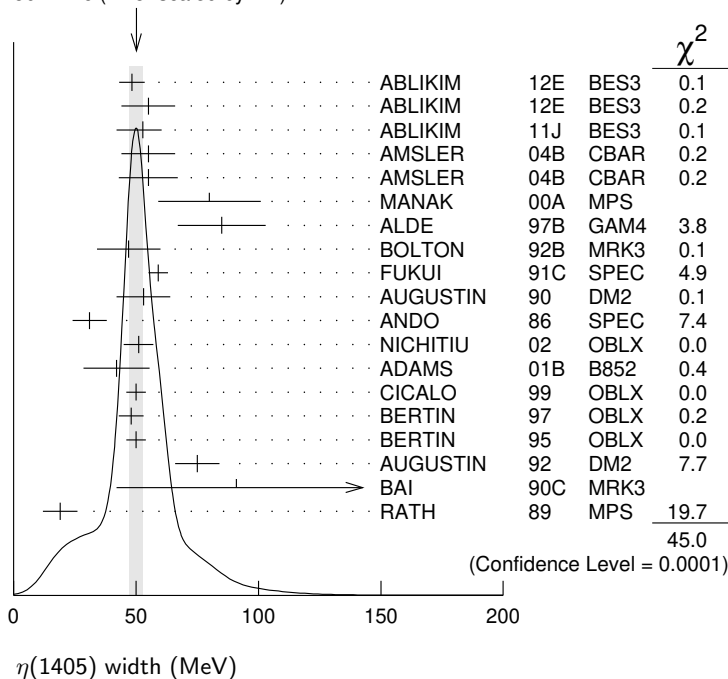
 **$\eta(1405)$  WIDTH**

NODE=M027210

VALUE (MeV) DOCUMENT ID  
**50.1 $\pm$ 2.6 OUR AVERAGE** Includes data from the 2 datablocks that follow this one. Error includes scale factor of 1.7. See the ideogram below.

NODE=M027WX

WEIGHTED AVERAGE  
50.1 $\pm$ 2.6 (Error scaled by 1.7)

 **$\eta\pi\pi$  MODE**

VALUE (MeV) EVTs DOCUMENT ID TECN COMMENT  
The data in this block is included in the average printed for a previous datablock.

NODE=M027W1  
NODE=M027W1

**52.6 $\pm$  3.2 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

|                              |     |                      |          |                                                       |
|------------------------------|-----|----------------------|----------|-------------------------------------------------------|
| $48.3 \pm 5.2$               | 743 | ABLIKIM              | 12E BES3 | $J/\psi \rightarrow \gamma(\pi^+ \pi^- \pi^0)$        |
| $55.0 \pm 11.0$              | 198 | ABLIKIM              | 12E BES3 | $J/\psi \rightarrow \gamma(\pi^0 \pi^0 \pi^0)$        |
| $52.8 \pm 7.6^{+0.1}_{-7.6}$ |     | <sup>1</sup> ABLIKIM | 11J BES3 | $J/\psi \rightarrow \omega(\eta \pi^+ \pi^-)$         |
| $55 \pm 11$                  | 900 | AMSLER               | 04B CBAR | $0 \bar{p}p \rightarrow \pi^+ \pi^- \pi^+ \pi^- \eta$ |

OCCUR=2

|        |      |                       |          |                                                          |
|--------|------|-----------------------|----------|----------------------------------------------------------|
| 55 ±12 | 6.6k | AMSLER                | 04B CBAR | $0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0 \pi^0 \gamma$ |
| 80 ±21 | 9.0k | MANAK                 | 00A MPS  | $18 \pi^- p \rightarrow \eta \pi^+ \pi^- n$              |
| 85 ±18 | 2.2k | ALDE                  | 97B GAM4 | $100 \pi^- p \rightarrow \eta \pi^0 \pi^0 n$             |
| 47 ±13 |      | <sup>2</sup> BOLTON   | 92B MRK3 | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$             |
| 59 ± 4 |      | FUKUI                 | 91C SPEC | $8.95 \pi^- p \rightarrow \eta \pi^+ \pi^- n$            |
| 53 ±11 |      | <sup>3</sup> AUGUSTIN | 90 DM2   | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$             |
| 31 ± 7 |      | ANDO                  | 86 SPEC  | $8 \pi^- p \rightarrow \eta \pi^+ \pi^- n$               |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |     |                     |           |                                                        |
|-----------|-----|---------------------|-----------|--------------------------------------------------------|
| 79.0±16.0 | 195 | ABLIKIM             | 19BA BES3 | $e^+ e^- \rightarrow \psi(2S)$                         |
| 86 ±10    |     | <sup>4</sup> AMSLER | 95F CBAR  | $0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0 \pi^0 \eta$ |

<sup>1</sup> The selected process is  $J/\psi \rightarrow \omega a_0(980) \pi$ .

<sup>2</sup> From fit to the  $a_0(980) \pi^0 \pi^+$  partial wave.

<sup>3</sup> From  $\eta \pi^+ \pi^-$  mass distribution - mainly  $a_0(980) \pi$  - no spin-parity determination available.

<sup>4</sup> Superseded by AMSLER 04B.

OCCUR=2

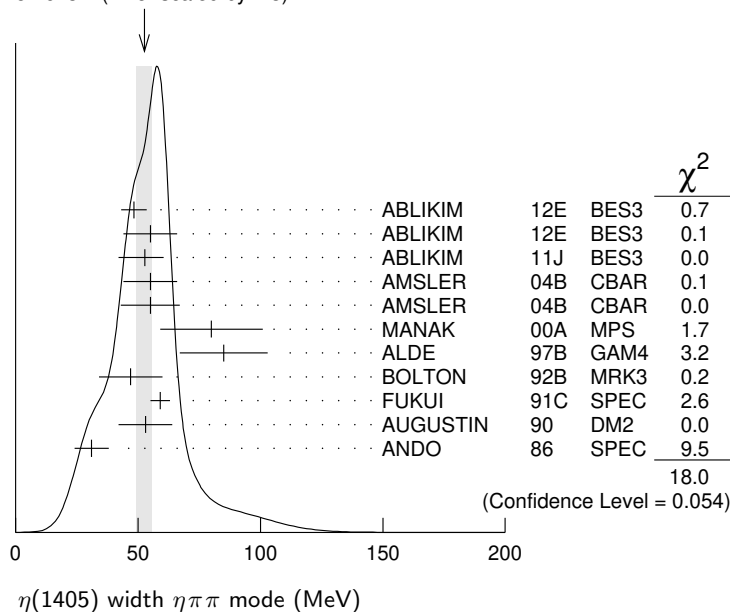
NODE=M027W1;LINKAGE=BL

NODE=M027W1;LINKAGE=A1

NODE=M027W1;LINKAGE=D1

NODE=M027W1;LINKAGE=A

WEIGHTED AVERAGE  
52.6±3.2 (Error scaled by 1.3)



### $K \bar{K} \pi$ MODE ( $a_0(980) \pi$ or direct $K \bar{K} \pi$ )

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

The data in this block is included in the average printed for a previous datablock.

**48± 4 OUR AVERAGE** Error includes scale factor of 2.1. See the ideogram below.

|                                |      |                       |          |                                                             |
|--------------------------------|------|-----------------------|----------|-------------------------------------------------------------|
| 51 ± 6                         | 3651 | <sup>1</sup> NICHITIU | 02 OBLX  | $0 \bar{p} p \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$         |
| 42±10± 9                       | 20k  | ADAMS                 | 01B B852 | $18 \text{ GeV } \pi^- p \rightarrow K^+ K^- \pi^0 n$       |
| 50 ± 4                         |      | CICALO                | 99 OBLX  | $0 \bar{p} p \rightarrow K^\pm K_S^0 \pi^\mp \pi^+ \pi^-$   |
| 48 ± 5                         |      | <sup>2</sup> BERTIN   | 97 OBLX  | $0.0 \bar{p} p \rightarrow K^\pm (K^0) \pi^\mp \pi^+ \pi^-$ |
| 50 ± 4                         |      | <sup>2</sup> BERTIN   | 95 OBLX  | $0 \bar{p} p \rightarrow K \bar{K} \pi \pi \pi$             |
| 75 ± 9                         |      | AUGUSTIN              | 92 DM2   | $J/\psi \rightarrow \gamma K \bar{K} \pi$                   |
| 91 <sup>+67+15</sup><br>-31-38 |      | <sup>3</sup> BAI      | 90C MRK3 | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$             |
| 19 ± 7                         |      | <sup>3</sup> RATH     | 89 MPS   | $21.4 \pi^- p \rightarrow n K_S^0 K_S^0 \pi^0$              |

<sup>1</sup> Decaying dominantly directly to  $K^+ K^- \pi^0$ .

<sup>2</sup> Decaying into  $(K \bar{K})_S \pi$ ,  $(K \pi)_S \bar{K}$ , and  $a_0(980) \pi$ .

<sup>3</sup> From fit to the  $a_0(980) \pi^0 \pi^+$  partial wave, but  $a_0(980) \pi^+ \pi^+$  cannot be excluded.

NODE=M027W4

NODE=M027W4

OCCUR=2

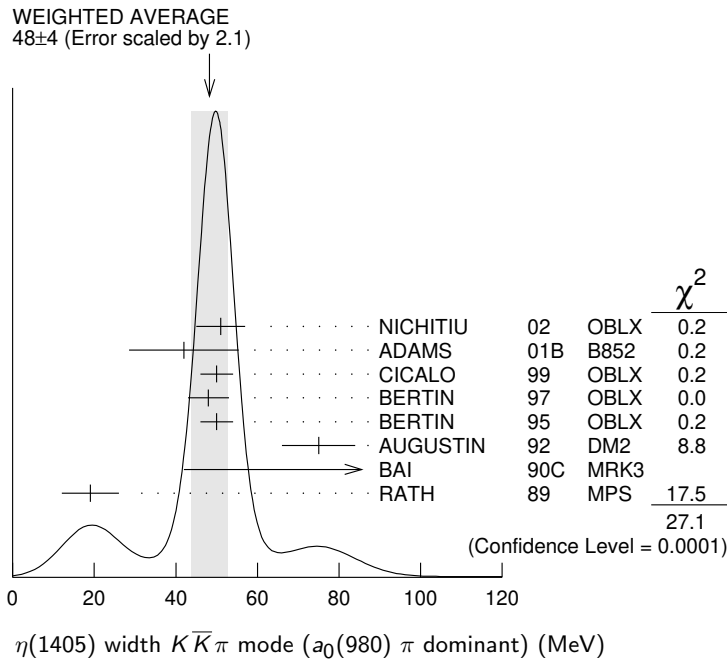
OCCUR=3

NODE=M027W;LINKAGE=NC

NODE=M027W4;LINKAGE=FX

NODE=M027W4;LINKAGE=C





### $\pi\pi\gamma$ MODE

| VALUE (MeV)    | EVTS               | DOCUMENT ID                         | TECN     | COMMENT                                            |
|----------------|--------------------|-------------------------------------|----------|----------------------------------------------------|
| <b>89 ±17</b>  | <b>OUR AVERAGE</b> | Error includes scale factor of 1.7. |          |                                                    |
| 64 ±18         | 235 ± 91           | AMSLER                              | 04B CBAR | $0\bar{p}p \rightarrow \pi^+\pi^-\pi^+\pi^-\gamma$ |
| 101.0± 8.8±8.8 | 547                | BAI                                 | 04J BES2 | $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$        |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |                      |    |      |                                             |
|---------|----------------------|----|------|---------------------------------------------|
| 174 ±44 | AUGUSTIN             | 90 | DM2  | $J/\psi \rightarrow \pi^+\pi^-\gamma\gamma$ |
| 90 ±26  | <sup>1</sup> COFFMAN | 90 | MRK3 | $J/\psi \rightarrow \pi^+\pi^-2\gamma$      |

<sup>1</sup> This peak in the  $\gamma\rho$  channel may not be related to the  $\eta(1405)$ .

NODE=M027W2  
NODE=M027W2

OCCUR=2

NODE=M027W2;LINKAGE=X

### $4\pi$ MODE

| VALUE (MeV) | EVTS | DOCUMENT ID          | TECN    | COMMENT                                         |
|-------------|------|----------------------|---------|-------------------------------------------------|
| 160±30      |      | BUGG                 | 95 MRK3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$ |
| 144±13      | 3270 | <sup>1</sup> BISELLO | 89B DM2 | $J/\psi \rightarrow 4\pi\gamma$                 |

<sup>1</sup> Estimated by us from various fits.

NODE=M027W3  
NODE=M027W3

NODE=M027W3;LINKAGE=F2

### $K\bar{K}\pi$ MODE (unresolved)

| VALUE (MeV)   | EVTS     | DOCUMENT ID            | TECN     | COMMENT                                            |
|---------------|----------|------------------------|----------|----------------------------------------------------|
| 45.9± 8.2     | 191      | <sup>1,2</sup> ABLIKIM | 13M BES3 | $\psi(2S) \rightarrow \omega K K \pi$              |
| 48.9± 9.0     | 249 ± 35 | <sup>1,2</sup> ABLIKIM | 08E BES2 | $J/\psi \rightarrow \omega K_S^0 K^+ \pi^- + c.c.$ |
| 34.2±18.5     | 62 ± 18  | <sup>1,2</sup> ABLIKIM | 08E BES2 | $J/\psi \rightarrow \omega K^+ K^- \pi^0$          |
| 93 ±14        | 296      | <sup>1</sup> AUGUSTIN  | 90 DM2   | $J/\psi \rightarrow \gamma K^+ K^- \pi^0$          |
| 105 ±10       | 693      | <sup>1</sup> AUGUSTIN  | 90 DM2   | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$    |
| 62 ±16        | 500      | <sup>1</sup> DUCH      | 89 ASTE  | $\bar{p}p \rightarrow K\bar{K}\pi\pi\pi$           |
| 100 ±11       | 170      | <sup>1</sup> RATH      | 89 MPS   | $21.4\pi^-p \rightarrow K_S^0 K_S^0 \pi^0 n$       |
| 66 ± 2        | 8800     | <sup>1</sup> BIRMAN    | 88 MPS   | $8\pi^-p \rightarrow K^+ \bar{K}^0 \pi^- n$        |
| 60 ±10        | 620      | <sup>1</sup> REEVES    | 86 SPEC  | $6.6 p\bar{p} \rightarrow K K \pi X$               |
| 60 ±10        |          | <sup>1</sup> CHUNG     | 85 SPEC  | $8\pi^-p \rightarrow K\bar{K}\pi n$                |
| 55 +20<br>-30 | 174      | <sup>1</sup> EDWARDS   | 82E CBAL | $J/\psi \rightarrow \gamma K^+ K^- \pi^0$          |
| 50 +30<br>-20 |          | <sup>1</sup> SCHARRE   | 80 MRK2  | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$    |
| 80 ±10        | 800      | <sup>1,3</sup> BAILLON | 67 HBC   | $0.0\bar{p}p \rightarrow K\bar{K}\pi\pi\pi$        |

<sup>1</sup> These experiments identify only one pseudoscalar in the 1400–1500 range. Data could also refer to  $\eta(1475)$ .

<sup>2</sup> Systematic uncertainty not evaluated.

<sup>3</sup> From best fit to  $0^- +$  partial wave, 50%  $K^*(892)K$ , 50%  $a_0(980)\pi$ .

NODE=M027W6  
NODE=M027W6

OCCUR=2

OCCUR=2

OCCUR=3

OCCUR=2

NODE=M027W;LINKAGE=NP

NODE=M027W;LINKAGE=NS

NODE=M027W6;LINKAGE=H1

**$\eta(1405)$  DECAY MODES**

NODE=M027215;NODE=M027

| Mode                                                   | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|--------------------------------------------------------|--------------------------------|------------------|
| $\Gamma_1$ $K\bar{K}\pi$                               | seen                           |                  |
| $\Gamma_2$ $\eta\pi\pi$                                | seen                           |                  |
| $\Gamma_3$ $a_0(980)\pi$                               | seen                           |                  |
| $\Gamma_4$ $\eta(\pi\pi)$ S-wave                       | seen                           |                  |
| $\Gamma_5$ $f_0(980)\pi^0 \rightarrow \pi^+\pi^-\pi^0$ | not seen                       |                  |
| $\Gamma_6$ $f_0(980)\eta$                              | seen                           |                  |
| $\Gamma_7$ $4\pi$                                      | seen                           |                  |
| $\Gamma_8$ $\rho\rho$                                  | <58 %                          | 99.85%           |
| $\Gamma_9$ $\gamma\gamma$                              |                                |                  |
| $\Gamma_{10}$ $\rho^0\gamma$                           | seen                           |                  |
| $\Gamma_{11}$ $\phi\gamma$                             |                                |                  |
| $\Gamma_{12}$ $K^*(892)K$                              | seen                           |                  |

DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=5;OUR EST;→ UNCHECKED ←  
DESIG=4;OUR EST;→ UNCHECKED ←  
DESIG=9;OUR EST;→ UNCHECKED ←  
DESIG=15  
DESIG=10;OUR EST;→ UNCHECKED ←  
DESIG=6;OUR EST;→ UNCHECKED ←  
DESIG=12  
DESIG=7  
DESIG=8;OUR EST;→ UNCHECKED ←  
DESIG=13  
DESIG=11;OUR EST;→ UNCHECKED ←

 **$\eta(1405) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

NODE=M027220

| $\Gamma(K\bar{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | $\Gamma_1\Gamma_9/\Gamma$ |
|-------------------------------------------------------------------------|---------------------------|
| VALUE (keV) CL% DOCUMENT ID TECN COMMENT                                |                           |

NODE=M027G3  
NODE=M027G3

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.035 90 1,2 AHOHE 05 CLE2 10.6  $e^+e^- \rightarrow e^+e^- K_S^0 K^\pm \pi^\mp$

<sup>1</sup> Using  $\eta(1405)$  mass and width 1410 MeV and 51 MeV, respectively.

<sup>2</sup> Assuming three-body phase-space decay to  $K_S^0 K^\pm \pi^\mp$ .

NODE=M027G3;LINKAGE=AH  
NODE=M027G3;LINKAGE=B3

| $\Gamma(\eta\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | $\Gamma_2\Gamma_9/\Gamma$ |
|------------------------------------------------------------------------|---------------------------|
| VALUE (keV) CL% DOCUMENT ID TECN COMMENT                               |                           |

NODE=M027G5  
NODE=M027G5

<0.095 95 ACCIARRI 01G L3 183–202  $e^+e^- \rightarrow e^+e^- \eta\pi^+\pi^-$

| $\Gamma(\rho^0\gamma) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | $\Gamma_{10}\Gamma_9/\Gamma$ |
|--------------------------------------------------------------------------|------------------------------|
| VALUE (keV) CL% DOCUMENT ID TECN COMMENT                                 |                              |

NODE=M027G8  
NODE=M027G8

• • • We do not use the following data for averages, fits, limits, etc. • • •

<1.5 95 ALTHOFF 84E TASS  $e^+e^- \rightarrow e^+e^- \pi^+\pi^-\gamma$

 **$\eta(1405)$  BRANCHING RATIOS**

NODE=M027225

| $\Gamma(\eta\pi\pi)/\Gamma(K\bar{K}\pi)$ | $\Gamma_2/\Gamma_1$ |
|------------------------------------------|---------------------|
| VALUE CL% DOCUMENT ID TECN COMMENT       |                     |

NODE=M027R3  
NODE=M027R3

1.09±0.48 <sup>1</sup> AMSLER 04B CBAR 0  $\bar{p}p \rightarrow \pi^+\pi^-\pi^+\pi^-\eta$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.5 90 EDWARDS 83B CBAL  $J/\psi \rightarrow \eta\pi\pi\gamma$

<1.1 90 SCHARRE 80 MRK2  $J/\psi \rightarrow \eta\pi\pi\gamma$

<1.5 95 FOSTER 68B HBC 0.0  $\bar{p}p$

<sup>1</sup> Using the data of BAILLON 67 on  $\bar{p}p \rightarrow K\bar{K}\pi$ .

NODE=M027R3;LINKAGE=AM

| $\Gamma(\rho^0\gamma)/\Gamma(\eta\pi\pi)$ | $\Gamma_{10}/\Gamma_2$ |
|-------------------------------------------|------------------------|
| VALUE DOCUMENT ID TECN COMMENT            |                        |

NODE=M027R12  
NODE=M027R12

0.111±0.064 AMSLER 04B CBAR 0  $\bar{p}p$

| $\Gamma(a_0(980)\pi)/\Gamma(K\bar{K}\pi)$ | $\Gamma_3/\Gamma_1$ |
|-------------------------------------------|---------------------|
| VALUE EVTS DOCUMENT ID TECN COMMENT       |                     |

NODE=M027R4  
NODE=M027R4

• • • We do not use the following data for averages, fits, limits, etc. • • •

~0.15 <sup>1</sup> BERTIN 95 OBLX 0  $\bar{p}p \rightarrow K\bar{K}\pi\pi\pi$

~0.8 500 <sup>1</sup> DUCH 89 ASTE  $\bar{p}p \rightarrow \pi^+\pi^-\pi^0\pi^\mp K^0$

~0.75 <sup>1</sup> REEVES 86 SPEC 6.6  $p\bar{p} \rightarrow K K \pi X$

<sup>1</sup> Assuming that the  $a_0(980)$  decays only into  $K\bar{K}$ .

NODE=M027R4;LINKAGE=C

| $\Gamma(a_0(980)\pi)/\Gamma(\eta\pi\pi)$ | $\Gamma_3/\Gamma_2$ |
|------------------------------------------|---------------------|
| VALUE EVTS DOCUMENT ID TECN COMMENT      |                     |

NODE=M027R2  
NODE=M027R2

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.29±0.10 ABELE 98E CBAR 0  $p\bar{p} \rightarrow \eta\pi^0\pi^0\pi^0$

0.19±0.04 2200 <sup>1</sup> ALDE 97B GAM4 100  $\pi^-\pi^+ \rightarrow \eta\pi^0\pi^0\pi^0$

0.56±0.04±0.03 <sup>1</sup> AMSLER 95F CBAR 0  $\bar{p}p \rightarrow \pi^+\pi^-\pi^0\pi^0\eta$

<sup>1</sup> Assuming that the  $a_0(980)$  decays only into  $\eta\pi$ .

NODE=M027R2;LINKAGE=A

$\Gamma(a_0(980)\pi)/\Gamma(\eta(\pi\pi)_{S\text{-wave}})$  $\Gamma_3/\Gamma_4$ 

| VALUE                                                                         | EVTs | DOCUMENT ID        | TECN | COMMENT                                                      |
|-------------------------------------------------------------------------------|------|--------------------|------|--------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                    |      |                                                              |
| $0.91 \pm 0.12$                                                               |      | ANISOVICH          | 01   | SPEC $0.0 \bar{p}p \rightarrow \eta \pi^+ \pi^- \pi^+ \pi^-$ |
| $0.15 \pm 0.04$                                                               | 9082 | <sup>1</sup> MANAK | 00A  | MPS $18 \pi^- p \rightarrow \eta \pi^+ \pi^- n$              |
| $0.70 \pm 0.12 \pm 0.20$                                                      |      | <sup>2</sup> BAI   | 99   | BES $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$             |

<sup>1</sup> Statistical error only.<sup>2</sup> Assuming that the  $a_0(980)$  decays only into  $\eta\pi$ .NODE=M027R9  
NODE=M027R9NODE=M027R;LINKAGE=K3  
NODE=M027R9;LINKAGE=BK $\Gamma(\rho^0\gamma)/\Gamma(K\bar{K}\pi)$  $\Gamma_{10}/\Gamma_1$ 

| VALUE                                                                                                                                                                                                                  | DOCUMENT ID          | TECN | COMMENT                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|-----------------------------------------------------|
| <b>0.0152 ± 0.0038</b>                                                                                                                                                                                                 | <sup>1</sup> COFFMAN | 90   | MRK3 $J/\psi \rightarrow \gamma \gamma \pi^+ \pi^-$ |
| <sup>1</sup> Using $B(J/\psi \rightarrow \gamma \eta(1405) \rightarrow \gamma K\bar{K}\pi) = 4.2 \times 10^{-3}$ and $B(J/\psi \rightarrow \gamma \eta(1405) \rightarrow \gamma \gamma \rho^0) = 6.4 \times 10^{-5}$ . |                      |      |                                                     |

NODE=M027R7  
NODE=M027R7

NODE=M027R7;LINKAGE=D

 $\Gamma(\gamma\gamma)/\Gamma(K\bar{K}\pi)$  $\Gamma_9/\Gamma_1$ 

| VALUE                                    | CL% | DOCUMENT ID          | TECN | COMMENT                                                      |
|------------------------------------------|-----|----------------------|------|--------------------------------------------------------------|
| <b>&lt; 1.78 × 10<sup>-3</sup></b>       | 90  | <sup>1</sup> ABLIKIM | 180  | BES3 $\psi(2S) \rightarrow \pi^+ \pi^- \gamma \gamma \gamma$ |
| <sup>1</sup> Using results from BAI 00D. |     |                      |      |                                                              |

NODE=M027R02  
NODE=M027R02

NODE=M027R02;LINKAGE=A

 $\Gamma(\eta(\pi\pi)_{S\text{-wave}})/\Gamma(\eta\pi\pi)$  $\Gamma_4/\Gamma_2$ 

| VALUE                                                                         | EVTs | DOCUMENT ID | TECN | COMMENT                                           |
|-------------------------------------------------------------------------------|------|-------------|------|---------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |      |                                                   |
| $0.81 \pm 0.04$                                                               | 2200 | ALDE        | 97B  | GAM4 $100 \pi^- p \rightarrow \eta \pi^0 \pi^0 n$ |

NODE=M027R8  
NODE=M027R8 $\Gamma(f_0(980)\eta)/\Gamma(\eta\pi\pi)$  $\Gamma_6/\Gamma_2$ 

| VALUE                                                                         | DOCUMENT ID            | TECN | COMMENT                                                 |
|-------------------------------------------------------------------------------|------------------------|------|---------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |                                                         |
| $0.32 \pm 0.07$                                                               | <sup>1</sup> ANISOVICH | 00   | SPEC $0.9\text{--}1.2 \bar{p}p \rightarrow \eta 3\pi^0$ |
| <sup>1</sup> Using preliminary Crystal Barrel data.                           |                        |      |                                                         |

NODE=M027R10  
NODE=M027R10

NODE=M027R10;LINKAGE=D

 $\Gamma(f_0(980)\pi^0 \rightarrow \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE                                                                                                                                                                      | DOCUMENT ID          | TECN | COMMENT                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|------------------------------------------------------|
| <b>not seen</b>                                                                                                                                                            | <sup>1</sup> ABLIKIM | 17AJ | BES3 $\psi(2S) \rightarrow \gamma \pi^+ \pi^- \pi^0$ |
| <sup>1</sup> ABLIKIM 17AJ reports $B(\psi(2S) \rightarrow \gamma \eta(1405) \rightarrow \gamma f_0(980)\pi^0 \rightarrow \gamma \pi^+ \pi^- \pi^0) < 5.0 \times 10^{-7}$ . |                      |      |                                                      |

NODE=M027R00  
NODE=M027R00

NODE=M027R00;LINKAGE=A

 $\Gamma(\rho\rho)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE                                                                                                                      | CL%   | DOCUMENT ID           | TECN | COMMENT           |
|----------------------------------------------------------------------------------------------------------------------------|-------|-----------------------|------|-------------------|
| <b>&lt; 0.58</b>                                                                                                           | 99.85 | <sup>1,2</sup> AMSLER | 04B  | CBAR $0 \bar{p}p$ |
| <sup>1</sup> Assuming that the $\eta(1405)$ decays are saturated by the $\pi\pi\eta$ , $K\bar{K}\pi$ and $\rho\rho$ modes. |       |                       |      |                   |
| <sup>2</sup> Using the data of BAILLON 67 on $\bar{p}p \rightarrow K\bar{K}\pi$ .                                          |       |                       |      |                   |

NODE=M027R13  
NODE=M027R13NODE=M027R13;LINKAGE=AM  
NODE=M027R13;LINKAGE=AS $\Gamma(K^*(892)K)/\Gamma(a_0(980)\pi)$  $\Gamma_{12}/\Gamma_3$ 

| VALUE                                                                         | DOCUMENT ID        | TECN | COMMENT                                                    |
|-------------------------------------------------------------------------------|--------------------|------|------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |      |                                                            |
| $0.084 \pm 0.024$                                                             | <sup>1</sup> ADAMS | 01B  | B852 $18 \text{ GeV } \pi^- p \rightarrow K^+ K^- \pi^0 n$ |
| <sup>1</sup> Statistical error only.                                          |                    |      |                                                            |

NODE=M027R11  
NODE=M027R11

NODE=M027R11;LINKAGE=K3

 $\Gamma(\phi\gamma)/\Gamma(\rho^0\gamma)$  $\Gamma_{11}/\Gamma_{10}$ 

| VALUE                                                                                                                                                                                                                                                  | CL% | DOCUMENT ID          | TECN | COMMENT                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|------|----------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                          |     |                      |      |                                                    |
| $0.09 \pm 0.03$                                                                                                                                                                                                                                        |     | <sup>1</sup> ABLIKIM | 18I  | BES3 $J/\psi \rightarrow \gamma \gamma \phi(1020)$ |
| $0.13 \pm 0.04$                                                                                                                                                                                                                                        |     | <sup>2</sup> ABLIKIM | 18I  | BES3 $J/\psi \rightarrow \gamma \gamma \phi(1020)$ |
| $< 0.77$                                                                                                                                                                                                                                               | 95  | <sup>3</sup> BAI     | 04J  | BES2 $J/\psi \rightarrow \gamma \gamma K^+ K^-$    |
| <sup>1</sup> Constructive interference between $X(1835)$ and $\eta(1405)/\eta(1475)$ decays to $\gamma\phi$ is assumed. Also see $\eta(1475)$ . ABLIKIM 18I reports the inverse as $11.10 \pm 3.5$ .                                                   |     |                      |      |                                                    |
| <sup>2</sup> Destructive interference between $X(1835)$ and $\eta(1405)/\eta(1475)$ decays to $\gamma\phi$ is assumed. Also see $\eta(1475)$ . ABLIKIM 18I reports the inverse as $7.53 \pm 2.49$ .                                                    |     |                      |      |                                                    |
| <sup>3</sup> Calculated by us from $B(J/\psi \rightarrow \eta(1405)\gamma \rightarrow \phi\gamma\gamma) < 0.82 \times 10^{-4}$ and $B(J/\psi \rightarrow \eta(1405)\gamma \rightarrow \rho^0\gamma\gamma) = (1.07 \pm 0.17 \pm 0.11) \times 10^{-4}$ . |     |                      |      |                                                    |

NODE=M027R14  
NODE=M027R14

OCCUR=2

NODE=M027R14;LINKAGE=A

NODE=M027R14;LINKAGE=B

NODE=M027R14;LINKAGE=BA

$\eta(1405)$  REFERENCES

NODE=M027

|           |      |                             |                              |                              |             |
|-----------|------|-----------------------------|------------------------------|------------------------------|-------------|
| ABLIKIM   | 19BA | PR D100 092003              | M. Ablikim <i>et al.</i>     | (BESIII Collab.)             | REFID=60024 |
| ABLIKIM   | 18I  | PR D97 051101               | M. Ablikim <i>et al.</i>     | (BESIII Collab.)             | REFID=58893 |
| ABLIKIM   | 18O  | PR D97 072014               | M. Ablikim <i>et al.</i>     | (BESIII Collab.)             | REFID=58925 |
| ABLIKIM   | 17AJ | PR D96 112008               | M. Ablikim <i>et al.</i>     | (BESIII Collab.)             | REFID=58322 |
| ABLIKIM   | 13M  | PR D87 092006               | M. Ablikim <i>et al.</i>     | (BESIII Collab.)             | REFID=55386 |
| ABLIKIM   | 12E  | PRL 108 182001              | M. Ablikim <i>et al.</i>     | (BESIII Collab.)             | REFID=54270 |
| ABLIKIM   | 11J  | PRL 107 182001              | M. Ablikim <i>et al.</i>     | (BESIII Collab.)             | REFID=53931 |
| ABLIKIM   | 08E  | PR D77 032005               | M. Ablikim <i>et al.</i>     | (BES Collab.)                | REFID=52143 |
| AHOHE     | 05   | PR D71 072001               | R. Ahohe <i>et al.</i>       | (CLEO Collab.)               | REFID=50764 |
| AMSLER    | 04B  | EPJ C33 23                  | C. Amsler <i>et al.</i>      | (Crystal Barrel Collab.)     | REFID=51079 |
| BAI       | 04J  | PL B594 47                  | J.Z. Bai <i>et al.</i>       | (BES Collab.)                | REFID=50167 |
| NICHITIU  | 02   | PL B545 261                 | F. Nichitiu <i>et al.</i>    | (OBELIX Collab.)             | REFID=48848 |
| ACCIARRI  | 01G  | PL B501 1                   | M. Acciarri <i>et al.</i>    | (L3 Collab.)                 | REFID=48319 |
| ADAMS     | 01B  | PL B516 264                 | G.S. Adams <i>et al.</i>     | (BNL E852 Collab.)           | REFID=49649 |
| ANISOVICH | 01   | NP A690 567                 | A.V. Anisovich <i>et al.</i> |                              | REFID=48308 |
| ANISOVICH | 00   | PL B472 168                 | A.V. Anisovich <i>et al.</i> |                              | REFID=47429 |
| BAI       | 00D  | PL B476 25                  | J.Z. Bai <i>et al.</i>       | (BES Collab.)                | REFID=47954 |
| MANAK     | 00A  | PR D62 012003               | J.J. Manak <i>et al.</i>     | (BNL E852 Collab.)           | REFID=47989 |
| BAI       | 99   | PL B446 356                 | J.Z. Bai <i>et al.</i>       | (BES Collab.)                | REFID=46606 |
| CICALO    | 99   | PL B462 453                 | C. Cicalo <i>et al.</i>      | (OBELIX Collab.)             | REFID=47394 |
| ABELE     | 98E  | NP B514 45                  | A. Abele <i>et al.</i>       | (Crystal Barrel Collab.)     | REFID=46314 |
| BAI       | 98C  | PL B440 217                 | J.Z. Bai <i>et al.</i>       | (BES Collab.)                | REFID=46337 |
| ALDE      | 97B  | PAN 60 386                  | D. Alde <i>et al.</i>        | (GAMS Collab.)               | REFID=45396 |
|           |      | Translated from YAF 60 458. |                              |                              |             |
| BERTIN    | 97   | PL B400 226                 | A. Bertin <i>et al.</i>      | (OBELIX Collab.)             | REFID=45417 |
| AMSLER    | 95F  | PL B358 389                 | C. Amsler <i>et al.</i>      | (Crystal Barrel Collab.)     | REFID=44613 |
| BERTIN    | 95   | PL B361 187                 | A. Bertin <i>et al.</i>      | (OBELIX Collab.)             | REFID=44614 |
| BUGG      | 95   | PL B353 378                 | D.V. Bugg <i>et al.</i>      | (LOQM, PNPI, WASH)           | REFID=44438 |
| AUGUSTIN  | 92   | PR D46 1951                 | J.E. Augustin, G. Cosme      | (DM2 Collab.)                | REFID=41584 |
| BOLTON    | 92B  | PRL 69 1328                 | T. Bolton <i>et al.</i>      | (Mark III Collab.)           | REFID=42176 |
| FUKUI     | 91C  | PL B267 293                 | S. Fukui <i>et al.</i>       | (SUGI, NAGO, KEK, KYOT+)     | REFID=41748 |
| AUGUSTIN  | 90   | PR D42 10                   | J.E. Augustin <i>et al.</i>  | (DM2 Collab.)                | REFID=41352 |
| BAI       | 90C  | PRL 65 2507                 | Z. Bai <i>et al.</i>         | (Mark III Collab.)           | REFID=41578 |
| COFFMAN   | 90   | PR D41 1410                 | D.M. Coffman <i>et al.</i>   | (Mark III Collab.)           | REFID=41350 |
| BISELLO   | 89B  | PR D39 701                  | G. Busetto <i>et al.</i>     | (DM2 Collab.)                | REFID=40575 |
| DUCH      | 89   | ZPHY C45 223                | K.D. Duch <i>et al.</i>      | (ASTERIX Collab.) JP         | REFID=41016 |
| RATH      | 89   | PR D40 693                  | M.G. Rath <i>et al.</i>      | (NDAM, BRAN, BNL, CUNY+)     | REFID=40924 |
| BIRMAN    | 88   | PRL 61 1557                 | A. Birman <i>et al.</i>      | (BNL, FSU, IND, MASD) JP     | REFID=40568 |
| ANDO      | 86   | PRL 57 1296                 | A. Ando <i>et al.</i>        | (KEK, KYOT, NIRS, SAGA+) IJP | REFID=20891 |
| REEVES    | 86   | PR D34 1960                 | D.F. Reeves <i>et al.</i>    | (FLOR, BNL, IND+) JP         | REFID=20936 |
| CHUNG     | 85   | PRL 55 779                  | S.U. Chung <i>et al.</i>     | (BNL, FLOR, IND+) JP         | REFID=20934 |
| ALTHOFF   | 84E  | PL 147B 487                 | M. Althoff <i>et al.</i>     | (TASSO Collab.)              | REFID=20305 |
| EDWARDS   | 83B  | PRL 51 859                  | C. Edwards <i>et al.</i>     | (CIT, HARV, PRIN+)           | REFID=21318 |
| EDWARDS   | 82E  | PRL 49 259                  | C. Edwards <i>et al.</i>     | (CIT, HARV, PRIN+)           | REFID=21314 |
| Also      |      | PRL 50 219                  | C. Edwards <i>et al.</i>     | (CIT, HARV, PRIN+)           | REFID=21315 |
| SCHARRE   | 80   | PL 97B 329                  | D.L. Scharre <i>et al.</i>   | (SLAC, LBL)                  | REFID=21329 |
| FOSTER    | 68B  | NP B8 174                   | M. Foster <i>et al.</i>      | (CERN, CDEF)                 | REFID=21179 |
| BAILLON   | 67   | NC 50A 393                  | P.H. Baillon <i>et al.</i>   | (CERN, CDEF, IRAD)           | REFID=20407 |

NODE=M109

**$h_1(1415)$**

$I^G(J^{PC}) = 0^-(1^{+-})$

was  $h_1(1380)$

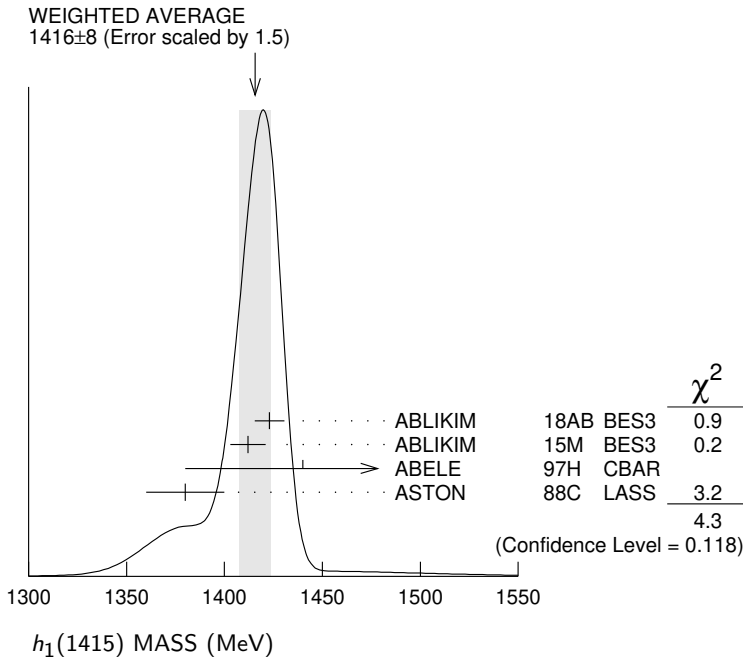
**$h_1(1415)$  MASS**

NODE=M109M

| VALUE (MeV)                                                           | EVTs               | DOCUMENT ID                                                 | TECN      | COMMENT                                                                                              |
|-----------------------------------------------------------------------|--------------------|-------------------------------------------------------------|-----------|------------------------------------------------------------------------------------------------------|
| <b>1416 ± 8</b>                                                       | <b>OUR AVERAGE</b> | Error includes scale factor of 1.5. See the ideogram below. |           |                                                                                                      |
| 1423 ± 2.1 ± 7.3                                                      | 2.2k               | <sup>1</sup> ABLIKIM                                        | 18AB BES3 | $J/\psi \rightarrow \eta' h_1 \rightarrow \eta' K^* \bar{K}$                                         |
| 1412 ± 4 ± 8                                                          |                    | <sup>1</sup> ABLIKIM                                        | 15M BES3  | $\psi(2S) \rightarrow \gamma \chi_{c1,2} \rightarrow$<br>$\gamma \phi (h_1 \rightarrow K^* \bar{K})$ |
| 1440 ± 60                                                             |                    | ABELE                                                       | 97H CBAR  | $\bar{p} p \rightarrow K_L^0 K_S^0 \pi^0 \pi^0$                                                      |
| 1380 ± 20                                                             |                    | ASTON                                                       | 88C LASS  | 11 $K^- p \rightarrow K_S^0 K^\pm \pi^\mp \Lambda$                                                   |
| <sup>1</sup> Final states $K^+ K^- \pi^0$ and $K_S^0 K^\pm \pi^\mp$ . |                    |                                                             |           |                                                                                                      |

NODE=M109M

NODE=M109M;LINKAGE=A



**$h_1(1415)$  WIDTH**

NODE=M109W

| VALUE (MeV)                                                           | EVTs               | DOCUMENT ID          | TECN      | COMMENT                                                                                              |
|-----------------------------------------------------------------------|--------------------|----------------------|-----------|------------------------------------------------------------------------------------------------------|
| <b>90 ± 15</b>                                                        | <b>OUR AVERAGE</b> |                      |           |                                                                                                      |
| 90.3 ± 9.8 ± 17.5                                                     | 2.2k               | <sup>1</sup> ABLIKIM | 18AB BES3 | $J/\psi \rightarrow \eta' h_1 \rightarrow \eta' K^* \bar{K}$                                         |
| 84 ± 12 ± 40                                                          |                    | <sup>1</sup> ABLIKIM | 15M BES3  | $\psi(2S) \rightarrow \gamma \chi_{c1,2} \rightarrow$<br>$\gamma \phi (h_1 \rightarrow K^* \bar{K})$ |
| 170 ± 80                                                              |                    | ABELE                | 97H CBAR  | $\bar{p} p \rightarrow K_L^0 K_S^0 \pi^0 \pi^0$                                                      |
| 80 ± 30                                                               |                    | ASTON                | 88C LASS  | 11 $K^- p \rightarrow K_S^0 K^\pm \pi^\mp \Lambda$                                                   |
| <sup>1</sup> Final states $K^+ K^- \pi^0$ and $K_S^0 K^\pm \pi^\mp$ . |                    |                      |           |                                                                                                      |

NODE=M109W

NODE=M109W;LINKAGE=A

**$h_1(1415)$  DECAY MODES**

NODE=M109215;NODE=M109

| Mode                                            |
|-------------------------------------------------|
| $\Gamma_1 \quad K \bar{K}^*(892) + \text{c.c.}$ |

DESIG=1

**$h_1(1415)$  REFERENCES**

NODE=M109

|                            |                          |                          |             |
|----------------------------|--------------------------|--------------------------|-------------|
| ABLIKIM 18AB PR D98 072005 | M. Ablikim <i>et al.</i> | (BESIII Collab.)         | REFID=59456 |
| ABLIKIM 15M PR D91 112008  | M. Ablikim <i>et al.</i> | (BESIII Collab.)         | REFID=56778 |
| ABELE 97H PL B415 280      | A. Abele <i>et al.</i>   | (Crystal Barrel Collab.) | REFID=45765 |
| ASTON 88C PL B201 573      | D. Aston <i>et al.</i>   | (SLAC, NAGO, CINC, INUS) | REFID=40282 |

NODE=M230

**$a_1(1420)$**

$I^G(J^{PC}) = 1^-(1^{++})$

OMITTED FROM SUMMARY TABLE

**$a_1(1420)$  MASS**

NODE=M230M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN | COMMENT                                            |
|-------------------------------------------------------------------------------|------|-----------------------|------|----------------------------------------------------|
| $1411^{+4}_{-5}$                                                              | 46M  | <sup>1</sup> AGHASYAN | 18B  | COMP 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |      |                                                    |
| $1414^{+15}_{-13}$                                                            |      | <sup>2,3</sup> ADOLPH | 15C  | COMP 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ |
| <sup>1</sup> Statistical error negligible.                                    |      |                       |      |                                                    |
| <sup>2</sup> Using the isobar model and partial-wave analysis with 88 waves.  |      |                       |      |                                                    |
| <sup>3</sup> Superseded by AGHASYAN 2018B.                                    |      |                       |      |                                                    |

NODE=M230M

NODE=M230M;LINKAGE=C  
NODE=M230M;LINKAGE=A  
NODE=M230M;LINKAGE=B

**$a_1(1420)$  WIDTH**

NODE=M230W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN | COMMENT                                            |
|-------------------------------------------------------------------------------|------|-----------------------|------|----------------------------------------------------|
| $161^{+11}_{-14}$                                                             | 46M  | <sup>1</sup> AGHASYAN | 18B  | COMP 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |      |                                                    |
| $153^{+8}_{-23}$                                                              |      | <sup>2,3</sup> ADOLPH | 15C  | COMP 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ |
| <sup>1</sup> Statistical error negligible.                                    |      |                       |      |                                                    |
| <sup>2</sup> Using the isobar model and partial-wave analysis with 88 waves.  |      |                       |      |                                                    |
| <sup>3</sup> Superseded by AGHASYAN 2018B.                                    |      |                       |      |                                                    |

NODE=M230W

NODE=M230W;LINKAGE=D  
NODE=M230W;LINKAGE=A  
NODE=M230W;LINKAGE=C

**$a_1(1420)$  DECAY MODES**

NODE=M230215;NODE=M230

| Mode                         | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------|--------------------------------|
| $\Gamma_1 \quad f_0(980)\pi$ | seen                           |

DESIG=1

**$a_1(1420)$  BRANCHING RATIOS**

NODE=M230220

| $\Gamma(f_0(980)\pi)/\Gamma_{\text{total}}$                                  | $\Gamma_1/\Gamma$   |      |         |                                               |
|------------------------------------------------------------------------------|---------------------|------|---------|-----------------------------------------------|
| VALUE                                                                        | DOCUMENT ID         | TECN | COMMENT |                                               |
| seen                                                                         | <sup>1</sup> ADOLPH | 15C  | COMP    | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ |
| <sup>1</sup> Using the isobar model and partial-wave analysis with 88 waves. |                     |      |         |                                               |

NODE=M230R01  
NODE=M230R01

NODE=M230R01;LINKAGE=A

**$a_1(1420)$  REFERENCES**

NODE=M230

|          |     |                |                           |                   |
|----------|-----|----------------|---------------------------|-------------------|
| AGHASYAN | 18B | PR D98 092003  | M. Aghasyan <i>et al.</i> | (COMPASS Collab.) |
| ADOLPH   | 15C | PRL 115 082001 | C. Adolph <i>et al.</i>   | (COMPASS Collab.) |

REFID=59471  
REFID=56790

$f_1(1420)$

$$J^{PC} = 0^+(1^{++})$$

See the review on "Pseudoscalar and Pseudovector Mesons in the 1400 MeV Region."

NODE=M006

NODE=M006

NODE=M006M2

NODE=M006M2

### $f_1(1420)$ MASS

| VALUE (MeV)                                                                                            | EVTS | DOCUMENT ID                         | TECN     | COMMENT                                                           |
|--------------------------------------------------------------------------------------------------------|------|-------------------------------------|----------|-------------------------------------------------------------------|
| <b>1426.3 ± 0.9 OUR AVERAGE</b>                                                                        |      | Error includes scale factor of 1.1. |          |                                                                   |
| 1434 ± 5 ± 5                                                                                           | 133  | <sup>1</sup> ACHARD                 | 07 L3    | 183-209 $e^+e^- \rightarrow e^+e^- K_S^0 K^\pm \pi^\mp$           |
| 1426 ± 6                                                                                               | 711  | ABDALLAH                            | 03H DLPH | 91.2 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp + X$                 |
| 1420 ± 14                                                                                              | 3651 | NICHITIU                            | 02 OBLX  | 0 $\bar{p}p \rightarrow K^+K^-\pi^+\pi^-\pi^0$                    |
| 1428 ± 4 ± 2                                                                                           | 20k  | ADAMS                               | 01B B852 | 18 GeV $\pi^-p \rightarrow K^+K^-\pi^0 n$                         |
| 1426 ± 1                                                                                               |      | BARBERIS                            | 97C OMEG | 450 $pp \rightarrow pp K_S^0 K^\pm \pi^\mp$                       |
| 1425 ± 8                                                                                               |      | BERTIN                              | 97 OBLX  | 0.0 $\bar{p}p \rightarrow K^\pm(K^0)\pi^\mp\pi^+\pi^-$            |
| 1430 ± 4                                                                                               |      | <sup>2</sup> ARMSTRONG              | 92E OMEG | 85,300 $\pi^+p, pp \rightarrow \pi^+p, pp(K\bar{K}\pi)$           |
| 1462 ± 20                                                                                              |      | <sup>3</sup> AUGUSTIN               | 92 DM2   | $J/\psi \rightarrow \gamma K\bar{K}\pi$                           |
| 1443 $\begin{smallmatrix} +7 \\ -6 \end{smallmatrix}$ $\begin{smallmatrix} +3 \\ -2 \end{smallmatrix}$ | 1100 | BAI                                 | 90C MRK3 | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$                   |
| 1425 ± 10                                                                                              | 17   | BEHREND                             | 89 CELL  | $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$                    |
| 1442 ± 5 $\begin{smallmatrix} +10 \\ -17 \end{smallmatrix}$                                            | 111  | BECKER                              | 87 MRK3  | $e^+e^-, \omega K\bar{K}\pi$                                      |
| 1423 ± 4                                                                                               |      | GIDAL                               | 87B MRK2 | $e^+e^- \rightarrow e^+e^- K\bar{K}\pi$                           |
| 1417 ± 13                                                                                              | 13   | AIHARA                              | 86C TPC  | $e^+e^- \rightarrow e^+e^- K\bar{K}\pi$                           |
| 1422 ± 3                                                                                               |      | CHAUVAT                             | 84 SPEC  | ISR 31.5 $pp$                                                     |
| 1440 ± 10                                                                                              |      | <sup>4</sup> BROMBERG               | 80 SPEC  | 100 $\pi^-p \rightarrow K\bar{K}\pi X$                            |
| 1426 ± 6                                                                                               | 221  | DIONISI                             | 80 HBC   | 4 $\pi^-p \rightarrow K\bar{K}\pi n$                              |
| 1420 ± 20                                                                                              |      | DAHL                                | 67 HBC   | 1.6-4.2 $\pi^-p$                                                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                          |      |                                     |          |                                                                   |
| 1430.8 ± 0.9                                                                                           |      | <sup>5</sup> SOSA                   | 99 SPEC  | $pp \rightarrow p_{\text{slow}}(K_S^0 K^+ \pi^-) p_{\text{fast}}$ |
| 1433.4 ± 0.8                                                                                           |      | <sup>5</sup> SOSA                   | 99 SPEC  | $pp \rightarrow p_{\text{slow}}(K_S^0 K^- \pi^+) p_{\text{fast}}$ |
| 1435 ± 9                                                                                               |      | PROKOSHKIN                          | 97B GAM4 | 100 $\pi^-p \rightarrow \eta\pi^0\pi^0 n$                         |
| 1429 ± 3                                                                                               | 389  | ARMSTRONG                           | 89 OMEG  | 300 $pp \rightarrow K\bar{K}\pi pp$                               |
| 1425 ± 2                                                                                               | 1520 | ARMSTRONG                           | 84 OMEG  | 85 $\pi^+p, pp \rightarrow (\pi^+, p)(K\bar{K}\pi)p$              |
| ~ 1420                                                                                                 |      | BITYUKOV                            | 84 SPEC  | 32 $K^-p \rightarrow K^+K^-\pi^0 Y$                               |

<sup>1</sup> From a fit with a width fixed at 55 MeV.

<sup>2</sup> This result supersedes ARMSTRONG 84, ARMSTRONG 89.

<sup>3</sup> From fit to the  $K^*(892)K 1^{++}$  partial wave.

<sup>4</sup> Mass error increased to account for  $a_0(980)$  mass cut uncertainties.

<sup>5</sup> No systematic error given.

NODE=M006M2;LINKAGE=CH

NODE=M006M2;LINKAGE=C

NODE=M006M2;LINKAGE=B

NODE=M006M2;LINKAGE=A

NODE=M006M2;LINKAGE=N1

OCCUR=2

### $f_1(1420)$ WIDTH

| VALUE (MeV)                   | EVTS | DOCUMENT ID | TECN     | COMMENT                                                |
|-------------------------------|------|-------------|----------|--------------------------------------------------------|
| <b>54.5 ± 2.6 OUR AVERAGE</b> |      |             |          |                                                        |
| 51 ± 14                       | 711  | ABDALLAH    | 03H DLPH | 91.2 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp + X$      |
| 61 ± 8                        | 3651 | NICHITIU    | 02 OBLX  | 0 $\bar{p}p \rightarrow K^+K^-\pi^+\pi^-\pi^0$         |
| 38 ± 9 ± 6                    | 20k  | ADAMS       | 01B B852 | 18 GeV $\pi^-p \rightarrow K^+K^-\pi^0 n$              |
| 58 ± 4                        |      | BARBERIS    | 97C OMEG | 450 $pp \rightarrow pp K_S^0 K^\pm \pi^\mp$            |
| 45 ± 10                       |      | BERTIN      | 97 OBLX  | 0.0 $\bar{p}p \rightarrow K^\pm(K^0)\pi^\mp\pi^+\pi^-$ |

NODE=M006W

NODE=M006W

|                                                                               |      |                   |     |                        |     |      |                                                                    |
|-------------------------------------------------------------------------------|------|-------------------|-----|------------------------|-----|------|--------------------------------------------------------------------|
| 58 ±10                                                                        |      |                   |     | <sup>6</sup> ARMSTRONG | 92E | OMEG | 85,300 $\pi^+ p, pp \rightarrow \pi^+ p, pp(K\bar{K}\pi)$          |
| 129 ±41                                                                       |      |                   |     | <sup>7</sup> AUGUSTIN  | 92  | DM2  | $J/\psi \rightarrow \gamma K\bar{K}\pi$                            |
| 68 $^{+29}_{-18}$ $^{+8}_{-9}$                                                | 1100 | BAI               | 90C | MRK3                   |     |      | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$                    |
| 42 ±22                                                                        | 17   | BEHREND           | 89  | CELL                   |     |      | $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$                     |
| 40 $^{+17}_{-13}$ ±5                                                          | 111  | BECKER            | 87  | MRK3                   |     |      | $e^+e^- \rightarrow \omega K\bar{K}\pi$                            |
| 35 $^{+47}_{-20}$                                                             | 13   | AIHARA            | 86C | TPC                    |     |      | $e^+e^- \rightarrow e^+e^- K\bar{K}\pi$                            |
| 47 ±10                                                                        |      | CHAUVAT           | 84  | SPEC                   |     |      | ISR 31.5 $pp$                                                      |
| 62 ±14                                                                        |      | BROMBERG          | 80  | SPEC                   |     |      | 100 $\pi^- p \rightarrow K\bar{K}\pi X$                            |
| 40 ±15                                                                        | 221  | DIONISI           | 80  | HBC                    |     |      | 4 $\pi^- p \rightarrow K\bar{K}\pi n$                              |
| 60 ±20                                                                        |      | DAHL              | 67  | HBC                    |     |      | 1.6–4.2 $\pi^- p$                                                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                   |     |                        |     |      |                                                                    |
| 68.7 ± 2.9                                                                    |      | <sup>8</sup> SOSA | 99  | SPEC                   |     |      | $pp \rightarrow p_{\text{slow}} (K_S^0 K^+ \pi^-) p_{\text{fast}}$ |
| 58.8 ± 3.3                                                                    |      | <sup>8</sup> SOSA | 99  | SPEC                   |     |      | $pp \rightarrow p_{\text{slow}} (K_S^0 K^- \pi^+) p_{\text{fast}}$ |
| 90 ±25                                                                        |      | PROKOSHKIN        | 97B | GAM4                   |     |      | 100 $\pi^- p \rightarrow \eta \pi^0 \pi^0 n$                       |
| 58 ± 8                                                                        | 389  | ARMSTRONG         | 89  | OMEG                   |     |      | 300 $pp \rightarrow K\bar{K}\pi pp$                                |
| 62 ± 5                                                                        | 1520 | ARMSTRONG         | 84  | OMEG                   |     |      | 85 $\pi^+ p, pp \rightarrow (\pi^+, p)(K\bar{K}\pi)p$              |
| ~ 50                                                                          |      | BITYUKOV          | 84  | SPEC                   |     |      | 32 $K^- p \rightarrow K^+ K^- \pi^0 \gamma$                        |

<sup>6</sup> This result supersedes ARMSTRONG 84, ARMSTRONG 89.

<sup>7</sup> From fit to the  $K^*(892)K$   $1^{++}$  partial wave.

<sup>8</sup> No systematic error given.

OCCUR=2

NODE=M006W;LINKAGE=C  
 NODE=M006W;LINKAGE=B  
 NODE=M006W;LINKAGE=N1

### $f_1(1420)$ DECAY MODES

| Mode                                       | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------------------|--------------------------------|
| $\Gamma_1$ $K\bar{K}\pi$                   | seen                           |
| $\Gamma_2$ $K\bar{K}^*(892) + \text{c.c.}$ | seen                           |
| $\Gamma_3$ $\eta\pi\pi$                    | possibly seen                  |
| $\Gamma_4$ $a_0(980)\pi$                   |                                |
| $\Gamma_5$ $\pi\pi\rho$                    |                                |
| $\Gamma_6$ $4\pi$                          |                                |
| $\Gamma_7$ $\rho^0\gamma$                  |                                |
| $\Gamma_8$ $\phi\gamma$                    | seen                           |

NODE=M006215;NODE=M006

DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=4  
 DESIG=3  
 DESIG=6  
 DESIG=8  
 DESIG=9;OUR EST;→ UNCHECKED ←

### $f_1(1420) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

$\Gamma(K\bar{K}\pi) \times \Gamma(\gamma\gamma^*)/\Gamma_{\text{total}}$

| VALUE (keV)                                                                   | CL% | EVTS | DOCUMENT ID              | TECN     | COMMENT                                                 |
|-------------------------------------------------------------------------------|-----|------|--------------------------|----------|---------------------------------------------------------|
| <b>1.9±0.4 OUR AVERAGE</b>                                                    |     |      |                          |          |                                                         |
| 3.2±0.6±0.7                                                                   |     | 133  | <sup>9,10</sup> ACHARD   | 07 L3    | 183–209 $e^+e^- \rightarrow e^+e^- K_S^0 K^\pm \pi^\mp$ |
| 3.0±0.9±0.7                                                                   |     |      | <sup>11,12</sup> BEHREND | 89 CELL  | $e^+e^- \rightarrow e^+e^- K_S^0 K\pi$                  |
| 2.3 $^{+1.0}_{-0.9}$ ±0.8                                                     |     |      | HILL                     | 89 JADE  | $e^+e^- \rightarrow e^+e^- K^\pm K_S^0 \pi^\mp$         |
| 1.3±0.5±0.3                                                                   |     |      | AIHARA                   | 88B TPC  | $e^+e^- \rightarrow e^+e^- K^\pm K_S^0 \pi^\mp$         |
| 1.6±0.7±0.3                                                                   |     |      | <sup>11,13</sup> GIDAL   | 87B MRK2 | $e^+e^- \rightarrow e^+e^- K\bar{K}\pi$                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                          |          |                                                         |
| <8.0                                                                          | 95  |      | JENNI                    | 83 MRK2  | $e^+e^- \rightarrow e^+e^- K\bar{K}\pi$                 |

<sup>9</sup> From a fit with a width fixed at 55 MeV.

<sup>10</sup> The form factor parameter from the fit is  $926 \pm 78$  MeV.

<sup>11</sup> Assume a  $\rho$ -pole form factor.

<sup>12</sup> A  $\phi$ -pole form factor gives considerably smaller widths.

<sup>13</sup> Published value divided by 2.

NODE=M006220

NODE=M006G2  
 NODE=M006G2

NODE=M006G2;LINKAGE=CH  
 NODE=M006G2;LINKAGE=CR  
 NODE=M006G2;LINKAGE=A  
 NODE=M006G2;LINKAGE=D  
 NODE=M006G2;LINKAGE=B



**$f_1(1420)$  BRANCHING RATIOS**

NODE=M006225

 **$\Gamma(K\bar{K}^*(892)+c.c.)/\Gamma(K\bar{K}\pi)$**  **$\Gamma_2/\Gamma_1$** 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                      |
|-------------------------------------------------------------------------------|-------------|------|----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                              |
| $0.76 \pm 0.06$                                                               | BROMBERG    | 80   | SPEC $100 \pi^- p \rightarrow K\bar{K}\pi X$ |
| $0.86 \pm 0.12$                                                               | DIONISI     | 80   | HBC $4 \pi^- p \rightarrow K\bar{K}\pi n$    |

NODE=M006R1  
NODE=M006R1 **$\Gamma(\pi\pi\rho)/\Gamma(K\bar{K}\pi)$**  **$\Gamma_5/\Gamma_1$** 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT               |
|-------------------------------------------------------------------------------|-----|-------------|------|-----------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                       |
| $<0.3$                                                                        | 95  | CORDEN      | 78   | OMEG $12-15 \pi^- p$  |
| $<2.0$                                                                        |     | DAHL        | 67   | HBC $1.6-4.2 \pi^- p$ |

NODE=M006R2  
NODE=M006R2 **$\Gamma(\eta\pi\pi)/\Gamma(K\bar{K}\pi)$**  **$\Gamma_3/\Gamma_1$** 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                                     |
|-------------------------------------------------------------------------------|-----|-------------|------|-------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                                             |
| <b><math>&lt;0.1</math></b>                                                   | 95  | ARMSTRONG   | 91B  | OMEG $300 p p \rightarrow p p \eta \pi^+ \pi^-$             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                                             |
| $1.35 \pm 0.75$                                                               |     | KOPKE       | 89   | MRK3 $J/\psi \rightarrow \omega \eta \pi \pi (K\bar{K}\pi)$ |
| $<0.6$                                                                        | 90  | GIDAL       | 87   | MRK2 $e^+ e^- \rightarrow e^+ e^- \eta \pi^+ \pi^-$         |
| $<0.5$                                                                        | 95  | CORDEN      | 78   | OMEG $12-15 \pi^- p$                                        |
| $1.5 \pm 0.8$                                                                 |     | DEFOIX      | 72   | HBC $0.7 \bar{p} p \rightarrow 7\pi$                        |

NODE=M006R3  
NODE=M006R3 **$\Gamma(a_0(980)\pi)/\Gamma(\eta\pi\pi)$**  **$\Gamma_4/\Gamma_3$** 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                           |
|-------------------------------------------------------------------------------|-----|-------------|------|---------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                                   |
| $>0.1$                                                                        | 90  | PROKOSHKIN  | 97B  | GAM4 $100 \pi^- p \rightarrow \eta \pi^0 \pi^0 n$ |
| not seen in either mode                                                       |     | ANDO        | 86   | SPEC $8 \pi^- p$                                  |
| not seen in either mode                                                       |     | CORDEN      | 78   | OMEG $12-15 \pi^- p$                              |
| $0.4 \pm 0.2$                                                                 |     | DEFOIX      | 72   | HBC $0.7 \bar{p} p \rightarrow 7\pi$              |

NODE=M006R4  
NODE=M006R4 **$\Gamma(4\pi)/\Gamma(K\bar{K}^*(892)+c.c.)$**  **$\Gamma_6/\Gamma_2$** 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT         |
|-------------------------------------------------------------------------------|-----|-------------|------|-----------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                 |
| $<0.90$                                                                       | 95  | DIONISI     | 80   | HBC $4 \pi^- p$ |

NODE=M006R5  
NODE=M006R5 **$\Gamma(K\bar{K}\pi)/[\Gamma(K\bar{K}^*(892)+c.c.)+\Gamma(a_0(980)\pi)]$**  **$\Gamma_1/(\Gamma_2+\Gamma_4)$** 

| VALUE                                                                                                       | DOCUMENT ID           | TECN | COMMENT         |
|-------------------------------------------------------------------------------------------------------------|-----------------------|------|-----------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                               |                       |      |                 |
| $0.65 \pm 0.27$                                                                                             | <sup>14</sup> DIONISI | 80   | HBC $4 \pi^- p$ |
| <sup>14</sup> Calculated using $\Gamma(K\bar{K})/\Gamma(\eta\pi) = 0.24 \pm 0.07$ for $a_0(980)$ fractions. |                       |      |                 |

NODE=M006R6  
NODE=M006R6

NODE=M006R6;LINKAGE=C

 **$\Gamma(a_0(980)\pi)/\Gamma(K\bar{K}^*(892)+c.c.)$**  **$\Gamma_4/\Gamma_2$** 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                      |
|-------------------------------------------------------------------------------|-----|-------------|------|----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                              |
| <b><math>0.04 \pm 0.01 \pm 0.01</math></b>                                    |     | BARBERIS    | 98C  | OMEG $450 p p \rightarrow p_f f_1(1420) p_s$ |
| $<0.04$                                                                       | 68  | ARMSTRONG   | 84   | OMEG $85 \pi^+ p$                            |

NODE=M006R7  
NODE=M006R7 **$\Gamma(4\pi)/\Gamma(K\bar{K}\pi)$**  **$\Gamma_6/\Gamma_1$** 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                            |
|-------------------------------------------------------------------------------|-----|-------------|------|------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                    |
| <b><math>&lt;0.62</math></b>                                                  | 95  | ARMSTRONG   | 89G  | OMEG $85 \pi p \rightarrow 4\pi X$ |

NODE=M006R8  
NODE=M006R8 **$\Gamma(\rho^0\gamma)/\Gamma_{\text{total}}$**  **$\Gamma_7/\Gamma$** 

| VALUE                                                                         | CL% | DOCUMENT ID             | TECN | COMMENT                                           |
|-------------------------------------------------------------------------------|-----|-------------------------|------|---------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                         |      |                                                   |
| $<0.08$                                                                       | 95  | <sup>15</sup> ARMSTRONG | 92C  | SPEC $300 p p \rightarrow p p \pi^+ \pi^- \gamma$ |
| <sup>15</sup> Using the data on the $\bar{K} K \pi$ mode from ARMSTRONG 89.   |     |                         |      |                                                   |

NODE=M006R9  
NODE=M006R9

NODE=M006R9;LINKAGE=A

 **$\Gamma(\rho^0\gamma)/\Gamma(K\bar{K}\pi)$**  **$\Gamma_7/\Gamma_1$** 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                      |
|-------------------------------------------------------------------------------|-----|-------------|------|----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                              |
| <b><math>&lt;0.02</math></b>                                                  | 95  | BARBERIS    | 98C  | OMEG $450 p p \rightarrow p_f f_1(1420) p_s$ |

NODE=M006R10  
NODE=M006R10

$\Gamma(\phi\gamma)/\Gamma(K\bar{K}\pi)$  $\Gamma_8/\Gamma_1$ 

| VALUE                    | DOCUMENT ID | TECN     | COMMENT                                            |
|--------------------------|-------------|----------|----------------------------------------------------|
| <b>0.003±0.001±0.001</b> | BARBERIS    | 98C OMEG | 450 $p\bar{p} \rightarrow p_f \bar{f}_1(1420) p_S$ |

NODE=M006R11  
 NODE=M006R11

 **$f_1(1420)$  REFERENCES**

NODE=M006

|            |     |                               |                                 |                             |             |
|------------|-----|-------------------------------|---------------------------------|-----------------------------|-------------|
| ACHARD     | 07  | JHEP 0703 018                 | P. Achard <i>et al.</i>         | (L3 Collab.)                | REFID=51698 |
| ABDALLAH   | 03H | PL B569 129                   | J. Abdallah <i>et al.</i>       | (DELPHI Collab.)            | REFID=49548 |
| NICHITIU   | 02  | PL B545 261                   | F. Nichitiu <i>et al.</i>       | (OBELIX Collab.)            | REFID=48848 |
| ADAMS      | 01B | PL B516 264                   | G.S. Adams <i>et al.</i>        | (BNL E852 Collab.)          | REFID=49649 |
| SOSA       | 99  | PRL 83 913                    | M. Sosa <i>et al.</i>           |                             | REFID=46937 |
| BARBERIS   | 98C | PL B440 225                   | D. Barberis <i>et al.</i>       | (WA 102 Collab.)            | REFID=46346 |
| BARBERIS   | 97C | PL B413 225                   | D. Barberis <i>et al.</i>       | (WA 102 Collab.)            | REFID=45759 |
| BERTIN     | 97  | PL B400 226                   | A. Bertin <i>et al.</i>         | (OBELIX Collab.)            | REFID=45417 |
| PROKOSHKIN | 97B | PD 42 298                     | Yu.D. Prokoshkin, S.A. Sadovsky |                             | REFID=45549 |
|            |     | Translated from DANS 354 751. |                                 |                             |             |
| ARMSTRONG  | 92C | ZPHY C54 371                  | T.A. Armstrong <i>et al.</i>    | (ATHU, BARI, BIRM+)         | REFID=42097 |
| ARMSTRONG  | 92E | ZPHY C56 29                   | T.A. Armstrong <i>et al.</i>    | (ATHU, BARI, BIRM+) JPC     | REFID=43173 |
| AUGUSTIN   | 92  | PR D46 1951                   | J.E. Augustin, G. Cosme         | (DM2 Collab.)               | REFID=41584 |
| ARMSTRONG  | 91B | ZPHY C52 389                  | T.A. Armstrong <i>et al.</i>    | (ATHU, BARI, BIRM+)         | REFID=41862 |
| BAI        | 90C | PRL 65 2507                   | Z. Bai <i>et al.</i>            | (Mark III Collab.)          | REFID=41578 |
| ARMSTRONG  | 89  | PL B221 216                   | T.A. Armstrong <i>et al.</i>    | (CERN, CDEF, BIRM+) JPC     | REFID=40729 |
| ARMSTRONG  | 89G | ZPHY C43 55                   | T.A. Armstrong <i>et al.</i>    | (CERN, BIRM, BARI+)         | REFID=40930 |
| BEHREND    | 89  | ZPHY C42 367                  | H.J. Behrend <i>et al.</i>      | (CELLO Collab.)             | REFID=40732 |
| HILL       | 89  | ZPHY C42 355                  | P. Hill <i>et al.</i>           | (JADE Collab.) JP           | REFID=40741 |
| KOPKE      | 89  | PRPL 174 67                   | L. Kopke <i>et al.</i>          | (CERN)                      | REFID=41863 |
| AIHARA     | 88B | PL B209 107                   | H. Aihara <i>et al.</i>         | (TPC-2 $\gamma$ Collab.)    | REFID=40572 |
| BECKER     | 87  | PRL 59 186                    | J.J. Becker <i>et al.</i>       | (Mark III Collab.) JP       | REFID=40015 |
| GIDAL      | 87  | PRL 59 2012                   | G. Gidal <i>et al.</i>          | (LBL, SLAC, HARV)           | REFID=40223 |
| GIDAL      | 87B | PRL 59 2016                   | G. Gidal <i>et al.</i>          | (LBL, SLAC, HARV)           | REFID=40224 |
| AIHARA     | 86C | PRL 57 2500                   | H. Aihara <i>et al.</i>         | (TPC-2 $\gamma$ Collab.) JP | REFID=21326 |
| ANDO       | 86  | PRL 57 1296                   | A. Ando <i>et al.</i>           | (KEK, KYOT, NIRS, SAGA+)    | REFID=20891 |
| ARMSTRONG  | 84  | PL 146B 273                   | T.A. Armstrong <i>et al.</i>    | (ATHU, BARI, BIRM+) JP      | REFID=20929 |
| BITYUKOV   | 84  | SJNP 39 735                   | S. Bityukov <i>et al.</i>       | (SERP)                      | REFID=45856 |
|            |     | Translated from YAF 39 1165.  |                                 |                             |             |
| CHAUVAT    | 84  | PL 148B 382                   | P. Chauvat <i>et al.</i>        | (CERN, CLER, UCLA+)         | REFID=20932 |
| JENNI      | 83  | PR D27 1031                   | P. Jenni <i>et al.</i>          | (SLAC, LBL)                 | REFID=20304 |
| BROMBERG   | 80  | PR D22 1513                   | C.M. Bromberg <i>et al.</i>     | (CIT, FNAL, ILLC+)          | REFID=20922 |
| DIONISI    | 80  | NP B169 1                     | C. Dionisi <i>et al.</i>        | (CERN, MADR, CDEF+) IJP     | REFID=20924 |
| CORDEN     | 78  | NP B144 253                   | M.J. Corden <i>et al.</i>       | (BIRM, RHEL, TELA+)         | REFID=20452 |
| DEFOIX     | 72  | NP B44 125                    | C. Defoix <i>et al.</i>         | (CDEF, CERN)                | REFID=20435 |
| DAHL       | 67  | PR 163 1377                   | O.I. Dahl <i>et al.</i>         | (LRL) IJP                   | REFID=20321 |
| Also       |     | PRL 14 1074                   | D.H. Miller <i>et al.</i>       | (LRL, UCB)                  | REFID=21291 |

NODE=M125

 $\omega(1420)$ 

$$I^G(J^{PC}) = 0^-(1^--)$$

See also the  $\omega(1650)$  particle listing.

NODE=M125

 **$\omega(1420)$  MASS**

NODE=M125M

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**1410± 60 OUR ESTIMATE**

NODE=M125M  
 → UNCHECKED ←

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                      |       |                             |           |                                                    |
|--------------------------------------|-------|-----------------------------|-----------|----------------------------------------------------|
| 1418± 30± 10                         | 824   | <sup>1</sup> AKHMETSHIN 17A | CMD3      | 1.4–2.0 $e^+e^- \rightarrow \omega\eta$            |
| 1470± 50                             | 13.1k | <sup>2</sup> AULCHENKO 15A  | SND       | 1.05–1.80 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$     |
| 1382± 23± 70                         |       | AUBERT                      | 07AU BABR | 10.6 $e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$   |
| 1350± 20± 20                         |       | AUBERT,B                    | 04N BABR  | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$    |
| 1400± 50± 130                        | 1.2M  | <sup>3</sup> ACHASOV        | 03D RVUE  | 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$     |
| 1450± 10                             |       | <sup>4</sup> HENNER         | 02 RVUE   | 1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |
| 1373± 70                             | 177   | <sup>5</sup> AKHMETSHIN 00D | CMD2      | 1.2–1.38 $e^+e^- \rightarrow \omega\pi^+\pi^-$     |
| 1370± 25                             | 5095  | ANISOVICH                   | 00H SPEC  | 0.0 $p\bar{p} \rightarrow \omega\pi^0\pi^0\pi^0$   |
| 1400 <sup>+100</sup> <sub>-200</sub> |       | <sup>6</sup> ACHASOV        | 98H RVUE  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$               |
| ~ 1400                               |       | <sup>7</sup> ACHASOV        | 98H RVUE  | $e^+e^- \rightarrow \omega\pi^+\pi^-$              |
| ~ 1460                               |       | <sup>8</sup> ACHASOV        | 98H RVUE  | $e^+e^- \rightarrow K^+K^-$                        |
| 1440± 70                             |       | <sup>9</sup> CLEGG          | 94 RVUE   |                                                    |
| 1419± 31                             | 315   | <sup>10</sup> ANTONELLI     | 92 DM2    | 1.34–2.4 $e^+e^- \rightarrow \rho\pi$              |

OCCUR=2

OCCUR=3

- <sup>1</sup> From a fit of the interfering  $\omega(1420)$  and  $\omega(1650)$  with a relative phase of  $\pi$  and other parameters floating.
- <sup>2</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . See ACHASOV 20A for a further analysis of the  $\pi^+\pi^-\pi^0$  data.
- <sup>3</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.
- <sup>4</sup> Using results of CORDIER 81 and preliminary data of DOLINSKY 91 and ANTONELLI 92.
- <sup>5</sup> Using the data of AKHMETSHIN 00D and ANTONELLI 92. The  $\rho\pi$  dominance for the energy dependence of the  $\omega(1420)$  and  $\omega(1650)$  width assumed.
- <sup>6</sup> Using data from BARKOV 87, DOLINSKY 91, and ANTONELLI 92.
- <sup>7</sup> Using the data from ANTONELLI 92.
- <sup>8</sup> Using the data from IVANOV 81 and BISELLO 88B.
- <sup>9</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.
- <sup>10</sup> From a fit to two Breit-Wigner functions interfering between them and with the  $\omega, \phi$  tails with fixed (+, -, +) phases.

NODE=M125M;LINKAGE=F  
 NODE=M125M;LINKAGE=E  
 NODE=M125M;LINKAGE=VH  
 NODE=M125M;LINKAGE=AB  
 NODE=M125M;LINKAGE=KL  
 NODE=M125M;LINKAGE=L1  
 NODE=M125M;LINKAGE=L2  
 NODE=M125M;LINKAGE=L3  
 NODE=M125M;LINKAGE=AD  
 NODE=M125M;LINKAGE=B

### $\omega(1420)$ WIDTH

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID                 | TECN | COMMENT                                                     |
|-------------------------------------------------------------------------------|-------|-----------------------------|------|-------------------------------------------------------------|
| <b>290±190 OUR ESTIMATE</b>                                                   |       |                             |      |                                                             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                             |      |                                                             |
| 440±125                                                                       | 267   | <sup>1</sup> ACHASOV 20B    | SND  | $e^+e^- \rightarrow \omega\eta \rightarrow \eta\pi^0\gamma$ |
| 104± 35± 10                                                                   | 824   | <sup>2</sup> AKHMETSHIN 17A | CMD3 | $1.4-2.0 e^+e^- \rightarrow \omega\eta$                     |
| 880±170                                                                       | 13.1k | <sup>3</sup> AULCHENKO 15A  | SND  | $1.05-1.80 e^+e^- \rightarrow \pi^+\pi^-\pi^0$              |
| 480±180                                                                       |       | <sup>4</sup> ACHASOV 10D    | SND  | $1.075-2.0 e^+e^- \rightarrow \pi^0\gamma$                  |
| 130± 50±100                                                                   |       | AUBERT 07AU                 | BABR | $10.6 e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$            |
| 450± 70± 70                                                                   |       | AUBERT,B 04N                | BABR | $10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$             |
| 870 <sup>+500</sup> <sub>-300</sub> ±450                                      | 1.2M  | <sup>5</sup> ACHASOV 03D    | RVUE | $0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$              |
| 199± 15                                                                       |       | <sup>6</sup> HENNER 02      | RVUE | $1.2-2.0 e^+e^- \rightarrow \rho\pi, \omega\pi\pi$          |
| 188± 45                                                                       | 177   | <sup>7</sup> AKHMETSHIN 00D | CMD2 | $1.2-1.38 e^+e^- \rightarrow \omega\pi^+\pi^-$              |
| 360 <sup>+100</sup> <sub>-60</sub>                                            | 5095  | ANISOVICH 00H               | SPEC | $0.0 \rho\bar{p} \rightarrow \omega\pi^0\pi^0\pi^0$         |
| 240± 70                                                                       |       | <sup>8</sup> CLEGG 94       | RVUE |                                                             |
| 174± 59                                                                       | 315   | <sup>9</sup> ANTONELLI 92   | DM2  | $1.34-2.4 e^+e^- \rightarrow \rho\pi$                       |

- <sup>1</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ . The mass of  $\omega(1420)$  is fixed to the PDG 18 value of 1420 MeV.
- <sup>2</sup> From a fit of the interfering  $\omega(1420)$  and  $\omega(1650)$  with a relative phase of  $\pi$  and other parameters floating.
- <sup>3</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . See ACHASOV 20A for a further analysis of the  $\pi^+\pi^-\pi^0$  data.
- <sup>4</sup> From a fit of a VMD model with two effective resonances with masses of 1450 MeV and 1700 MeV to describe the excited vector states  $\omega(1420)$ ,  $\rho(1450)$ ,  $\omega(1650)$ , and  $\rho(1700)$ . Systematic errors not evaluated.
- <sup>5</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.
- <sup>6</sup> Using results of CORDIER 81 and preliminary data of DOLINSKY 91 and ANTONELLI 92.
- <sup>7</sup> Using the data of AKHMETSHIN 00D and ANTONELLI 92. The  $\rho\pi$  dominance for the energy dependence of the  $\omega(1420)$  and  $\omega(1650)$  width assumed.
- <sup>8</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.
- <sup>9</sup> From a fit to two Breit-Wigner functions interfering between them and with the  $\omega, \phi$  tails with fixed (+, -, +) phases.

NODE=M125W  
 NODE=M125W  
 → UNCHECKED ←

NODE=M125W;LINKAGE=H  
 NODE=M125W;LINKAGE=F  
 NODE=M125W;LINKAGE=E  
 NODE=M125W;LINKAGE=G  
 NODE=M125W;LINKAGE=VH  
 NODE=M125W;LINKAGE=AB  
 NODE=M125W;LINKAGE=KL  
 NODE=M125W;LINKAGE=AD  
 NODE=M125W;LINKAGE=B

### $\omega(1420)$ DECAY MODES

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $\rho\pi$      | seen                           |
| $\Gamma_2$ $\omega\pi\pi$ | seen                           |
| $\Gamma_3$ $\omega\eta$   |                                |
| $\Gamma_4$ $b_1(1235)\pi$ | seen                           |
| $\Gamma_5$ $e^+e^-$       | seen                           |
| $\Gamma_6$ $\pi^0\gamma$  |                                |

NODE=M125215;NODE=M125

DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=7  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=3;OUR EST;→ UNCHECKED ←  
 DESIG=6

$\omega(1420) \Gamma(i) \Gamma(e^+ e^-) / \Gamma^2(\text{total})$ 

NODE=M125230

 $\Gamma(\rho\pi) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_1 / \Gamma \times \Gamma_5 / \Gamma$ NODE=M125G3  
NODE=M125G3

| VALUE (units $10^{-6}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                            |       |                          |     |      |                                                     |
|----------------------------|-------|--------------------------|-----|------|-----------------------------------------------------|
| 0.73 $\pm$ 0.08            | 13.1k | <sup>1</sup> AULCHENKO   | 15A | SND  | 1.05–1.80 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$   |
| 0.82 $\pm$ 0.05 $\pm$ 0.06 |       | AUBERT,B                 | 04N | BABR | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \gamma$ |
| 0.65 $\pm$ 0.13 $\pm$ 0.21 | 1.2M  | <sup>2,3</sup> ACHASOV   | 03D | RVUE | 0.44–2.00 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0$   |
| 0.625 $\pm$ 0.160          |       | <sup>4,5</sup> CLEGG     | 94  | RVUE |                                                     |
| 0.466 $\pm$ 0.178          |       | <sup>6,7</sup> ANTONELLI | 92  | DM2  | 1.34–2.4 $e^+ e^- \rightarrow \rho\pi$              |

<sup>1</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . See ACHASOV 20A for a further analysis of the  $\pi^+ \pi^- \pi^0$  data.

<sup>2</sup> Calculated by us from the cross section at the peak.

<sup>3</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+ \pi^- \pi^0$  and ANTONELLI 92 on the  $\omega \pi^+ \pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.

<sup>4</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.

<sup>5</sup> From the partial and leptonic width given by the authors.

<sup>6</sup> From a fit to two Breit-Wigner functions interfering between them and with the  $\omega, \phi$  tails with fixed (+, -, +) phases.

<sup>7</sup> From the product of the leptonic width and partial branching ratio given by the authors.

NODE=M125G3;LINKAGE=A

NODE=M125G;LINKAGE=AW  
NODE=M125G;LINKAGE=VH

NODE=M125G;LINKAGE=AD

NODE=M125G;LINKAGE=SE  
NODE=M125G;LINKAGE=A

NODE=M125G;LINKAGE=ES

 $\Gamma(\omega\pi\pi) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_2 / \Gamma \times \Gamma_5 / \Gamma$ NODE=M125G4  
NODE=M125G4

| VALUE (units $10^{-8}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |                         |      |      |                                                      |
|----------------|-------------------------|------|------|------------------------------------------------------|
| 19.7 $\pm$ 5.7 | AUBERT                  | 07AU | BABR | 10.6 $e^+ e^- \rightarrow \omega \pi^+ \pi^- \gamma$ |
| 1.9 $\pm$ 1.9  | <sup>1</sup> AKHMETSHIN | 00D  | CMD2 | 1.2–2.4 $e^+ e^- \rightarrow \omega \pi^+ \pi^-$     |

<sup>1</sup> Using the data of AKHMETSHIN 00D and ANTONELLI 92. The  $\rho\pi$  dominance for the energy dependence of the  $\omega(1420)$  and  $\omega(1650)$  width assumed.

NODE=M125G;LINKAGE=KL

 $\Gamma(\omega\eta) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_3 / \Gamma \times \Gamma_5 / \Gamma$ NODE=M125G6  
NODE=M125G6

| VALUE (units $10^{-8}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                         |     |                         |     |      |                                                              |
|-------------------------|-----|-------------------------|-----|------|--------------------------------------------------------------|
| 2.5 $\pm$ 0.6           | 267 | <sup>1</sup> ACHASOV    | 20B | SND  | $e^+ e^- \rightarrow \omega\eta \rightarrow \eta\pi^0\gamma$ |
| 2.1 $^{+1.0}_{-0.8}$    |     | ACHASOV                 | 19  | SND  | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0\eta$                  |
| 5.0 $\pm$ 2.6 $\pm$ 0.3 | 824 | <sup>2</sup> AKHMETSHIN | 17A | CMD3 | 1.4–2.0 $e^+ e^- \rightarrow \omega\eta$                     |
| 1.6 $^{+0.9}_{-0.7}$    | 898 | <sup>3</sup> ACHASOV    | 16B | SND  | 1.34–2.00 $e^+ e^- \rightarrow \omega\eta$                   |

<sup>1</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ . The mass of  $\omega(1420)$  is fixed to the PDG 18 value of 1420 MeV. Fixing also the width of  $\omega(1420)$  to the PDG 18 value of 220 MeV results in  $(3.0 \pm 1.6) \times 10^{-8}$  measurement.

<sup>2</sup> From a fit of the interfering  $\omega(1420)$  and  $\omega(1650)$  with a relative phase of  $\pi$  and other parameters floating. From an alternative fit  $\Gamma(\omega(1420) \rightarrow \omega\eta) / \Gamma_{\text{total}} \times \Gamma(\omega(1420) \rightarrow e^+ e^-) = 5.3 \pm 1.6$  eV.

<sup>3</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ . The mass and the width of  $\omega(1420)$  are fixed to the 2014 edition (PDG 14) of this review.

NODE=M125G6;LINKAGE=C

NODE=M125G6;LINKAGE=B

NODE=M125G6;LINKAGE=A

 $\Gamma(\pi^0\gamma) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_6 / \Gamma \times \Gamma_5 / \Gamma$ NODE=M125G5  
NODE=M125G5

| VALUE (units $10^{-8}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                         |                         |     |      |                                             |
|-------------------------|-------------------------|-----|------|---------------------------------------------|
| 0.23 $\pm$ 0.14         | <sup>1</sup> ACHASOV    | 10D | SND  | 1.075–2.0 $e^+ e^- \rightarrow \pi^0\gamma$ |
| 2.03 $^{+0.70}_{-0.75}$ | <sup>2</sup> AKHMETSHIN | 05  | CMD2 | 0.60–1.38 $e^+ e^- \rightarrow \pi^0\gamma$ |

<sup>1</sup> From a fit of a VMD model with two effective resonances with masses of 1450 MeV and 1700 MeV to describe the excited vector states  $\omega(1420)$ ,  $\rho(1450)$ ,  $\omega(1650)$ , and  $\rho(1700)$ . Systematic errors not evaluated.

<sup>2</sup> Using 1420 MeV and 220 MeV for the  $\omega(1420)$  mass and width.

NODE=M125G5;LINKAGE=A

NODE=M125G5;LINKAGE=AK

**$\omega(1420)$  BRANCHING RATIOS**

NODE=M125225

 **$\Gamma(\omega\pi\pi)/\Gamma_{\text{total}}$**  **$\Gamma_2/\Gamma$** 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |                     |     |                                                         |
|---------------|---------------------|-----|---------------------------------------------------------|
| 0.301±0.029   | <sup>1</sup> HENNER | 02  | RVUE 1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |
| possibly seen | AKHMETSHIN          | 00D | CMD2 $e^+e^- \rightarrow \omega\pi^+\pi^-$              |

NODE=M125R2  
NODE=M125R2 **$\Gamma(\omega\pi\pi)/\Gamma(b_1(1235)\pi)$**  **$\Gamma_2/\Gamma_4$** 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |      |           |     |                                                       |
|-----------|------|-----------|-----|-------------------------------------------------------|
| 0.60±0.16 | 5095 | ANISOVICH | 00H | SPEC 0.0 $p\bar{p} \rightarrow \omega\pi^0\pi^0\pi^0$ |
|-----------|------|-----------|-----|-------------------------------------------------------|

NODE=M125R1  
NODE=M125R1 **$\Gamma(\rho\pi)/\Gamma_{\text{total}}$**  **$\Gamma_1/\Gamma$** 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |                     |     |                                                         |
|-------------|---------------------|-----|---------------------------------------------------------|
| seen        | ACHASOV             | 20A | SND 1.15–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$      |
| 0.699±0.029 | <sup>1</sup> HENNER | 02  | RVUE 1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

NODE=M125R3  
NODE=M125R3 **$\Gamma(e^+e^-)/\Gamma_{\text{total}}$**  **$\Gamma_5/\Gamma$** 

| VALUE (units 10 <sup>-7</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |      |                        |     |                                                         |
|-------|------|------------------------|-----|---------------------------------------------------------|
| ~ 6.6 | 1.2M | <sup>2,3</sup> ACHASOV | 03D | RVUE 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$     |
| 23 ±1 |      | <sup>1</sup> HENNER    | 02  | RVUE 1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

NODE=M125R4  
NODE=M125R4<sup>1</sup> Assuming that the  $\omega(1420)$  decays into  $\rho\pi$  and  $\omega\pi\pi$  only.<sup>2</sup> Calculated by us from the cross section at the peak.<sup>3</sup> Assuming that the  $\omega(1420)$  decays into  $\rho\pi$  only.NODE=M125R;LINKAGE=AC  
NODE=M125R;LINKAGE=AW  
NODE=M125R;LINKAGE=GS **$\omega(1420)$  REFERENCES**

NODE=M125

|            |      |                               |                                |                             |
|------------|------|-------------------------------|--------------------------------|-----------------------------|
| ACHASOV    | 20A  | EPJ C80 993                   | M.N. Achasov <i>et al.</i>     | (SND Collab.)               |
| ACHASOV    | 20B  | EPJ C80 1008                  | M.N. Achasov <i>et al.</i>     | (SND Collab.)               |
| ACHASOV    | 19   | PR D99 112004                 | M.N. Achasov <i>et al.</i>     | (SND Collab.)               |
| PDG        | 18   | PR D98 030001                 | M. Tanabashi <i>et al.</i>     | (PDG Collab.)               |
| AKHMETSHIN | 17A  | PL B773 150                   | R.R. Akhmetshin <i>et al.</i>  | (CMD-3 Collab.)             |
| ACHASOV    | 16B  | PR D94 092002                 | M.N. Achasov <i>et al.</i>     | (SND Collab.)               |
| AULCHENKO  | 15A  | JETP 121 27                   | V.M. Aulchenko <i>et al.</i>   | (SND Collab.)               |
|            |      | Translated from ZETF 148 34.  |                                |                             |
| PDG        | 14   | CP C38 070001                 | K. Olive <i>et al.</i>         | (PDG Collab.)               |
| ACHASOV    | 10D  | PR D98 112001                 | M.N. Achasov <i>et al.</i>     | (SND Collab.)               |
| AUBERT     | 07AU | PR D76 092005                 | B. Aubert <i>et al.</i>        | (BABAR Collab.)             |
| AKHMETSHIN | 05   | PL B605 26                    | R.R. Akhmetshin <i>et al.</i>  | (Novosibirsk CMD-2 Collab.) |
| AUBERT,B   | 04N  | PR D70 072004                 | B. Aubert <i>et al.</i>        | (BABAR Collab.)             |
| ACHASOV    | 03D  | PR D68 052006                 | M.N. Achasov <i>et al.</i>     | (Novosibirsk SND Collab.)   |
| ACHASOV    | 02E  | PR D66 032001                 | M.N. Achasov <i>et al.</i>     | (Novosibirsk SND Collab.)   |
| HENNER     | 02   | EPJ C26 3                     | V.K. Henner <i>et al.</i>      |                             |
| ACHASOV    | 01E  | PR D63 072002                 | M.N. Achasov <i>et al.</i>     | (Novosibirsk SND Collab.)   |
| AKHMETSHIN | 00D  | PL B489 125                   | R.R. Akhmetshin <i>et al.</i>  | (Novosibirsk CMD-2 Collab.) |
| ANISOVICH  | 00H  | PL B485 341                   | A.V. Anisovich <i>et al.</i>   |                             |
| ACHASOV    | 99E  | PL B462 365                   | M.N. Achasov <i>et al.</i>     | (Novosibirsk SND Collab.)   |
| ACHASOV    | 98H  | PR D57 4334                   | N.N. Achasov, A.A. Kozhevnikov |                             |
| CLEGG      | 94   | ZPHY C62 455                  | A.B. Clegg, A. Donnachie       | (LANC, MCHS)                |
| ANTONELLI  | 92   | ZPHY C56 15                   | A. Antonelli <i>et al.</i>     | (DM2 Collab.)               |
| DOLINSKY   | 91   | PRPL 202 99                   | S.I. Dolinsky <i>et al.</i>    | (NOVO)                      |
| BISELLO    | 88B  | ZPHY C39 13                   | D. Bisello <i>et al.</i>       | (PADO, CLER, FRAS+)         |
| BARKOV     | 87   | JETPL 46 164                  | L.M. Barkov <i>et al.</i>      | (NOVO)                      |
|            |      | Translated from ZETFP 46 132. |                                |                             |
| CORDIER    | 81   | PL 106B 155                   | A. Cordier <i>et al.</i>       | (ORSAY)                     |
| IVANOV     | 81   | PL 107B 297                   | P.M. Ivanov <i>et al.</i>      | (NOVO)                      |

REFID=60923  
REFID=60924  
REFID=59887  
REFID=59304  
REFID=58239  
REFID=57537  
REFID=56843  
  
REFID=55687  
REFID=59494  
REFID=52049  
REFID=50330  
REFID=50184  
REFID=49577  
REFID=48815  
REFID=49177  
REFID=48311  
REFID=47935  
REFID=47948  
REFID=47391  
REFID=46323  
REFID=44081  
REFID=43168  
REFID=41369  
REFID=40581  
REFID=40280  
  
REFID=21586  
REFID=20553

**$f_2(1430)$**

$I^G(J^{PC}) = 0^+(2^{++})$

OMITTED FROM SUMMARY TABLE

This entry lists nearby peaks observed in the  $D$  wave of the  $K\bar{K}$  and  $\pi^+\pi^-$  systems. Needs confirmation.

NODE=M066

NODE=M066

**$f_2(1430)$  MASS**

NODE=M066M1

| VALUE (MeV)                                                                   | DOCUMENT ID                  | TECN | COMMENT                                           |
|-------------------------------------------------------------------------------|------------------------------|------|---------------------------------------------------|
| <b><math>\approx 1430</math> OUR ESTIMATE</b>                                 |                              |      |                                                   |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                              |      |                                                   |
| $1453 \pm 4$                                                                  | <sup>1</sup> VLADIMIRSK...01 | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$            |
| $1421 \pm 5$                                                                  | AUGUSTIN 87                  | DM2  | $J/\psi \rightarrow \gamma \pi^+ \pi^-$           |
| $1480 \pm 50$                                                                 | AKESSON 86                   | SPEC | $pp \rightarrow pp \pi^+ \pi^-$                   |
| $1436^{+26}_{-16}$                                                            | DAUM 84                      | CNTR | $17-18 \pi^- p \rightarrow K^+ K^- n$             |
| $1412 \pm 3$                                                                  | DAUM 84                      | CNTR | $63 \pi^- p \rightarrow K_S^0 K_S^0 n, K^+ K^- n$ |
| $1439^{+5}_{-6}$                                                              | <sup>2</sup> BEUSCH 67       | OSPK | $5,7,12 \pi^- p \rightarrow K_S^0 K_S^0 n$        |
| <sup>1</sup> $J^{PC} = 0^{++}$ or $2^{++}$ .                                  |                              |      |                                                   |
| <sup>2</sup> Not seen by WETZEL 76.                                           |                              |      |                                                   |

NODE=M066M1  
→ UNCHECKED ←

OCCUR=2

NODE=M066M;LINKAGE=AC  
NODE=M066M;LINKAGE=C

**$f_2(1430)$  WIDTH**

NODE=M066W1

| VALUE (MeV)                                                                   | DOCUMENT ID                  | TECN | COMMENT                                           |
|-------------------------------------------------------------------------------|------------------------------|------|---------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                              |      |                                                   |
| $13 \pm 5$                                                                    | <sup>3</sup> VLADIMIRSK...01 | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$            |
| $30 \pm 9$                                                                    | AUGUSTIN 87                  | DM2  | $J/\psi \rightarrow \gamma \pi^+ \pi^-$           |
| $150 \pm 50$                                                                  | AKESSON 86                   | SPEC | $pp \rightarrow pp \pi^+ \pi^-$                   |
| $81^{+56}_{-29}$                                                              | DAUM 84                      | CNTR | $17-18 \pi^- p \rightarrow K^+ K^- n$             |
| $14 \pm 6$                                                                    | DAUM 84                      | CNTR | $63 \pi^- p \rightarrow K_S^0 K_S^0 n, K^+ K^- n$ |
| $43^{+17}_{-18}$                                                              | <sup>4</sup> BEUSCH 67       | OSPK | $5,7,12 \pi^- p \rightarrow K_S^0 K_S^0 n$        |
| <sup>3</sup> $J^{PC} = 0^{++}$ or $2^{++}$ .                                  |                              |      |                                                   |
| <sup>4</sup> Not seen by WETZEL 76.                                           |                              |      |                                                   |

NODE=M066W1

OCCUR=2

NODE=M066W;LINKAGE=AC  
NODE=M066W;LINKAGE=C

**$f_2(1430)$  DECAY MODES**

NODE=M066215;NODE=M066

| Mode       |            |
|------------|------------|
| $\Gamma_1$ | $K\bar{K}$ |
| $\Gamma_2$ | $\pi\pi$   |

DESIG=1  
DESIG=2

**$f_2(1430)$  REFERENCES**

NODE=M066

|                  |                                             |                               |
|------------------|---------------------------------------------|-------------------------------|
| VLADIMIRSK... 01 | PAN 64 1895<br>Translated from YAF 64 1979. | V.V. Vladmirsky <i>et al.</i> |
| AUGUSTIN 87      | ZPHY C36 369                                | J.E. Augustin <i>et al.</i>   |
| AKESSON 86       | NP B264 154                                 | T. Akesson <i>et al.</i>      |
| DAUM 84          | ZPHY C23 339                                | C. Daum <i>et al.</i>         |
| WETZEL 76        | NP B115 208                                 | W. Wetzels <i>et al.</i>      |
| BEUSCH 67        | PL 25B 357                                  | W. Beusch <i>et al.</i>       |

REFID=48571  
REFID=40268  
REFID=21123  
REFID=21372  
REFID=20362  
REFID=20320

**$a_0(1450)$** 

$$J^{PC} = 1^-(0^{++})$$

See the review on "Scalar Mesons below 2 GeV."

NODE=M149

NODE=M149

NODE=M149M

NODE=M149M

 **$a_0(1450)$  MASS**

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID                | TECN | COMMENT                                                                         |
|-------------------------------------------------------------------------------|------|----------------------------|------|---------------------------------------------------------------------------------|
| <b>1474 ±19 OUR AVERAGE</b>                                                   |      |                            |      |                                                                                 |
| 1480 ±30                                                                      |      | ABELE 98                   | CBAR | 0.0 $\bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$                                  |
| 1470 ±25                                                                      |      | <sup>1</sup> AMSLER 95D    | CBAR | 0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                            |      |                                                                                 |
| 1302.1 ± 1.1 ± 3.9                                                            |      | <sup>2</sup> ALBRECHT 20   | RVUE | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$     |
| 1458 ±14 ±15 190k                                                             |      | <sup>3</sup> AAIJ 16N      | LHCB | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$                                           |
| 1515 ±30                                                                      |      | <sup>4</sup> ANISOVICH 09  | RVUE | 0.0 $\bar{p}p, \pi N$                                                           |
| 1316.8 <sup>+</sup> <sub>-1.0</sub> <sup>0.7+24.7</sup> <sub>-4.6</sub>       |      | <sup>5</sup> UEHARA 09A    | BELL | $\gamma\gamma \rightarrow \pi^0 \eta$                                           |
| 1432 ±13 ±25                                                                  |      | <sup>6</sup> BUGG 08A      | RVUE | $\bar{p}p$                                                                      |
| 1477 ±10 80k                                                                  |      | <sup>7</sup> UMAN 06       | E835 | 5.2 $\bar{p}p \rightarrow \eta \eta \pi^0$                                      |
| 1441 <sup>+</sup> <sub>-15</sub>                                              | 35k  | <sup>4</sup> BAKER 03      | SPEC | $\bar{p}p \rightarrow \omega \pi^+ \pi^- \pi^0$                                 |
| 1303 ±16                                                                      |      | <sup>8</sup> BARGIOTTI 03  | OBLX | $\bar{p}p$                                                                      |
| 1296 ±10                                                                      |      | <sup>9</sup> AMSLER 02     | CBAR | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$                                     |
| 1565 ±30                                                                      |      | <sup>9</sup> ANISOVICH 98B | RVUE | Compilation                                                                     |
| 1290 ±10                                                                      |      | <sup>10</sup> BERTIN 98B   | OBLX | 0.0 $\bar{p}p \rightarrow K^\pm K_S^0 \pi^\mp$                                  |
| 1450 ±40                                                                      |      | AMSLER 94D                 | CBAR | 0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$                                     |
| 1410 ±25                                                                      |      | ETKIN 82C                  | MPS  | 23 $\pi^- p \rightarrow n 2 K_S^0$                                              |
| ~ 1300                                                                        |      | MARTIN 78                  | SPEC | 10 $K^\pm p \rightarrow K_S^0 \pi p$                                            |
| 1255 ± 5                                                                      |      | <sup>11</sup> CASON 76     |      |                                                                                 |

<sup>1</sup> Coupled-channel analysis of AMSLER 95B, AMSLER 95C, and AMSLER 94D.<sup>2</sup> T-matrix pole, 2 poles, 2 channels ( $\pi \eta, K \bar{K}$ ).<sup>3</sup> Using a model with Gaussian constraints to the PDG averaged values.<sup>4</sup> From the pole position.<sup>5</sup> May be a different state.<sup>6</sup> Using data from AMSLER 94D, ABELE 98, and BAKER 03. Supersedes BUGG 94.<sup>7</sup> Statistical error only.<sup>8</sup> Coupled channel analysis of  $\pi^+ \pi^- \pi^0, K^+ K^- \pi^0$ , and  $K^\pm K_S^0 \pi^\mp$ .<sup>9</sup> T-matrix pole.<sup>10</sup> Not confirmed by BUGG 08A.<sup>11</sup> Isospin 0 not excluded.

NODE=M149M;LINKAGE=AB

NODE=M149M;LINKAGE=C

NODE=M149M;LINKAGE=A

NODE=M149M;LINKAGE=PP

NODE=M149M;LINKAGE=UE

NODE=M149M;LINKAGE=BU

NODE=M149M;LINKAGE=ST

NODE=M149M;LINKAGE=BG

NODE=M149M;LINKAGE=B

NODE=M149M;LINKAGE=BE

NODE=M149M;LINKAGE=CC

 **$a_0(1450)$  WIDTH**

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID                | TECN | COMMENT                                                                         |
|-------------------------------------------------------------------------------|------|----------------------------|------|---------------------------------------------------------------------------------|
| <b>265 ±13 OUR AVERAGE</b>                                                    |      |                            |      |                                                                                 |
| 265 ±15                                                                       |      | ABELE 98                   | CBAR | 0.0 $\bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$                                  |
| 265 ±30                                                                       |      | <sup>1</sup> AMSLER 95D    | CBAR | 0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                            |      |                                                                                 |
| 112.4 ± 1.4 ± 3.4                                                             |      | <sup>2</sup> ALBRECHT 20   | RVUE | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$     |
| 282 ±12 ±13 190k                                                              |      | <sup>3</sup> AAIJ 16N      | LHCB | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$                                           |
| 230 ±36                                                                       |      | <sup>4</sup> ANISOVICH 09  | RVUE | 0.0 $\bar{p}p, \pi N$                                                           |
| 65.0 <sup>+</sup> <sub>-5.4</sub> <sup>2.1+99.1</sup> <sub>-32.6</sub>        |      | <sup>5</sup> UEHARA 09A    | BELL | $\gamma\gamma \rightarrow \pi^0 \eta$                                           |
| 196 ±10 ±10                                                                   |      | <sup>6</sup> BUGG 08A      | RVUE | $\bar{p}p$                                                                      |
| 267 ±11 80k                                                                   |      | <sup>7</sup> UMAN 06       | E835 | 5.2 $\bar{p}p \rightarrow \eta \eta \pi^0$                                      |
| 110 ±14 35k                                                                   |      | <sup>4</sup> BAKER 03      | SPEC | $\bar{p}p \rightarrow \omega \pi^+ \pi^- \pi^0$                                 |
| 92 ±16                                                                        |      | <sup>8</sup> BARGIOTTI 03  | OBLX | $\bar{p}p$                                                                      |
| 81 ±21                                                                        |      | <sup>9</sup> AMSLER 02     | CBAR | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$                                     |
| 292 ±40                                                                       |      | <sup>9</sup> ANISOVICH 98B | RVUE | Compilation                                                                     |
| 80 ± 5                                                                        |      | <sup>10</sup> BERTIN 98B   | OBLX | 0.0 $\bar{p}p \rightarrow K^\pm K_S^0 \pi^\mp$                                  |
| 270 ±40                                                                       |      | AMSLER 94D                 | CBAR | 0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$                                     |
| 230 ±30                                                                       |      | ETKIN 82C                  | MPS  | 23 $\pi^- p \rightarrow n 2 K_S^0$                                              |
| ~ 250                                                                         |      | MARTIN 78                  | SPEC | 10 $K^\pm p \rightarrow K_S^0 \pi p$                                            |
| 79 ±10                                                                        |      | <sup>11</sup> CASON 76     |      |                                                                                 |

NODE=M149W

NODE=M149W

- <sup>1</sup> Coupled-channel analysis of AMSLER 95B, AMSLER 95C, and AMSLER 94D.  
<sup>2</sup> T-matrix pole, 2 poles, 2 channels ( $\pi\eta$ ,  $K\bar{K}$ ).  
<sup>3</sup> Using a model with Gaussian constraints to the PDG averaged values.  
<sup>4</sup> From the pole position.  
<sup>5</sup> May be a different state.  
<sup>6</sup> Using data from AMSLER 94D, ABELE 98, and BAKER 03. Supersedes BUGG 94.  
<sup>7</sup> Statistical error only.  
<sup>8</sup> Coupled channel analysis of  $\pi^+\pi^-\pi^0$ ,  $K^+K^-\pi^0$ , and  $K^\pm K_S^0\pi^\mp$ .  
<sup>9</sup> T-matrix pole.  
<sup>10</sup> Not confirmed by BUGG 08A.  
<sup>11</sup> Isospin 0 not excluded.

NODE=M149W;LINKAGE=AB  
 NODE=M149W;LINKAGE=C  
 NODE=M149W;LINKAGE=A  
 NODE=M149W;LINKAGE=PP  
 NODE=M149W;LINKAGE=UE  
 NODE=M149W;LINKAGE=BU  
 NODE=M149W;LINKAGE=ST  
 NODE=M149W;LINKAGE=BG  
 NODE=M149W;LINKAGE=B  
 NODE=M149W;LINKAGE=BE  
 NODE=M149W;LINKAGE=CC

### $a_0(1450)$ DECAY MODES

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $\pi\eta$        | $0.093 \pm 0.020$              |
| $\Gamma_2$ $\pi\eta'(958)$  | $0.033 \pm 0.017$              |
| $\Gamma_3$ $K\bar{K}$       | $0.082 \pm 0.028$              |
| $\Gamma_4$ $\omega\pi\pi$   | <b>DEFINED AS 1</b>            |
| $\Gamma_5$ $a_0(980)\pi\pi$ | seen                           |
| $\Gamma_6$ $\gamma\gamma$   | seen                           |

NODE=M149215;NODE=M149

DESIG=1

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=6

### $a_0(1450)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

| $\Gamma(\pi\eta) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$           | $\Gamma_1\Gamma_6/\Gamma$                                         |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------|
| VALUE (eV)                                                                    | DOCUMENT ID TECN COMMENT                                          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                                   |
| $432 \pm 6^{+1073}_{-256}$                                                    | <sup>1</sup> UEHARA 09A BELL $\gamma\gamma \rightarrow \pi^0\eta$ |
| <sup>1</sup> May be a different state.                                        |                                                                   |

NODE=M149225

NODE=M149G01  
 NODE=M149G01

NODE=M149G01;LINKAGE=UE

### $a_0(1450)$ BRANCHING RATIOS

| $\Gamma(\pi\eta'(958))/\Gamma(\pi\eta)$                                                   | $\Gamma_2/\Gamma_1$                                                                                   |
|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| VALUE                                                                                     | DOCUMENT ID TECN COMMENT                                                                              |
| <b>0.35 ± 0.16</b>                                                                        | <sup>1</sup> ABELE 98 CBAR $0.0 \bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$                             |
| • • • We do not use the following data for averages, fits, limits, etc. • • •             |                                                                                                       |
| $0.43 \pm 0.19$                                                                           | ABELE 97C CBAR $0.0 \bar{p}p \rightarrow \pi^0\pi^0\eta'$                                             |
| <sup>1</sup> Using $\pi^0\eta$ from AMSLER 94D.                                           |                                                                                                       |
| $\Gamma(K\bar{K})/\Gamma(\pi\eta)$                                                        | $\Gamma_3/\Gamma_1$                                                                                   |
| VALUE                                                                                     | DOCUMENT ID TECN COMMENT                                                                              |
| <b>0.88 ± 0.23</b>                                                                        | <sup>1</sup> ABELE 98 CBAR $0.0 \bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$                             |
| • • • We do not use the following data for averages, fits, limits, etc. • • •             |                                                                                                       |
| $1.887 \pm 0.041 \pm 0.97$                                                                | <sup>2</sup> ALBRECHT 20 RVUE $0.9 \bar{p}p \rightarrow \pi^0\pi^0\eta, \pi^0\eta\eta, \pi^0 K^+ K^-$ |
| <sup>1</sup> Using $\pi^0\eta$ from AMSLER 94D.                                           |                                                                                                       |
| <sup>2</sup> Residues from T-matrix pole, 2 poles, 2 channels ( $\pi\eta$ , $K\bar{K}$ ). |                                                                                                       |

NODE=M149220

NODE=M149R1  
 NODE=M149R1

NODE=M149R1;LINKAGE=A

NODE=M149R2  
 NODE=M149R2

NODE=M149R2;LINKAGE=A  
 NODE=M149R2;LINKAGE=B

| $\Gamma(\omega\pi\pi)/\Gamma(\pi\eta)$                                                                                                                                                         | $\Gamma_4/\Gamma_1$                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| VALUE                                                                                                                                                                                          | DOCUMENT ID TECN COMMENT                                                |
| <b>10.7 ± 2.3</b>                                                                                                                                                                              | <sup>1</sup> BAKER 03 SPEC $\bar{p}p \rightarrow \omega\pi^+\pi^-\pi^0$ |
| <sup>1</sup> Using results on $\bar{p}p \rightarrow a_0(1450)^0\pi^0$ , $a_0(1450) \rightarrow \eta\pi^0$ from ABELE 96C and assuming the $\omega\rho$ mechanism for the $\omega\pi\pi$ state. |                                                                         |

NODE=M149R3  
 NODE=M149R3

NODE=M149R;LINKAGE=PP

| $\Gamma(a_0(980)\pi\pi)/\Gamma_{\text{total}}$ | $\Gamma_5/\Gamma$        |
|------------------------------------------------|--------------------------|
| VALUE                                          | DOCUMENT ID TECN COMMENT |
| seen                                           | BUGG 08A RVUE $\bar{p}p$ |

NODE=M149R01  
 NODE=M149R01

| $\Gamma(a_0(980)\pi\pi)/\Gamma(\pi\eta)$                                      | $\Gamma_5/\Gamma_1$                                           |
|-------------------------------------------------------------------------------|---------------------------------------------------------------|
| VALUE                                                                         | DOCUMENT ID TECN CHG COMMENT                                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                               |
| $\leq 4.3$                                                                    | ANISOVICH 01 RVUE 0 $\bar{p}p \rightarrow \eta 2\pi^+ 2\pi^-$ |

NODE=M149R02  
 NODE=M149R02



$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE | DOCUMENT ID         | TECN     | COMMENT                               |
|-------|---------------------|----------|---------------------------------------|
| seen  | <sup>1</sup> UEHARA | 09A BELL | $\gamma\gamma \rightarrow \pi^0 \eta$ |

<sup>1</sup> May be a different state.

NODE=M149R03  
 NODE=M149R03

NODE=M149R03;LINKAGE=UE

 **$\rho(1450)$  REFERENCES**

|           |     |                              |                                |                                |
|-----------|-----|------------------------------|--------------------------------|--------------------------------|
| ALBRECHT  | 20  | EPJ C80 453                  | M. Albrecht <i>et al.</i>      | (Crystal Barrel Collab.)       |
| AAIJ      | 16N | PR D93 052018                | R. Aaij <i>et al.</i>          | (LHCb Collab.)                 |
| ANISOVICH | 09  | IJMP A24 2481                | V.V. Anisovich, A.V. Sarantsev |                                |
| UEHARA    | 09A | PR D80 032001                | S. Uehara <i>et al.</i>        | (BELLE Collab.)                |
| BUGG      | 08A | PR D78 074023                | D.V. Bugg                      | (LOQM)                         |
| UMAN      | 06  | PR D73 052009                | I. Uman <i>et al.</i>          | (FNAL E835)                    |
| BAKER     | 03  | PL B563 140                  | C.A. Baker <i>et al.</i>       |                                |
| BARGIOTTI | 03  | EPJ C26 371                  | M. Bargiotti <i>et al.</i>     | (OBELIX Collab.)               |
| AMSLER    | 02  | EPJ C23 29                   | C. Amsler <i>et al.</i>        |                                |
| ANISOVICH | 01  | NP A690 567                  | A.V. Anisovich <i>et al.</i>   |                                |
| ABELE     | 98  | PR D57 3860                  | A. Abele <i>et al.</i>         | (Crystal Barrel Collab.)       |
| ANISOVICH | 98B | SPU 41 419                   | V.V. Anisovich <i>et al.</i>   |                                |
|           |     | Translated from UFN 168 481. |                                |                                |
| BERTIN    | 98B | PL B434 180                  | A. Bertin <i>et al.</i>        | (OBELIX Collab.)               |
| ABELE     | 97C | PL B404 179                  | A. Abele <i>et al.</i>         | (Crystal Barrel Collab.)       |
| ABELE     | 96C | NP A609 562                  | A. Abele <i>et al.</i>         | (Crystal Barrel Collab.)       |
| AMSLER    | 95B | PL B342 433                  | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.)       |
| AMSLER    | 95C | PL B353 571                  | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.)       |
| AMSLER    | 95D | PL B355 425                  | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.)       |
| AMSLER    | 94D | PL B333 277                  | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.) IGJPC |
| BUGG      | 94  | PR D50 4412                  | D.V. Bugg <i>et al.</i>        | (LOQM)                         |
| ETKIN     | 82C | PR D25 2446                  | A. Etkin <i>et al.</i>         | (BNL, CUNY, TUFTS, VAND)       |
| MARTIN    | 78  | NP B134 392                  | A.D. Martin <i>et al.</i>      | (DURH, GEVA)                   |
| CASON     | 76  | PRL 36 1485                  | N.M. Cason <i>et al.</i>       | (NDAM, ANL)                    |

NODE=M149

REFID=60439  
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 REFID=44441  
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 REFID=44078  
 REFID=20391  
 REFID=22446  
 REFID=21064

NODE=M105

 **$\rho(1450)$** 

$$I^G(J^{PC}) = 1^+(1^--)$$

NODE=M105

**THE  $\rho(1450)$  AND THE  $\rho(1700)$** 

Updated September 2019 by S. Eidelman (Novosibirsk), C. Hanhart (Juelich) and G. Venanzoni (Pisa).

In our 1988 edition, we replaced the  $\rho(1600)$  entry with two new ones, the  $\rho(1450)$  and the  $\rho(1700)$ , because there was emerging evidence that the 1600-MeV region actually contains two  $\rho$ -like resonances. Erkal [1] had pointed out this possibility with a theoretical analysis on the consistency of  $2\pi$  and  $4\pi$  electromagnetic form factors and the  $\pi\pi$  scattering length. Donnachie [2], with a full analysis of data on the  $2\pi$  and  $4\pi$  final states in  $e^+e^-$  annihilation and photoproduction reactions, had also argued that in order to obtain a consistent picture, two resonances were necessary. The existence of  $\rho(1450)$  was supported by the analysis of  $\eta\rho^0$  mass spectra obtained in photoproduction and  $e^+e^-$  annihilation [3], as well as that of  $e^+e^- \rightarrow \omega\pi$  [4].

The analysis of [2] was further extended by [5,6] to include new data on  $4\pi$ -systems produced in  $e^+e^-$  annihilation, and in  $\tau$ -decays ( $\tau$  decays to  $4\pi$ , and  $e^+e^-$  annihilation to  $4\pi$  can be related by the Conserved Vector Current assumption). These systems were successfully analyzed using interfering contributions from two  $\rho$ -like states, and from the tail of the  $\rho(770)$  decaying into two-body states. While specific conclusions on

$\rho(1450) \rightarrow 4\pi$  were obtained, little could be said about the  $\rho(1700)$ .

Independent evidence for two  $1^-$  states is provided by [7] in  $4\pi$  electroproduction at  $\langle Q^2 \rangle = 1$  (GeV/c)<sup>2</sup>, and by [8] in a high-statistics sample of the  $\eta\pi\pi$  system in  $\pi^-p$  charge exchange.

This scenario with two overlapping resonances is supported by other data. Bisello [9] measured the pion form factor in the interval 1.35–2.4 GeV, and observed a deep minimum around 1.6 GeV. The best fit was obtained with the hypothesis of  $\rho$ -like resonances at 1420 and 1770 MeV, with widths of about 250 MeV. Antonelli [10] found that the  $e^+e^- \rightarrow \eta\pi^+\pi^-$  cross section is better fitted with two fully interfering Breit-Wigners, with parameters in fair agreement with those of [2] and [9]. These results can be considered as a confirmation of the  $\rho(1450)$ .

Decisive evidence for the  $\pi\pi$  decay mode of both  $\rho(1450)$  and  $\rho(1700)$  comes from  $\bar{p}p$  annihilation at rest [11]. It has been shown that these resonances also possess a  $K\bar{K}$  decay mode [12–14]. High-statistics studies of the decays  $\tau \rightarrow \pi\pi\nu_\tau$  [15,16], and  $\tau \rightarrow 4\pi\nu_\tau$  [17] also require the  $\rho(1450)$ , but are not sensitive to the  $\rho(1700)$ , because it is too close to the  $\tau$  mass. A recent very-high-statistics study of the  $\tau \rightarrow \pi\pi\nu_\tau$  decay performed at Belle [18] reports the first observation of both  $\rho(1450)$  and  $\rho(1700)$  in  $\tau$  decays. A clear picture of the two  $\pi^+\pi^-$  resonances interfering with the  $\rho(770)$  in  $e^+e^-$  annihilation was also reported by BaBar using the ISR method [19].

The structure of these  $\rho$  states is not yet completely clear. Barnes [20] and Close [21] claim that  $\rho(1450)$  has a mass consistent with radial  $2S$ , but its decays show characteristics of hybrids, and suggest that this state may be a  $2S$ -hybrid mixture. Donnachie [22] argues that hybrid states could have a  $4\pi$  decay mode dominated by the  $a_1\pi$ . Such behavior has been observed by [23] in  $e^+e^- \rightarrow 4\pi$  in the energy range 1.05–1.38 GeV, and by [17] in  $\tau \rightarrow 4\pi$  decays. CLEO [24] and Belle [25] observe the  $\rho(1450) \rightarrow \omega\pi$  decay mode in  $B$ -meson decays, however, do not find  $\rho(1700) \rightarrow \omega\pi^0$ . A similar conclusion is made by [26,27], who studied the process  $e^+e^- \rightarrow \omega\pi^0$  and do not observe a statistically significant signal of the  $\rho(1700)$ . Various decay modes of the  $\rho(1450)$  and  $\rho(1700)$  are observed in  $\bar{p}n$  and  $\bar{p}p$  annihilation [28,29], but no definite conclusions can be drawn. More data should be collected to clarify the nature of the  $\rho$  states, particularly in the energy range above 1.6 GeV.

We now list under a separate entry the  $\rho(1570)$ , the  $\phi\pi$  state with  $J^{PC} = 1^{--}$  earlier observed by [30] (referred to as  $C(1480)$ ) and recently confirmed by [31]. While [32] shows that it may be a threshold effect, [5] and [33] suggest two independent vector states with this decay mode. The  $C(1480)$  has not been seen in the  $\bar{p}p$  [34] and  $e^+e^-$  [35,36] experiments. However, the sensitivity of the two latter is an order of magnitude lower than that of [31]. Note that [31] can not exclude that their observation is due to an OZI-suppressed decay mode of the  $\rho(1700)$ .

Several observations on the  $\omega\pi$  system in the 1200-MeV region [37–43] may be interpreted in terms of either  $J^P = 1^-$   $\rho(770) \rightarrow \omega\pi$  production [44], or  $J^P = 1^+$   $b_1(1235)$  production [42,43]. We argue that no special entry for a  $\rho(1250)$  is needed. The LASS amplitude analysis [45] showing evidence for  $\rho(1270)$  is preliminary and needs confirmation. For completeness, the relevant observations are listed under the  $\rho(1450)$ .

Recently [46] reported a very broad  $1^{--}$  resonance-like  $K^+K^-$  state in  $J/\psi \rightarrow K^+K^-\pi^0$  decays. Its pole position corresponds to mass of 1576 MeV and width of 818 MeV. [47–49] suggest its exotic structure (molecular or multiquark), while [50] and [51] explain it by the interference between the  $\rho(1450)$  and  $\rho(1700)$ . The latter statement is qualitatively supported by BaBar [52] and SND [53]. We quote [46] as  $X(1575)$  in the section “Further States.”

Evidence for  $\rho$ -like mesons decaying into  $6\pi$  states was first noted by [54] in the analysis of  $6\pi$  mass spectra from  $e^+e^-$  annihilation [55,56] and diffractive photoproduction [57]. Clegg [54] argued that two states at about 2.1 and 1.8 GeV exist: while the former is a candidate for the  $\rho(2150)$ , the latter could be a manifestation of the  $\rho(1700)$  distorted by threshold effects. BaBar reported observations of the new decay modes of the  $\rho(2150)$  in the channels  $\eta'(958)\pi^+\pi^-$  and  $f_1(1285)\pi^+\pi^-$  [58]. The relativistic quark model [59] predicts the  $2^3D_1$  state with  $J^{PC} = 1^{--}$  at 2.15 GeV which can be identified with the  $\rho(2150)$ .

We no longer list under a separate particle  $\rho(1900)$  various observations of irregular behavior of the cross sections near the  $N\bar{N}$  threshold. Dips of various width around 1.9 GeV were reported by the E687 Collaboration (a narrow one in the  $3\pi^+3\pi^-$  diffractive photoproduction [60,61]), by the FENICE experiment (a narrow structure in the  $R$  value [62])

, by BaBar in ISR (a narrow structure in  $e^+e^- \rightarrow \phi\pi$  final state [63], but much broader in  $e^+e^- \rightarrow 3\pi^+3\pi^-$  and  $e^+e^- \rightarrow 2(\pi^+\pi^-\pi^0)$  [64]) , by CMD-3 (also a rather broad dip in  $e^+e^- \rightarrow 3\pi^+3\pi^-$  [65]) . A dedicated scan of the  $N\bar{N}$ -threshold region by CMD-3 confirms this effect in the  $e^+e^- \rightarrow 3\pi^+3\pi^-$  and  $e^+e^- \rightarrow K^+K^-\pi^+\pi^-$  final states, but does not see it in the cross section of  $e^+e^- \rightarrow 2\pi^+2\pi^-$  [66]. Most probably, these structures emerge as a threshold effect due to the opening of the  $N\bar{N}$  channel [67,68,69].

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-

**$\rho(1450)$  MASS** **$\rho(1450)$  MASS**

VALUE (MeV)

DOCUMENT ID

**1465±25 OUR ESTIMATE** This is only an educated guess; the error given is larger than the error on the average of the published values.

NODE=M105205

 NODE=M105M0  
 NODE=M105M0

→ UNCHECKED ←

 **$\eta\rho^0$  MODE**

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |       |                         |     |      |                                               |
|---------|-------|-------------------------|-----|------|-----------------------------------------------|
| 1506±11 | 13.4k | <sup>1</sup> GRIBANOV   | 20  | CMD3 | 1.1–2.0 $e^+e^- \rightarrow \eta\pi^+\pi^-$   |
| 1500±10 | 7.4k  | <sup>2</sup> ACHASOV    | 18  | SND  | 1.22–2.00 $e^+e^- \rightarrow \eta\pi^+\pi^-$ |
| 1497±14 |       | <sup>3</sup> AKHMETSHIN | 01B | CMD2 | $e^+e^- \rightarrow \eta\gamma$               |
| 1421±15 |       | <sup>4</sup> AKHMETSHIN | 00D | CMD2 | $e^+e^- \rightarrow \eta\pi^+\pi^-$           |
| 1470±20 |       | ANTONELLI               | 88  | DM2  | $e^+e^- \rightarrow \eta\pi^+\pi^-$           |
| 1446±10 |       | FUKUI                   | 88  | SPEC | 8.95 $\pi^-p \rightarrow \eta\pi^+\pi^-n$     |

<sup>1</sup> Mass and width of the  $\rho(770)$  fixed at 775 and 149 MeV, respectively; solution 2 of model 2,  $\eta \rightarrow \gamma\gamma$  decays used.

<sup>2</sup> From the combined fit of AULCHENKO 15 and ACHASOV 18 in the model with the interfering  $\rho(1450)$ ,  $\rho(1700)$  and  $\rho(2150)$  with the parameters of the  $\rho(1450)$  and  $\rho(1700)$  floating and the mass and width of the  $\rho(2150)$  fixed at 2155 MeV and 320 MeV, respectively. The phases of the resonances are  $\pi$ , 0 and  $\pi$ , respectively.

<sup>3</sup> Using the data of AKHMETSHIN 01B on  $e^+e^- \rightarrow \eta\gamma$ , AKHMETSHIN 00D and ANTONELLI 88 on  $e^+e^- \rightarrow \eta\pi^+\pi^-$ .

<sup>4</sup> Using the data of ANTONELLI 88, DOLINSKY 91, and AKHMETSHIN 00D. The energy-independent width of the  $\rho(1450)$  and  $\rho(1700)$  mesons assumed.

NODE=M105M1;LINKAGE=B

NODE=M105M1;LINKAGE=A

NODE=M105M;LINKAGE=SW

NODE=M105M1;LINKAGE=KL

 **$\omega\pi$  MODE**

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                       |       |                         |     |      |                                                 |
|---------------------------------------|-------|-------------------------|-----|------|-------------------------------------------------|
| 1510±7                                | 10.2k | <sup>1</sup> ACHASOV    | 16D | SND  | 1.05–2.00 $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1544±22 <sup>+11</sup> <sub>-46</sub> | 821   | <sup>2</sup> MATVIENKO  | 15  | BELL | $\bar{B}^0 \rightarrow D^{*+}\omega\pi^-$       |
| 1491±19                               | 7815  | <sup>3</sup> ACHASOV    | 13  | SND  | 1.05–2.00 $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1582±17±25                            | 2382  | <sup>4</sup> AKHMETSHIN | 03B | CMD2 | $e^+e^- \rightarrow \pi^0\pi^0\gamma$           |
| 1349±25 <sup>+10</sup> <sub>-5</sub>  | 341   | <sup>5</sup> ALEXANDER  | 01B | CLE2 | $B \rightarrow D^{(*)}\omega\pi^-$              |
| 1523±10                               |       | <sup>6</sup> EDWARDS    | 00A | CLE2 | $\tau^- \rightarrow \omega\pi^- \nu_\tau$       |
| 1463±25                               |       | <sup>7</sup> CLEGG      | 94  | RVUE |                                                 |
| 1250                                  |       | <sup>8</sup> ASTON      | 80C | OMEG | 20–70 $\gamma p \rightarrow \omega\pi^0 p$      |
| 1290±40                               |       | <sup>8</sup> BARBER     | 80C | SPEC | 3–5 $\gamma p \rightarrow \omega\pi^0 p$        |

<sup>1</sup> From a phenomenological model based on vector meson dominance with interfering  $\rho(770)$ ,  $\rho(1450)$ , and  $\rho(1700)$ . The  $\rho(1700)$  mass and width are fixed at 1720 MeV and 250 MeV, respectively. Systematic uncertainties not estimated. Supersedes ACHASOV 13.

<sup>2</sup> Using Breit-Wigner parameterization of the  $\rho(1450)$  and assuming equal probabilities of the  $\rho(1450) \rightarrow \pi\pi$  and  $\rho(1450) \rightarrow \omega\pi$  decays.

<sup>3</sup> From a phenomenological model based on vector meson dominance with the interfering  $\rho(1450)$  and  $\rho(1700)$  and their widths fixed at 400 and 250 MeV, respectively. Systematic uncertainty not estimated.

<sup>4</sup> Using the data of AKHMETSHIN 03B and BISELLO 91B assuming the  $\omega\pi^0$  and  $\pi^+\pi^-$  mass dependence of the total width.  $\rho(1700)$  mass and width fixed at 1700 MeV and 240 MeV, respectively.

<sup>5</sup> Using Breit-Wigner parameterization of the  $\rho(1450)$  and assuming the  $\omega\pi^-$  mass dependence for the total width.

<sup>6</sup> Mass-independent width parameterization.  $\rho(1700)$  mass and width fixed at 1700 MeV and 235 MeV respectively.

<sup>7</sup> Using data from BISELLO 91B, DOLINSKY 86 and ALBRECHT 87L.

<sup>8</sup> Not separated from  $b_1(1235)$ , not pure  $J^P = 1^-$  effect.

NODE=M105M3;LINKAGE=D

NODE=M105M3;LINKAGE=C

NODE=M105M3;LINKAGE=AC

NODE=M105M3;LINKAGE=HK

NODE=M105M3;LINKAGE=3Z

NODE=M105M;LINKAGE=E1

NODE=M105M3;LINKAGE=B

NODE=M105M3;LINKAGE=A

 **$4\pi$  MODE**

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |  |                        |     |      |                                                |
|---------|--|------------------------|-----|------|------------------------------------------------|
| 1435±40 |  | ABELE                  | 01B | CBAR | 0.0 $\bar{p}n \rightarrow 2\pi^- 2\pi^0 \pi^+$ |
| 1350±50 |  | ACHASOV                | 97  | RVUE | $e^+e^- \rightarrow 2(\pi^+\pi^-)$             |
| 1449±4  |  | <sup>1</sup> ARMSTRONG | 89E | OMEG | 300 $pp \rightarrow pp2(\pi^+\pi^-)$           |

<sup>1</sup> Not clear whether this observation has  $I=1$  or 0.

 NODE=M105M6  
 NODE=M105M6

NODE=M105M6;LINKAGE=A

**$\pi\pi$  MODE**

| VALUE (MeV)                                                                   | EVTS                 | DOCUMENT ID                  | TECN | COMMENT                                                 |
|-------------------------------------------------------------------------------|----------------------|------------------------------|------|---------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                      |                              |      |                                                         |
| 1326.35 ± 3.46                                                                |                      | <sup>1</sup> BARTOS 17       | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                         |
| 1342.31 ± 46.62                                                               |                      | <sup>2</sup> BARTOS 17A      | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                         |
| 1373.83 ± 11.37                                                               |                      | <sup>3</sup> BARTOS 17A      | RVUE | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$               |
| 1429 ± 41                                                                     | 20k                  | <sup>4</sup> LEES 17C        | BABR | $J/\psi \rightarrow \pi^+\pi^-\pi^0$                    |
| 1350 ± 20                                                                     | $^{+20}_{-30}$ 63.5k | <sup>5</sup> ABRAMOWICZ12    | ZEUS | $ep \rightarrow e\pi^+\pi^-p$                           |
| 1493 ± 15                                                                     |                      | <sup>6</sup> LEES 12G        | BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$                   |
| 1446 ± 7                                                                      | ± 28 5.4M            | <sup>7,8</sup> FUJIKAWA 08   | BELL | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$               |
| 1328 ± 15                                                                     |                      | <sup>9</sup> SCHAELE 05C     | ALEP | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$               |
| 1406 ± 15                                                                     | 87k                  | <sup>7,10</sup> ANDERSON 00A | CLE2 | $\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$               |
| ~ 1368                                                                        |                      | <sup>11</sup> ABELE 99C      | CBAR | $0.0 \bar{p}d \rightarrow \pi^+\pi^-\pi^-p$             |
| 1348 ± 33                                                                     |                      | BERTIN 98                    | OBLX | $0.05-0.405 \bar{n}p \rightarrow$<br>$2\pi^+\pi^-\pi^0$ |
| 1411 ± 14                                                                     |                      | <sup>12</sup> ABELE 97       | CBAR | $\bar{p}n \rightarrow \pi^-\pi^0\pi^0$                  |
| 1370 $^{+90}_{-70}$                                                           |                      | ACHASOV 97                   | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                         |
| 1359 ± 40                                                                     |                      | <sup>10</sup> BERTIN 97C     | OBLX | $0.0 \bar{p}p \rightarrow \pi^+\pi^-\pi^0$              |
| 1282 ± 37                                                                     |                      | BERTIN 97D                   | OBLX | $0.05 \bar{p}p \rightarrow 2\pi^+2\pi^-$                |
| 1424 ± 25                                                                     |                      | BISELLO 89                   | DM2  | $e^+e^- \rightarrow \pi^+\pi^-$                         |
| 1265.5 ± 75.3                                                                 |                      | DUBNICKA 89                  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                         |
| 1292 ± 17                                                                     |                      | <sup>13</sup> KURDADZE 83    | OLYA | $0.64-1.4 e^+e^- \rightarrow$<br>$\pi^+\pi^-$           |

<sup>1</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of LEES 12G and ABLIKIM 16C.

<sup>2</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, and AMBROSINO 11A.

<sup>3</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of FUJIKAWA 08.

<sup>4</sup> From a Dalitz plot analysis in an isobar model with  $\rho(1450)$  and  $\rho(1700)$  masses and widths floating.

<sup>5</sup> Using the KUHN 90 parametrization of the pion form factor, neglecting  $\rho-\omega$  interference.

<sup>6</sup> Using the GOUNARIS 68 parametrization of the pion form factor leaving the masses and widths of the  $\rho(1450)$ ,  $\rho(1700)$ , and  $\rho(2150)$  resonances as free parameters of the fit.

<sup>7</sup> From the GOUNARIS 68 parametrization of the pion form factor.

<sup>8</sup>  $|F_\pi(0)|^2$  fixed to 1.

<sup>9</sup> From the combined fit of the  $\tau^-$  data from ANDERSON 00A and SCHAELE 05C and  $e^+e^-$  data from the compilation of BARKOV 85, AKHMETSHIN 04, and ALOISIO 05.  $\rho(1700)$  mass and width fixed at 1713 MeV and 235 MeV, respectively. Supersedes BARATE 97M.

<sup>10</sup>  $\rho(1700)$  mass and width fixed at 1700 MeV and 235 MeV, respectively.

<sup>11</sup>  $\rho(1700)$  mass and width fixed at 1780 MeV and 275 MeV respectively.

<sup>12</sup> T-matrix pole.

<sup>13</sup> Using for  $\rho(1700)$  mass and width  $1600 \pm 20$  and  $300 \pm 10$  MeV respectively.

NODE=M105M5  
NODE=M105M5

OCCUR=2

OCCUR=2

NODE=M105M5;LINKAGE=D

NODE=M105M5;LINKAGE=E

NODE=M105M5;LINKAGE=F

NODE=M105M5;LINKAGE=B

NODE=M105M5;LINKAGE=AB

NODE=M105M5;LINKAGE=LE

NODE=M105M5;LINKAGE=1K

NODE=M105M5;LINKAGE=FU

NODE=M105M5;LINKAGE=SC

NODE=M105M5;LINKAGE=A

NODE=M105M5;LINKAGE=C5

NODE=M105M5;LINKAGE=QQ

NODE=M105M5;LINKAGE=KD

NODE=M105M7  
NODE=M105M7

 **$K\bar{K}$  MODE**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | CHG | COMMENT                                  |
|-------------------------------------------------------------------------------|------|------------------------|------|-----|------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                        |      |     |                                          |
| 1208 ± 8 ± 9                                                                  | 190k | <sup>1</sup> AAJ 16N   | LHCB |     | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$    |
| 1422.8 ± 6.5                                                                  | 27k  | <sup>2</sup> ABELE 99D | CBAR | ±   | $0.0 \bar{p}p \rightarrow K^+ K^- \pi^0$ |

<sup>1</sup> Using the GOUNARIS 68 parameterization with fixed width.

<sup>2</sup> K-matrix pole. Isospin not determined, could be  $\omega(1420)$ .

NODE=M105M7;LINKAGE=A

NODE=M105M7;LINKAGE=AN

 **$K\bar{K}^*(892) + c.c.$  MODE**

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|-------------|------|-------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |      |                                                 |
| 1505 ± 19 ± 7                                                                 | AUBERT 08S  | BABR | $10.6 e^+e^- \rightarrow K\bar{K}^*(892)\gamma$ |

NODE=M105M8  
NODE=M105M8

 **$m_{\rho(1450)^0} - m_{\rho(1450)^\pm}$** 

| VALUE (MeV)                                                                   | DOCUMENT ID             | TECN | COMMENT                                                                        |
|-------------------------------------------------------------------------------|-------------------------|------|--------------------------------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                         |      |                                                                                |
| -31.53 ± 47.99                                                                | <sup>1</sup> BARTOS 17A | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$ ,<br>$\tau^- \rightarrow \pi^- \pi^0 \nu_\tau$ |

<sup>1</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, AMBROSINO 11A, and FUJIKAWA 08.

NODE=M105DM  
NODE=M105DM

NODE=M105DM;LINKAGE=A

**$\rho(1450)$  WIDTH**

NODE=M105210

 **$\rho(1450)$  WIDTH**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**400± 60 OUR ESTIMATE** This is only an educated guess; the error given is larger than the error on the average of the published values.

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |                      |     |     |                                            |
|---------|----------------------|-----|-----|--------------------------------------------|
| 480±180 | <sup>1</sup> ACHASOV | 10D | SND | 1.075–2.0 $e^+e^- \rightarrow \pi^0\gamma$ |
|---------|----------------------|-----|-----|--------------------------------------------|

<sup>1</sup> From a fit of a VMD model with two effective resonances with masses of 1450 MeV and 1700 MeV to describe the excited vector states  $\omega(1420)$ ,  $\rho(1450)$ ,  $\omega(1650)$ , and  $\rho(1700)$ . Systematic errors not evaluated.

NODE=M105W0;LINKAGE=A

 **$\eta\rho^0$  MODE**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |       |                         |     |      |                                               |
|--------|-------|-------------------------|-----|------|-----------------------------------------------|
| 321±27 | 13.4k | <sup>1</sup> GRIBANOV   | 20  | CMD3 | 1.1–2.0 $e^+e^- \rightarrow \eta\pi^+\pi^-$   |
| 280±20 | 7.4k  | <sup>2</sup> ACHASOV    | 18  | SND  | 1.22–2.00 $e^+e^- \rightarrow \eta\pi^+\pi^-$ |
| 226±44 |       | <sup>3</sup> AKHMETSHIN | 01B | CMD2 | $e^+e^- \rightarrow \eta\gamma$               |
| 211±31 |       | <sup>4</sup> AKHMETSHIN | 00D | CMD2 | $e^+e^- \rightarrow \eta\pi^+\pi^-$           |
| 230±30 |       | ANTONELLI               | 88  | DM2  | $e^+e^- \rightarrow \eta\pi^+\pi^-$           |
| 60±15  |       | FUKUI                   | 88  | SPEC | 8.95 $\pi^-p \rightarrow \eta\pi^+\pi^-n$     |

<sup>1</sup> Mass and width of the  $\rho(770)$  fixed at 775 and 149 MeV, respectively; solution 2 of model 2,  $\eta \rightarrow \gamma\gamma$  decays used.

<sup>2</sup> From the combined fit of AULCHENKO 15 and ACHASOV 18 in the model with the interfering  $\rho(1450)$ ,  $\rho(1700)$  and  $\rho(2150)$  with the parameters of the  $\rho(1450)$  and  $\rho(1700)$  floating and the mass and width of the  $\rho(2150)$  fixed at 2155 MeV and 320 MeV, respectively. The phases of the resonances are  $\pi$ , 0 and  $\pi$ , respectively.

<sup>3</sup> Using the data of AKHMETSHIN 01B on  $e^+e^- \rightarrow \eta\gamma$ , AKHMETSHIN 00D and ANTONELLI 88 on  $e^+e^- \rightarrow \eta\pi^+\pi^-$ .

<sup>4</sup> Using the data of ANTONELLI 88, DOLINSKY 91, and AKHMETSHIN 00D. The energy-independent width of the  $\rho(1450)$  and  $\rho(1700)$  mesons assumed.

NODE=M105W1;LINKAGE=B

NODE=M105W1;LINKAGE=A

NODE=M105W;LINKAGE=SW

NODE=M105W1;LINKAGE=KL

 **$\omega\pi$  MODE**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                               |       |                         |     |      |                                                 |
|---------------------------------------------------------------|-------|-------------------------|-----|------|-------------------------------------------------|
| 440± 40                                                       | 10.2k | <sup>1</sup> ACHASOV    | 16D | SND  | 1.05–2.00 $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 303 <sup>+</sup> <sub>–</sub> 31 <sup>+</sup> <sub>52–7</sub> | 821   | <sup>2</sup> MATVIENKO  | 15  | BELL | $\bar{B}^0 \rightarrow D^{*+}\omega\pi^-$       |
| 429± 42±10                                                    | 2382  | <sup>3</sup> AKHMETSHIN | 03B | CMD2 | $e^+e^- \rightarrow \pi^0\pi^0\gamma$           |
| 547± 86 <sup>+</sup> <sub>–</sub> 46 <sub>–45</sub>           | 341   | <sup>4</sup> ALEXANDER  | 01B | CLE2 | $B \rightarrow D^{(*)}\omega\pi^-$              |
| 400± 35                                                       |       | <sup>5</sup> EDWARDS    | 00A | CLE2 | $\tau^- \rightarrow \omega\pi^-\nu_\tau$        |
| 311± 62                                                       |       | <sup>6</sup> CLEGG      | 94  | RVUE |                                                 |
| 300                                                           |       | <sup>7</sup> ASTON      | 80C | OMEG | 20–70 $\gamma p \rightarrow \omega\pi^0 p$      |
| 320±100                                                       |       | <sup>7</sup> BARBER     | 80C | SPEC | 3–5 $\gamma p \rightarrow \omega\pi^0 p$        |

<sup>1</sup> From a phenomenological model based on vector meson dominance with interfering  $\rho(770)$ ,  $\rho(1450)$ , and  $\rho(1700)$ . The  $\rho(1700)$  mass and width are fixed at 1720 MeV and 250 MeV, respectively. Systematic uncertainties not estimated. Supersedes ACHASOV 13.

<sup>2</sup> Using Breit-Wigner parameterization of the  $\rho(1450)$  and assuming equal probabilities of the  $\rho(1450) \rightarrow \pi\pi$  and  $\rho(1450) \rightarrow \omega\pi$  decays.

<sup>3</sup> Using the data of AKHMETSHIN 03B and BISELLO 91B assuming the  $\omega\pi^0$  and  $\pi^+\pi^-$  mass dependence of the total width.  $\rho(1700)$  mass and width fixed at 1700 MeV and 240 MeV, respectively.

<sup>4</sup> Using Breit-Wigner parameterization of the  $\rho(1450)$  and assuming the  $\omega\pi^-$  mass dependence for the total width.

<sup>5</sup> Mass-independent width parameterization.  $\rho(1700)$  mass and width fixed at 1700 MeV and 235 MeV respectively.

<sup>6</sup> Using data from BISELLO 91B, DOLINSKY 86 and ALBRECHT 87L.

<sup>7</sup> Not separated from  $b_1(1235)$ , not pure  $J^P = 1^-$  effect.

NODE=M105W3;LINKAGE=D

NODE=M105W3;LINKAGE=C

NODE=M105W3;LINKAGE=HK

NODE=M105W3;LINKAGE=3Z

NODE=M105W;LINKAGE=E1

NODE=M105W3;LINKAGE=B

NODE=M105W3;LINKAGE=A

 **$4\pi$  MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |       |     |      |                                               |
|---------|-------|-----|------|-----------------------------------------------|
| 325±100 | ABELE | 01B | CBAR | 0.0 $\bar{p}n \rightarrow 2\pi^- 2\pi^0\pi^+$ |
|---------|-------|-----|------|-----------------------------------------------|

NODE=M105W66

NODE=M105W66



**$\pi\pi$  MODE**

| VALUE (MeV)                                                                   | EVTS                                                     | DOCUMENT ID               | TECN     | COMMENT                                                |
|-------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------|----------|--------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                                                          |                           |          |                                                        |
| 324.13 ± 12.01                                                                |                                                          | <sup>1</sup> BARTOS       | 17 RVUE  | $e^+e^- \rightarrow \pi^+\pi^-$                        |
| 492.17 ± 138.38                                                               |                                                          | <sup>2</sup> BARTOS       | 17A RVUE | $e^+e^- \rightarrow \pi^+\pi^-$                        |
| 340.87 ± 23.84                                                                |                                                          | <sup>3</sup> BARTOS       | 17A RVUE | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$                |
| 576 ± 29                                                                      | 20k                                                      | <sup>4</sup> LEES         | 17C BABR | $J/\psi \rightarrow \pi^+\pi^-\pi^0$                   |
| 460 ± 30                                                                      | $\begin{smallmatrix} +40 \\ -45 \end{smallmatrix}$ 63.5k | <sup>5</sup> ABRAMOWICZ12 | ZEUS     | $ep \rightarrow e\pi^+\pi^-p$                          |
| 427 ± 31                                                                      |                                                          | <sup>6</sup> LEES         | 12G BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$                  |
| 434 ± 16                                                                      | ± 60 5.4M                                                | <sup>7,8</sup> FUJIKAWA   | 08 BELL  | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$                |
| 468 ± 41                                                                      |                                                          | <sup>9</sup> SCHAEEL      | 05C ALEP | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$                |
| 455 ± 41                                                                      | 87k                                                      | <sup>7,10</sup> ANDERSON  | 00A CLE2 | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$                |
| ~ 374                                                                         |                                                          | <sup>11</sup> ABELE       | 99C CBAR | $0.0 \bar{p}d \rightarrow \pi^+\pi^-\pi^-p$            |
| 275 ± 10                                                                      |                                                          | BERTIN                    | 98 OBLX  | $0.05-0.405 \bar{n}p \rightarrow$<br>$\pi^+\pi^+\pi^-$ |
| 343 ± 20                                                                      |                                                          | <sup>12</sup> ABELE       | 97 CBAR  | $\bar{p}n \rightarrow \pi^-\pi^0\pi^0$                 |
| 310 ± 40                                                                      |                                                          | <sup>10</sup> BERTIN      | 97C OBLX | $0.0 \bar{p}p \rightarrow \pi^+\pi^-\pi^0$             |
| 236 ± 36                                                                      |                                                          | BERTIN                    | 97D OBLX | $0.05 \bar{p}p \rightarrow 2\pi^+2\pi^-$               |
| 269 ± 31                                                                      |                                                          | BISELLO                   | 89 DM2   | $e^+e^- \rightarrow \pi^+\pi^-$                        |
| 391 ± 70                                                                      |                                                          | DUBNICKA                  | 89 RVUE  | $e^+e^- \rightarrow \pi^+\pi^-$                        |
| 218 ± 46                                                                      |                                                          | <sup>13</sup> KURDADZE    | 83 OLYA  | $0.64-1.4 e^+e^- \rightarrow$<br>$\pi^+\pi^-$          |

- 1 Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of LEES 12G and ABLIKIM 16C.
- 2 Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, and AMBROSINO 11A.
- 3 Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of FUJIKAWA 08.
- 4 From a Dalitz plot analysis in an isobar model with  $\rho(1450)$  and  $\rho(1700)$  masses and widths floating.
- 5 Using the KUHN 90 parametrization of the pion form factor, neglecting  $\rho-\omega$  interference.
- 6 Using the GOUNARIS 68 parametrization of the pion form factor leaving the masses and widths of the  $\rho(1450)$ ,  $\rho(1700)$ , and  $\rho(2150)$  resonances as free parameters of the fit.
- 7 From the GOUNARIS 68 parametrization of the pion form factor.
- 8  $|F_\pi(0)|^2$  fixed to 1.
- 9 From the combined fit of the  $\tau^-$  data from ANDERSON 00A and SCHAEEL 05C and  $e^+e^-$  data from the compilation of BARKOV 85, AKHMETSHIN 04, and ALOISIO 05.  $\rho(1700)$  mass and width fixed at 1713 MeV and 235 MeV, respectively. Supersedes BARATE 97M.
- 10  $\rho(1700)$  mass and width fixed at 1700 MeV and 235 MeV, respectively.
- 11  $\rho(1700)$  mass and width fixed at 1780 MeV and 275 MeV respectively.
- 12 T-matrix pole.
- 13 Using for  $\rho(1700)$  mass and width  $1600 \pm 20$  and  $300 \pm 10$  MeV respectively.

 **$K\bar{K}$  MODE**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID        | TECN     | CHG | COMMENT                                  |
|-------------------------------------------------------------------------------|------|--------------------|----------|-----|------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                    |          |     |                                          |
| 410 ± 19 ± 35                                                                 | 190k | <sup>1</sup> AAIJ  | 16N LHCb |     | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$    |
| 146.5 ± 10.5                                                                  | 27k  | <sup>2</sup> ABELE | 99D CBAR | ±   | $0.0 \bar{p}p \rightarrow K^+ K^- \pi^0$ |

- 1 Using the GOUNARIS 68 parameterization with fixed mass.
- 2 K-matrix pole. Isospin not determined, could be  $\omega(1420)$ .

 **$K\bar{K}^*(892) + \text{c.c.} \text{ MODE}$** 

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN     | COMMENT                                         |
|-------------------------------------------------------------------------------|-------------|----------|-------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |          |                                                 |
| 418 ± 25 ± 4                                                                  | AUBERT      | 08S BABR | $10.6 e^+e^- \rightarrow K\bar{K}^*(892)\gamma$ |

 **$\Gamma_{\rho(1450)^0} = \Gamma_{\rho(1450)^\pm}$** 

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN     | COMMENT                                                                      |
|-------------------------------------------------------------------------------|---------------------|----------|------------------------------------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                     |          |                                                                              |
| 151.30 ± 140.42                                                               | <sup>1</sup> BARTOS | 17A RVUE | $e^+e^- \rightarrow \pi^+\pi^-$ ,<br>$\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ |

- 1 Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, AMBROSINO 11A, and FUJIKAWA 08.

NODE=M105W5  
NODE=M105W5

OCCUR=2

NODE=M105W5;LINKAGE=C

NODE=M105W5;LINKAGE=D

NODE=M105W5;LINKAGE=E

NODE=M105W5;LINKAGE=B

NODE=M105W5;LINKAGE=AB

NODE=M105W5;LINKAGE=LE

NODE=M105W5;LINKAGE=1K

NODE=M105W5;LINKAGE=FU

NODE=M105W5;LINKAGE=SC

NODE=M105W5;LINKAGE=A

NODE=M105W5;LINKAGE=C5

NODE=M105W5;LINKAGE=QQ

NODE=M105W5;LINKAGE=KD

NODE=M105W7  
NODE=M105W7

NODE=M105W7;LINKAGE=A

NODE=M105W7;LINKAGE=AN

NODE=M105W8  
NODE=M105W8

NODE=M105DW  
NODE=M105DW

NODE=M105DW;LINKAGE=A

**$\rho(1450)$  DECAY MODES**

NODE=M105215;NODE=M105

| Mode                                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------------------------|--------------------------------|
| $\Gamma_1$ $\pi\pi$                           | seen                           |
| $\Gamma_2$ $\pi^+\pi^-$                       | seen                           |
| $\Gamma_3$ $4\pi$                             | seen                           |
| $\Gamma_4$ $\omega\pi$                        |                                |
| $\Gamma_5$ $a_1(1260)\pi$                     |                                |
| $\Gamma_6$ $h_1(1170)\pi$                     |                                |
| $\Gamma_7$ $\pi(1300)\pi$                     |                                |
| $\Gamma_8$ $\rho\rho$                         |                                |
| $\Gamma_9$ $\rho(\pi\pi)$ S-wave              |                                |
| $\Gamma_{10}$ $e^+e^-$                        | seen                           |
| $\Gamma_{11}$ $\eta\rho$                      | seen                           |
| $\Gamma_{12}$ $a_2(1320)\pi$                  | not seen                       |
| $\Gamma_{13}$ $K\bar{K}$                      | seen                           |
| $\Gamma_{14}$ $K^+K^-$                        | seen                           |
| $\Gamma_{15}$ $K\bar{K}^*(892) + \text{c.c.}$ | possibly seen                  |
| $\Gamma_{16}$ $\pi^0\gamma$                   |                                |
| $\Gamma_{17}$ $\eta\gamma$                    | seen                           |
| $\Gamma_{18}$ $f_0(500)\gamma$                | not seen                       |
| $\Gamma_{19}$ $f_0(980)\gamma$                | not seen                       |
| $\Gamma_{20}$ $f_0(1370)\gamma$               | not seen                       |
| $\Gamma_{21}$ $f_2(1270)\gamma$               | not seen                       |

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=20;OUR EVAL;→ UNCHECKED ←  
DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=6  
DESIG=10  
DESIG=11  
DESIG=12  
DESIG=13  
DESIG=14  
DESIG=4;OUR EST;→ UNCHECKED ←  
DESIG=3  
DESIG=8;OUR EST;→ UNCHECKED ←  
DESIG=7;OUR EVAL;→ UNCHECKED ←  
DESIG=21;OUR EVAL;→ UNCHECKED ←  
DESIG=15;OUR EST;→ UNCHECKED ←  
DESIG=23  
DESIG=9  
DESIG=16;OUR EST;→ UNCHECKED ←  
DESIG=17;OUR EST;→ UNCHECKED ←  
DESIG=18;OUR EST;→ UNCHECKED ←  
DESIG=19;OUR EST;→ UNCHECKED ←

 **$\rho(1450) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$** 

NODE=M105220

**$\Gamma(\pi\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**   **$\Gamma_1\Gamma_{10}/\Gamma$**

VALUE (keV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.12 <sup>1</sup> DIEKMAN 88 RVUE  $e^+e^- \rightarrow \pi^+\pi^-$   
0.027<sup>+0.015</sup><sub>-0.010</sub> <sup>2</sup> KURDADZE 83 OLYA 0.64–1.4  $e^+e^- \rightarrow \pi^+\pi^-$

<sup>1</sup> Using total width = 235 MeV.

<sup>2</sup> Using for  $\rho(1700)$  mass and width  $1600 \pm 20$  and  $300 \pm 10$  MeV respectively.

NODE=M105G3  
NODE=M105G3

NODE=M105G3;LINKAGE=B  
NODE=M105G3;LINKAGE=KD

**$\Gamma(\eta\rho) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**   **$\Gamma_{11}\Gamma_{10}/\Gamma$**

VALUE (eV) EVTS DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

335 $\pm$ 27 $\pm$ 20 13.4k <sup>1</sup> GRIBANOV 20 CMD3 1.1–2.0  $e^+e^- \rightarrow \eta\pi^+\pi^-$   
210 $\pm$ 24 $\pm$ 10 <sup>2</sup> LEES 18 BABR  $e^+e^- \rightarrow \eta\pi^+\pi^-$   
74 $\pm$ 20 <sup>3</sup> AKHMETSHIN 00D CMD2  $e^+e^- \rightarrow \eta\pi^+\pi^-$   
91 $\pm$ 19 ANTONELLI 88 DM2  $e^+e^- \rightarrow \eta\pi^+\pi^-$

<sup>1</sup> Mass and width of the  $\rho(770)$  fixed at 775 and 149 MeV, respectively; solution 2 of model 2,  $\eta \rightarrow \gamma\gamma$  decays used.

<sup>2</sup> Includes non-resonant contribution. The selected fit model includes three  $\rho$  excited states. Model uncertainty is 20%.

<sup>3</sup> Using the data of ANTONELLI 88, DOLINSKY 91, and AKHMETSHIN 00D. The energy-independent width of the  $\rho(1450)$  and  $\rho(1700)$  mesons assumed.

NODE=M105G4  
NODE=M105G4

NODE=M105G4;LINKAGE=B

NODE=M105G4;LINKAGE=A

NODE=M105G4;LINKAGE=KL

**$\Gamma(\eta\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$**   **$\Gamma_{17}\Gamma_{10}/\Gamma$**

VALUE (eV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

<16.4 <sup>1</sup> AKHMETSHIN 05 CMD2 0.60–1.38  $e^+e^- \rightarrow \eta\gamma$   
2.2 $\pm$ 0.5 $\pm$ 0.3 <sup>2</sup> AKHMETSHIN 01B CMD2  $e^+e^- \rightarrow \eta\gamma$

<sup>1</sup> From  $2\gamma$  decay mode of  $\eta$  using 1465 MeV and 310 MeV for the  $\rho(1450)$  mass and width. Recalculated by us.

<sup>2</sup> Using the data of AKHMETSHIN 01B on  $e^+e^- \rightarrow \eta\gamma$ , AKHMETSHIN 00D and ANTONELLI 88 on  $e^+e^- \rightarrow \eta\pi^+\pi^-$ . Recalculated by us using width of 226 MeV.

NODE=M105G6  
NODE=M105G6

NODE=M105G6;LINKAGE=AK

NODE=M105G;LINKAGE=SW

$$\Gamma(K\bar{K}^*(892)+c.c.) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{15}\Gamma_{10}/\Gamma$$

| VALUE (eV) | DOCUMENT ID | TECN | COMMENT |
|------------|-------------|------|---------|
|------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |        |          |                                                               |
|--------------|--------|----------|---------------------------------------------------------------|
| 127 ± 15 ± 6 | AUBERT | 08S BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → K $\bar{K}^*(892)\gamma$ |
|--------------|--------|----------|---------------------------------------------------------------|

NODE=M105G8  
NODE=M105G8

$$\rho(1450) \Gamma(i)/\Gamma(\text{total}) \times \Gamma(e^+e^-)/\Gamma(\text{total})$$

NODE=M105230

$$\Gamma(\omega\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units 10 <sup>-6</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |       |                      |         |                                                              |
|-----------|-------|----------------------|---------|--------------------------------------------------------------|
| 2.1 ± 0.4 | 10.2k | <sup>1</sup> ACHASOV | 16D SND | 1.05–2.00 e <sup>+</sup> e <sup>-</sup> → $\pi^0\pi^0\gamma$ |
| 5.3 ± 0.4 | 7815  | <sup>2</sup> ACHASOV | 13 SND  | 1.05–2.00 e <sup>+</sup> e <sup>-</sup> → $\pi^0\pi^0\gamma$ |

OCCUR=3

<sup>1</sup>From a phenomenological model based on vector meson dominance with interfering  $\rho(770)$ ,  $\rho(1450)$ , and  $\rho(1700)$ . The  $\rho(1700)$  mass and width are fixed at 1720 MeV and 250 MeV, respectively. Systematic uncertainties not estimated. Supersedes ACHASOV 13.

NODE=M105R05;LINKAGE=A

<sup>2</sup>From a phenomenological model based on vector meson dominance with the interfering  $\rho(1450)$  and  $\rho(1700)$  and their widths fixed at 400 and 250 MeV, respectively. Systematic uncertainty not estimated.

NODE=M105R05;LINKAGE=AC

$$\Gamma(\eta\rho)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{11}/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units 10 <sup>-7</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                           |      |                        |        |                                                            |
|-------------------------------------------|------|------------------------|--------|------------------------------------------------------------|
| 7.3 ± 0.3                                 | 7.4k | <sup>1</sup> ACHASOV   | 18 SND | 1.22–2.00 e <sup>+</sup> e <sup>-</sup> → $\eta\pi^+\pi^-$ |
| 4.3 <sup>+1.1</sup> <sub>-0.9</sub> ± 0.2 | 4.9k | <sup>2</sup> AULCHENKO | 15 SND | 1.22–2.00 e <sup>+</sup> e <sup>-</sup> → $\eta\pi^+\pi^-$ |

<sup>1</sup>From the combined fit of AULCHENKO 15 and ACHASOV 18 in the model with the interfering  $\rho(1450)$ ,  $\rho(1700)$  and  $\rho(2150)$  with the parameters of the  $\rho(1450)$  and  $\rho(1700)$  floating and the mass and width of the  $\rho(2150)$  fixed at 2155 MeV and 320 MeV, respectively. The phases of the resonances are  $\pi$ , 0 and  $\pi$ , respectively.

NODE=M105R00;LINKAGE=B

<sup>2</sup>From a fit to the  $e^+e^- \rightarrow \eta\pi^+\pi^-$  cross section with vector meson dominance model including  $\rho(770)$ ,  $\rho(1450)$ , and  $\rho(1700)$  decaying exclusively via  $\eta\rho(770)$ . Masses and widths of vector states are fixed to PDG 14. Coupling constants are assumed to be real.

NODE=M105R00;LINKAGE=A

$$\Gamma(f_0(500)\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{18}/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units 10 <sup>-9</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----|-------------|------|---------|
|---------------------------------|-----|-------------|------|---------|

|      |    |         |        |                                                    |
|------|----|---------|--------|----------------------------------------------------|
| <4.0 | 90 | ACHASOV | 11 SND | e <sup>+</sup> e <sup>-</sup> → $\pi^0\pi^0\gamma$ |
|------|----|---------|--------|----------------------------------------------------|

NODE=M105R01  
NODE=M105R01

$$\Gamma(\pi^0\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{16}/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units 10 <sup>-9</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |                      |         |                                                         |
|-----------|----------------------|---------|---------------------------------------------------------|
| 2.3 ± 1.4 | <sup>1</sup> ACHASOV | 10D SND | 1.075–2.0 e <sup>+</sup> e <sup>-</sup> → $\pi^0\gamma$ |
|-----------|----------------------|---------|---------------------------------------------------------|

<sup>1</sup>From a fit of a VMD model with two effective resonances with masses of 1450 MeV and 1700 MeV to describe the excited vector states  $\omega(1420)$ ,  $\rho(1450)$ ,  $\omega(1650)$ , and  $\rho(1700)$ . Systematic errors not evaluated.

NODE=M105R17;LINKAGE=A

$$\Gamma(f_0(980)\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{19}/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units 10 <sup>-9</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----|-------------|------|---------|
|---------------------------------|-----|-------------|------|---------|

|      |    |         |        |                                                    |
|------|----|---------|--------|----------------------------------------------------|
| <2.6 | 90 | ACHASOV | 11 SND | e <sup>+</sup> e <sup>-</sup> → $\pi^0\pi^0\gamma$ |
|------|----|---------|--------|----------------------------------------------------|

NODE=M105R02  
NODE=M105R02

$$\Gamma(f_0(1370)\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{20}/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units 10 <sup>-9</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----|-------------|------|---------|
|---------------------------------|-----|-------------|------|---------|

|      |    |         |        |                                                    |
|------|----|---------|--------|----------------------------------------------------|
| <3.5 | 90 | ACHASOV | 11 SND | e <sup>+</sup> e <sup>-</sup> → $\pi^0\pi^0\gamma$ |
|------|----|---------|--------|----------------------------------------------------|

NODE=M105R03  
NODE=M105R03

$$\Gamma(f_2(1270)\gamma)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{21}/\Gamma \times \Gamma_{10}/\Gamma$$

| VALUE (units 10 <sup>-9</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----|-------------|------|---------|
|---------------------------------|-----|-------------|------|---------|

|      |    |                      |        |                                                    |
|------|----|----------------------|--------|----------------------------------------------------|
| <0.8 | 90 | <sup>1</sup> ACHASOV | 11 SND | e <sup>+</sup> e <sup>-</sup> → $\pi^0\pi^0\gamma$ |
|------|----|----------------------|--------|----------------------------------------------------|

NODE=M105R04  
NODE=M105R04

<sup>1</sup>Using Breit-Wigner parametrization of the  $\rho(1450)$  with mass and width of 1465 MeV and 400 MeV, respectively.

NODE=M105R01;LINKAGE=AC

**$\rho(1450)$  BRANCHING RATIOS** **$\Gamma(\pi\pi)/\Gamma(4\pi)$** 

| VALUE     | DOCUMENT ID          | TECN | COMMENT                              |
|-----------|----------------------|------|--------------------------------------|
| 0.37±0.10 | <sup>1,2</sup> ABELE | 01B  | CBAR 0.0 $\bar{p}n \rightarrow 5\pi$ |

<sup>1</sup>  $\omega\pi$  not included.<sup>2</sup> Using ABELE 97. **$\Gamma_1/\Gamma_3$** 

NODE=M105225

NODE=M105R15  
NODE=M105R15 **$\Gamma(K^+K^-)/\Gamma(\pi^+\pi^-)$** 

| VALUE (%)    | EVTS | DOCUMENT ID       | TECN | COMMENT                                 |
|--------------|------|-------------------|------|-----------------------------------------|
| 30.7±8.4±8.2 | 20k  | <sup>1</sup> LEES | 17C  | BABR $J/\psi \rightarrow h^+ h^- \pi^0$ |

<sup>1</sup> From Dalitz plot analyses in isobar models. **$\Gamma_{14}/\Gamma_2$** NODE=M105R;LINKAGE=BL  
NODE=M105R;LINKAGE=LKNODE=M105R08  
NODE=M105R08

NODE=M105R08;LINKAGE=A

 **$\Gamma(\omega\pi)/\Gamma_{\text{total}}$** 

| VALUE  | EVTS | DOCUMENT ID            | TECN | COMMENT                                          |
|--------|------|------------------------|------|--------------------------------------------------|
| seen   | 821  | <sup>1</sup> MATVIENKO | 15   | BELL $\bar{B}^0 \rightarrow D^{*+} \omega \pi^-$ |
| seen   | 1.6k | ACHASOV                | 12   | SND $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$     |
| ~ 0.21 |      | CLEGG                  | 94   | RVUE                                             |

<sup>1</sup> Using Breit-Wigner parameterization of the  $\rho(1450)$  and assuming equal probabilities of the  $\rho(1450) \rightarrow \pi\pi$  and  $\rho(1450) \rightarrow \omega\pi$  decays. **$\Gamma_4/\Gamma$** NODE=M105R5  
NODE=M105R5

NODE=M105R5;LINKAGE=A

 **$\Gamma(\pi\pi)/\Gamma(\omega\pi)$** 

| VALUE  | DOCUMENT ID | TECN |
|--------|-------------|------|
| ~ 0.32 | CLEGG       | 94   |

 **$\Gamma(\omega\pi)/\Gamma(4\pi)$** 

| VALUE | DOCUMENT ID | TECN |
|-------|-------------|------|
| <0.14 | CLEGG       | 88   |

 **$\Gamma_1/\Gamma_4$** NODE=M105R6  
NODE=M105R6 **$\Gamma_4/\Gamma_3$** NODE=M105R3  
NODE=M105R3 **$\Gamma(a_1(1260)\pi)/\Gamma(4\pi)$** 

| VALUE     | DOCUMENT ID        | TECN | COMMENT                              |
|-----------|--------------------|------|--------------------------------------|
| 0.27±0.08 | <sup>1</sup> ABELE | 01B  | CBAR 0.0 $\bar{p}n \rightarrow 5\pi$ |

<sup>1</sup>  $\omega\pi$  not included. **$\Gamma_5/\Gamma_3$** NODE=M105R10  
NODE=M105R10

NODE=M105R10;LINKAGE=BL

 **$\Gamma(h_1(1170)\pi)/\Gamma(4\pi)$** 

| VALUE     | DOCUMENT ID        | TECN | COMMENT                              |
|-----------|--------------------|------|--------------------------------------|
| 0.08±0.04 | <sup>1</sup> ABELE | 01B  | CBAR 0.0 $\bar{p}n \rightarrow 5\pi$ |

<sup>1</sup>  $\omega\pi$  not included. **$\Gamma_6/\Gamma_3$** NODE=M105R11  
NODE=M105R11

NODE=M105R11;LINKAGE=BL

 **$\Gamma(\pi(1300)\pi)/\Gamma(4\pi)$** 

| VALUE     | DOCUMENT ID        | TECN | COMMENT                              |
|-----------|--------------------|------|--------------------------------------|
| 0.37±0.13 | <sup>1</sup> ABELE | 01B  | CBAR 0.0 $\bar{p}n \rightarrow 5\pi$ |

<sup>1</sup>  $\omega\pi$  not included. **$\Gamma_7/\Gamma_3$** NODE=M105R12  
NODE=M105R12

NODE=M105R12;LINKAGE=BL

 **$\Gamma(\rho\rho)/\Gamma(4\pi)$** 

| VALUE     | DOCUMENT ID        | TECN | COMMENT                              |
|-----------|--------------------|------|--------------------------------------|
| 0.11±0.05 | <sup>1</sup> ABELE | 01B  | CBAR 0.0 $\bar{p}n \rightarrow 5\pi$ |

<sup>1</sup>  $\omega\pi$  not included. **$\Gamma_8/\Gamma_3$** NODE=M105R13  
NODE=M105R13

NODE=M105R13;LINKAGE=BL

 **$\Gamma(\rho(\pi\pi)\text{S-wave})/\Gamma(4\pi)$** 

| VALUE     | DOCUMENT ID        | TECN | COMMENT                              |
|-----------|--------------------|------|--------------------------------------|
| 0.17±0.09 | <sup>1</sup> ABELE | 01B  | CBAR 0.0 $\bar{p}n \rightarrow 5\pi$ |

<sup>1</sup>  $\omega\pi$  not included. **$\Gamma_9/\Gamma_3$** NODE=M105R14  
NODE=M105R14

NODE=M105R14;LINKAGE=BL

$\Gamma(\eta\rho)/\Gamma_{\text{total}}$ 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

|      |    |                      |    |                                               |
|------|----|----------------------|----|-----------------------------------------------|
| seen | 35 | <sup>1</sup> ACHASOV | 14 | SND 1.15–2.00 $e^+e^- \rightarrow \eta\gamma$ |
|------|----|----------------------|----|-----------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |  |           |     |      |
|-------|--|-----------|-----|------|
| <0.04 |  | DONNACHIE | 87B | RVUE |
|-------|--|-----------|-----|------|

<sup>1</sup>From a phenomenological model based on vector meson dominance with  $\rho(1450)$  and  $\phi(1680)$  masses and widths from the PDG 12.

NODE=M105R2  
NODE=M105R2

NODE=M105R2;LINKAGE=A

 $\Gamma(\eta\rho)/\Gamma(\omega\pi)$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |                          |    |                                                   |
|-------------------|--------------------------|----|---------------------------------------------------|
| $0.081 \pm 0.020$ | <sup>1,2</sup> AULCHENKO | 15 | SND 1.22–2.00 $e^+e^- \rightarrow \eta\pi^+\pi^-$ |
|-------------------|--------------------------|----|---------------------------------------------------|

|             |                        |    |      |
|-------------|------------------------|----|------|
| $\sim 0.24$ | <sup>3</sup> DONNACHIE | 91 | RVUE |
|-------------|------------------------|----|------|

|    |       |    |                                             |
|----|-------|----|---------------------------------------------|
| >2 | FUKUI | 91 | SPEC 8.95 $\pi^-p \rightarrow \omega\pi^0n$ |
|----|-------|----|---------------------------------------------|

<sup>1</sup>From a fit to the  $e^+e^- \rightarrow \eta\pi^+\pi^-$  cross section with vector meson dominance model including  $\rho(770)$ ,  $\rho(1450)$ , and  $\rho(1700)$  decaying exclusively via  $\eta\rho(770)$ . Masses and widths of vector states are fixed to PDG 14. Coupling constants are assumed to be real.

<sup>2</sup>Reports the inverse of the quoted value as  $12.3 \pm 3.1$ .

<sup>3</sup>Using data from BISELLO 91B, DOLINSKY 86 and ALBRECHT 87L.

NODE=M105R4  
NODE=M105R4

NODE=M105R4;LINKAGE=A

NODE=M105R4;LINKAGE=B  
NODE=M105R;LINKAGE=A

 $\Gamma(\pi\pi)/\Gamma(\eta\rho)$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |                        |    |                                                   |
|---------------|------------------------|----|---------------------------------------------------|
| $1.3 \pm 0.4$ | <sup>1</sup> AULCHENKO | 15 | SND 1.22–2.00 $e^+e^- \rightarrow \eta\pi^+\pi^-$ |
|---------------|------------------------|----|---------------------------------------------------|

<sup>1</sup>From a fit to the  $e^+e^- \rightarrow \eta\pi^+\pi^-$  cross section with vector meson dominance model including  $\rho(770)$ ,  $\rho(1450)$ , and  $\rho(1700)$  decaying exclusively via  $\eta\rho(770)$ . Masses and widths of vector states are fixed to PDG 14. Coupling constants are assumed to be real.

NODE=M105R07  
NODE=M105R07

NODE=M105R07;LINKAGE=A

 $\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |        |    |                                             |
|----------|--------|----|---------------------------------------------|
| not seen | AMELIN | 00 | VES 37 $\pi^-p \rightarrow \eta\pi^+\pi^-n$ |
|----------|--------|----|---------------------------------------------|

NODE=M105R9  
NODE=M105R9

 $\Gamma(K\bar{K})/\Gamma(\omega\pi)$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |                        |    |      |
|-------|------------------------|----|------|
| <0.08 | <sup>1</sup> DONNACHIE | 91 | RVUE |
|-------|------------------------|----|------|

<sup>1</sup>Using data from BISELLO 91B, DOLINSKY 86 and ALBRECHT 87L.

NODE=M105R8  
NODE=M105R8

NODE=M105R8;LINKAGE=A

 $\Gamma(K\bar{K}^*(892)+\text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |      |    |                                                  |
|---------------|------|----|--------------------------------------------------|
| possibly seen | COAN | 04 | CLEO $\tau^- \rightarrow K^- \pi^- K^+ \nu_\tau$ |
|---------------|------|----|--------------------------------------------------|

NODE=M105R16  
NODE=M105R16

 $\Gamma(\eta\gamma)/\Gamma_{\text{total}}$ 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

|      |    |                      |    |                                               |
|------|----|----------------------|----|-----------------------------------------------|
| seen | 35 | <sup>1</sup> ACHASOV | 14 | SND 1.15–2.00 $e^+e^- \rightarrow \eta\gamma$ |
|------|----|----------------------|----|-----------------------------------------------|

<sup>1</sup>From a phenomenological model based on vector meson dominance with  $\rho(1450)$  and  $\phi(1680)$  masses and widths from the PDG 12.

NODE=M105R06  
NODE=M105R06

NODE=M105R06;LINKAGE=A

 $\rho(1450)$  REFERENCES

|            |     |                  |                              |                  |
|------------|-----|------------------|------------------------------|------------------|
| GRIBANOV   | 20  | JHEP 2001 112    | S.S. Gribanov <i>et al.</i>  | (CMD-3 Collab.)  |
| ACHASOV    | 18  | PR D97 012008    | M.N. Achasov <i>et al.</i>   | (SND Collab.)    |
| LEES       | 18  | PR D97 052007    | J.P. Lees <i>et al.</i>      | (BABAR Collab.)  |
| BARTOS     | 17  | PR D96 113004    | E. Bartos <i>et al.</i>      |                  |
| BARTOS     | 17A | IJMP A32 1750154 | E. Bartos <i>et al.</i>      |                  |
| LEES       | 17C | PR D95 072007    | J.P. Lees <i>et al.</i>      | (BABAR Collab.)  |
| AAIJ       | 16N | PR D93 052018    | R. Aaij <i>et al.</i>        | (LHCb Collab.)   |
| ABLIKIM    | 16C | PL B753 629      | M. Ablikim <i>et al.</i>     | (BESIII Collab.) |
| ACHASOV    | 16D | PR D94 112001    | M.N. Achasov <i>et al.</i>   | (SND Collab.)    |
| AULCHENKO  | 15  | PR D91 052013    | V.M. Aulchenko <i>et al.</i> | (SND Collab.)    |
| MATVIENKO  | 15  | PR D92 012013    | D. Matvienko <i>et al.</i>   | (BELLE Collab.)  |
| ACHASOV    | 14  | PR D90 032002    | M.N. Achasov <i>et al.</i>   | (SND Collab.)    |
| PDG        | 14  | CP C38 070001    | K. Olive <i>et al.</i>       | (PDG Collab.)    |
| ACHASOV    | 13  | PR D88 054013    | M.N. Achasov <i>et al.</i>   | (SND Collab.)    |
| ABRAMOWICZ | 12  | EPJ C72 1869     | H. Abramowicz <i>et al.</i>  | (ZEUS Collab.)   |
| ACHASOV    | 12  | JETPL 94 734     | M.N. Achasov <i>et al.</i>   |                  |

Translated from ZETFP 94 796.

NODE=M105

REFID=60620  
REFID=58785  
REFID=58900  
REFID=58325  
REFID=58367  
REFID=57981  
REFID=57273  
REFID=57138  
REFID=57618  
REFID=56793  
REFID=56601  
REFID=55912  
REFID=55687  
REFID=55584  
REFID=54274  
REFID=54275

|            |      |                               |                               |                                 |             |
|------------|------|-------------------------------|-------------------------------|---------------------------------|-------------|
| LEES       | 12G  | PR D86 032013                 | J.P. Lees <i>et al.</i>       | (BABAR Collab.)                 | REFID=54299 |
| PDG        | 12   | PR D86 010001                 | J. Beringer <i>et al.</i>     | (PDG Collab.)                   | REFID=54066 |
| ACHASOV    | 11   | JETP 113 75                   | M.N. Achasov <i>et al.</i>    | (SND Collab.)                   | REFID=16721 |
|            |      | Translated from ZETF 140 87.  |                               |                                 |             |
| AMBROSINO  | 11A  | PL B700 102                   | F. Ambrosino <i>et al.</i>    | (KLOE Collab.)                  | REFID=16683 |
| ACHASOV    | 10D  | PR D98 112001                 | M.N. Achasov <i>et al.</i>    | (SND Collab.)                   | REFID=59494 |
| DUBNICKA   | 10   | APS 60 1                      | S. Dubnicka, A.Z. Dubnickova  |                                 | REFID=58797 |
| AUBERT     | 09AS | PRL 103 231801                | B. Aubert <i>et al.</i>       | (BABAR Collab.)                 | REFID=53136 |
| AUBERT     | 08S  | PR D77 092002                 | B. Aubert <i>et al.</i>       | (BABAR Collab.)                 | REFID=52242 |
| FUJIKAWA   | 08   | PR D78 072006                 | M. Fujikawa <i>et al.</i>     | (BELLE Collab.)                 | REFID=52536 |
| AKHMETSHIN | 07   | PL B648 28                    | R.R. Akhmetshin <i>et al.</i> | (Novosibirsk CMD-2 Collab.)     | REFID=51615 |
| ACHASOV    | 06   | JETP 103 380                  | M.N. Achasov <i>et al.</i>    | (Novosibirsk SND Collab.)       | REFID=51113 |
|            |      | Translated from ZETF 130 437. |                               |                                 |             |
| AKHMETSHIN | 05   | PL B605 26                    | R.R. Akhmetshin <i>et al.</i> | (Novosibirsk CMD-2 Collab.)     | REFID=50330 |
| ALOISIO    | 05   | PL B606 12                    | A. Aloisio <i>et al.</i>      | (KLOE Collab.)                  | REFID=51112 |
| SCHAEEL    | 05C  | PRPL 421 191                  | S. Schaeel <i>et al.</i>      | (ALEPH Collab.)                 | REFID=50845 |
| AKHMETSHIN | 04   | PL B578 285                   | R.R. Akhmetshin <i>et al.</i> | (Novosibirsk CMD-2 Collab.)     | REFID=49609 |
| COAN       | 04   | PRL 92 232001                 | T.E. Coan <i>et al.</i>       | (CLEO Collab.)                  | REFID=49945 |
| AKHMETSHIN | 03B  | PL B562 173                   | R.R. Akhmetshin <i>et al.</i> | (Novosibirsk CMD-2 Collab.)     | REFID=49406 |
| ABELE      | 01B  | EPJ C21 261                   | A. Abele <i>et al.</i>        | (Crystal Barrel Collab.)        | REFID=48356 |
| AKHMETSHIN | 01B  | PL B509 217                   | R.R. Akhmetshin <i>et al.</i> | (Novosibirsk CMD-2 Collab.)     | REFID=48167 |
| ALEXANDER  | 01B  | PR D64 092001                 | J.P. Alexander <i>et al.</i>  | (CLEO Collab.)                  | REFID=48391 |
| AKHMETSHIN | 00D  | PL B489 125                   | R.R. Akhmetshin <i>et al.</i> | (Novosibirsk CMD-2 Collab.)     | REFID=47935 |
| AMELIN     | 00   | NP A668 83                    | D. Amelin <i>et al.</i>       | (VES Collab.)                   | REFID=47432 |
| ANDERSON   | 00A  | PR D61 112002                 | S. Anderson <i>et al.</i>     | (CLEO Collab.)                  | REFID=47468 |
| EDWARDS    | 00A  | PR D61 072003                 | K.W. Edwards <i>et al.</i>    | (CLEO Collab.)                  | REFID=47465 |
| ABELE      | 99C  | PL B450 275                   | A. Abele <i>et al.</i>        | (Crystal Barrel Collab.)        | REFID=46916 |
| ABELE      | 99D  | PL B468 178                   | A. Abele <i>et al.</i>        | (Crystal Barrel Collab.)        | REFID=47401 |
| BERTIN     | 98   | PR D57 55                     | A. Bertin <i>et al.</i>       | (OBELIX Collab.)                | REFID=45782 |
| ABELE      | 97   | PL B391 191                   | A. Abele <i>et al.</i>        | (Crystal Barrel Collab.)        | REFID=45415 |
| ACHASOV    | 97   | PR D55 2663                   | N.N. Achasov <i>et al.</i>    | (NOVM)                          | REFID=45382 |
| BARATE     | 97M  | ZPHY C76 15                   | R. Barate <i>et al.</i>       | (ALEPH Collab.)                 | REFID=45622 |
| BERTIN     | 97C  | PL B408 476                   | A. Bertin <i>et al.</i>       | (OBELIX Collab.)                | REFID=45701 |
| BERTIN     | 97D  | PL B414 220                   | A. Bertin <i>et al.</i>       | (OBELIX Collab.)                | REFID=45763 |
| CLEGG      | 94   | ZPHY C62 455                  | A.B. Clegg, A. Donnachie      | (LANC, MCHS)                    | REFID=44081 |
| BISELLO    | 91B  | NPBPS B21 111                 | D. Bisello                    | (DM2 Collab.)                   | REFID=41752 |
| DOLINSKY   | 91   | PRPL 202 99                   | S.I. Dolinsky <i>et al.</i>   | (NOVO)                          | REFID=41369 |
| DONNACHIE  | 91   | ZPHY C51 689                  | A. Donnachie, A.B. Clegg      | (MCHS, LANC)                    | REFID=41632 |
| FUKUI      | 91   | PL B257 241                   | S. Fukui <i>et al.</i>        | (SUGI, NAGO, KEK, KYOT+)        | REFID=41581 |
| KUHN       | 90   | ZPHY C48 445                  | J.H. Kuhn <i>et al.</i>       | (MPIM)                          | REFID=45862 |
| ARMSTRONG  | 89E  | PL B228 536                   | T.A. Armstrong, M. Benayoun   | (ATHU, BARI, BIRM+)             | REFID=41011 |
| BISELLO    | 89   | PL B220 321                   | D. Bisello <i>et al.</i>      | (DM2 Collab.)                   | REFID=40740 |
| DUBNICKA   | 89   | JP G15 1349                   | S. Dubnicka <i>et al.</i>     | (JINR, SLOV)                    | REFID=44082 |
| ANTONELLI  | 88   | PL B212 133                   | A. Antonelli <i>et al.</i>    | (DM2 Collab.)                   | REFID=40583 |
| CLEGG      | 88   | ZPHY C40 313                  | A.B. Clegg, A. Donnachie      | (MCHS, LANC)                    | REFID=40922 |
| DIEKMANN   | 88   | PRPL 159 99                   | B. Diekmann                   | (BONN)                          | REFID=40272 |
| FUKUI      | 88   | PL B202 441                   | S. Fukui <i>et al.</i>        | (SUGI, NAGO, KEK, KYOT+)        | REFID=40273 |
| ALBRECHT   | 87L  | PL B185 223                   | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)                 | REFID=40418 |
| DONNACHIE  | 87B  | ZPHY C34 257                  | A. Donnachie, A.B. Clegg      | (MCHS, LANC)                    | REFID=40920 |
| DOLINSKY   | 86   | PL B174 453                   | S.I. Dolinsky <i>et al.</i>   | (NOVO)                          | REFID=20246 |
| BARKOV     | 85   | NP B256 365                   | L.M. Barkov <i>et al.</i>     | (NOVO)                          | REFID=20134 |
| KURDADZE   | 83   | JETPL 37 733                  | L.M. Kurdadze <i>et al.</i>   | (NOVO)                          | REFID=20133 |
|            |      | Translated from ZETFP 37 613. |                               |                                 |             |
| ASTON      | 80C  | PL 92B 211                    | D. Aston                      | (BONN, CERN, EPOL, GLAS, LANC+) | REFID=20652 |
| BARBER     | 80C  | ZPHY C4 169                   | D.P. Barber <i>et al.</i>     | (DARE, LANC, SHEF)              | REFID=20653 |
| GOUNARIS   | 68   | PRL 21 244                    | G.J. Gounaris, J.J. Sakurai   |                                 | REFID=48054 |

**$\eta(1475)$** 

$$I^G(J^{PC}) = 0^+(0^-+)$$

See the  $\eta(1405)$  and the related review on "Pseudoscalar and Pseudovector Mesons in the 1400 MeV Region."

NODE=M175

NODE=M175

NODE=M175M5

NODE=M175M5

 **$\eta(1475)$  MASS**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                                  |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|----------|----------------------------------------------------------|
| <b>1475 ± 4 OUR AVERAGE</b>                                                   |      | Error includes scale factor of 1.4. See the ideogram below. |          |                                                          |
| 1469 ± 14 ± 13                                                                | 74   | ACHARD                                                      | 07 L3    | 183-209 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$         |
| 1460 ± 12                                                                     | 3651 | NICHITIU                                                    | 02 OBLX  | 0 $\bar{p}p \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$       |
| 1485 ± 8 ± 5                                                                  | 20k  | ADAMS                                                       | 01B B852 | 18 GeV $\pi^- p \rightarrow K^+ K^- \pi^0 n$             |
| 1500 ± 10                                                                     |      | CICALO                                                      | 99 OBLX  | 0 $\bar{p}p \rightarrow K^\pm K_S^0 \pi^\mp \pi^+ \pi^-$ |
| 1464 ± 10                                                                     |      | BERTIN                                                      | 97 OBLX  | 0 $\bar{p}p \rightarrow K^\pm (K^0) \pi^\mp \pi^+ \pi^-$ |
| 1460 ± 10                                                                     |      | BERTIN                                                      | 95 OBLX  | 0 $\bar{p}p \rightarrow K \bar{K} \pi \pi \pi$           |
| 1490 $^{+14}_{-8} + \frac{3}{-16}$                                            | 1100 | BAI                                                         | 90C MRK3 | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$          |
| 1475 ± 4                                                                      |      | RATH                                                        | 89 MPS   | 21.4 $\pi^- p \rightarrow n K_S^0 K_S^0 \pi^0$           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                             |          |                                                          |
| 1477 ± 7 ± 13                                                                 |      | <sup>1</sup> ABLIKIM                                        | 18i BES3 | $J/\psi \rightarrow \gamma \gamma \phi(1020)$            |
| 1565 ± 8 $^{+0}_{-63}$                                                        |      | <sup>2</sup> ABLIKIM                                        | 15T BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$             |
| 1421 ± 14                                                                     |      | AUGUSTIN                                                    | 92 DM2   | $J/\psi \rightarrow \gamma K \bar{K} \pi$                |

OCCUR=2

OCCUR=2

OCCUR=2

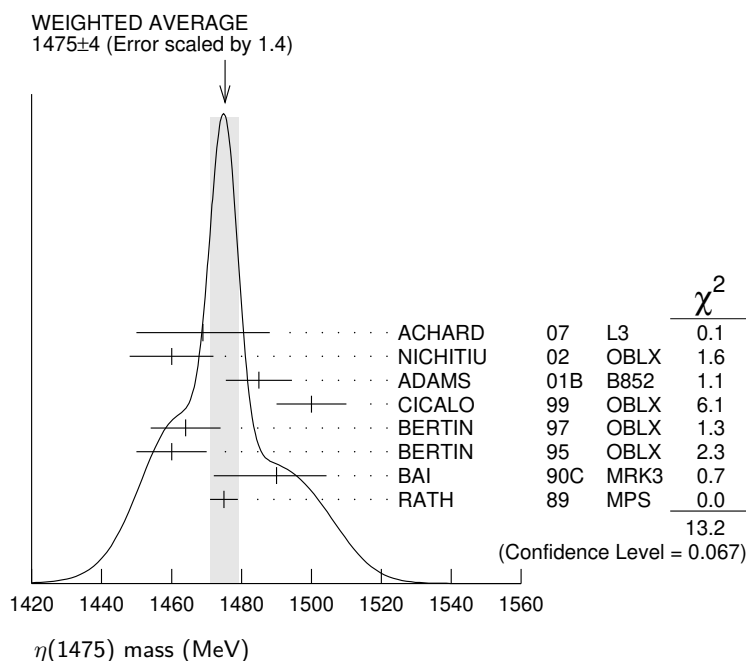
NODE=M175M5;LINKAGE=B

NODE=M175M5;LINKAGE=A

<sup>1</sup> From a fit to  $\gamma\phi$  invariant mass. Angular analysis consistent with  $J^{PC} = 0^-+$ . Other

$J^{PC}$  not excluded.

<sup>2</sup> Could also be the  $\eta(1405)$ .

 **$\eta(1475)$  WIDTH**

NODE=M175W5

NODE=M175W5

| VALUE (MeV)                        | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                                    |
|------------------------------------|------|-------------------------------------------------------------|----------|------------------------------------------------------------|
| <b>90 ± 9 OUR AVERAGE</b>          |      | Error includes scale factor of 1.6. See the ideogram below. |          |                                                            |
| 67 ± 18 ± 7                        | 74   | ACHARD                                                      | 07 L3    | 183-209 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$           |
| 120 ± 15                           | 3651 | NICHITIU                                                    | 02 OBLX  | 0 $\bar{p}p \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$         |
| 98 ± 18 ± 3                        | 20k  | ADAMS                                                       | 01B B852 | 18 GeV $\pi^- p \rightarrow K^+ K^- \pi^0 n$               |
| 100 ± 20                           |      | CICALO                                                      | 99 OBLX  | 0 $\bar{p}p \rightarrow K^\pm K_S^0 \pi^\mp \pi^+ \pi^-$   |
| 105 ± 15                           |      | BERTIN                                                      | 97 OBLX  | 0.0 $\bar{p}p \rightarrow K^\pm (K^0) \pi^\mp \pi^+ \pi^-$ |
| 105 ± 15                           |      | BERTIN                                                      | 95 OBLX  | 0 $\bar{p}p \rightarrow K \bar{K} \pi \pi \pi$             |
| 54 $^{+37}_{-21} + \frac{13}{-24}$ |      | BAI                                                         | 90C MRK3 | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$            |
| 51 ± 13                            |      | RATH                                                        | 89 MPS   | 21.4 $\pi^- p \rightarrow n K_S^0 K_S^0 \pi^0$             |

OCCUR=2

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                        |                      |     |      |                                              |
|------------------------|----------------------|-----|------|----------------------------------------------|
| $118 \pm 22 \pm 17$    | <sup>1</sup> ABLIKIM | 18I | BES3 | $J/\psi \rightarrow \gamma\gamma\phi(1020)$  |
| $45^{+14+21}_{-13-28}$ | <sup>2</sup> ABLIKIM | 15T | BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$ |
| $63 \pm 18$            | AUGUSTIN             | 92  | DM2  | $J/\psi \rightarrow \gamma K \bar{K} \pi$    |

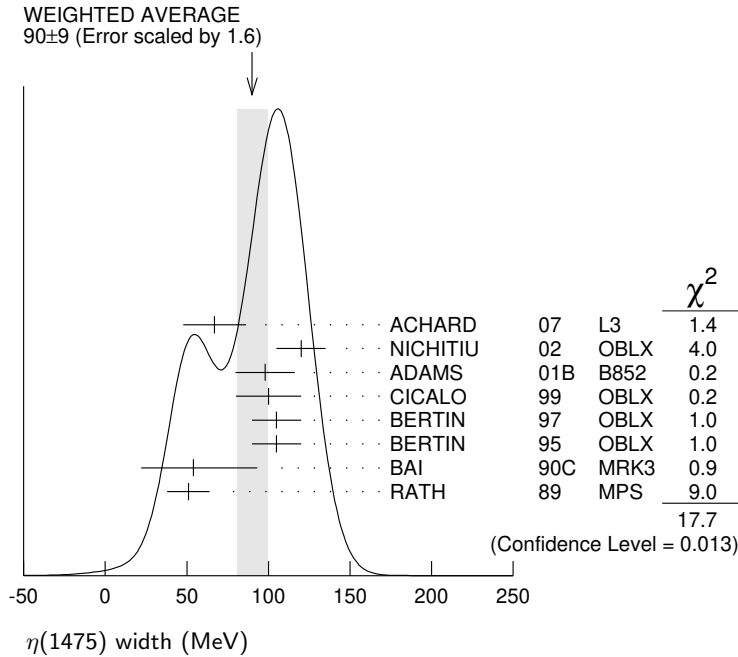
<sup>1</sup> From a fit to  $\gamma\phi$  invariant mass. Angular analysis consistent with  $J^{PC} = 0^{-+}$ . Other  $J^{PC}$  not excluded.

<sup>2</sup> Could also be the  $\eta(1405)$ .

OCCUR=2

NODE=M175W5;LINKAGE=B

NODE=M175W5;LINKAGE=A



### $\eta(1475)$ DECAY MODES

| Mode                                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------------------|--------------------------------|
| $\Gamma_1$ $K \bar{K} \pi$                  | seen                           |
| $\Gamma_2$ $K \bar{K}^*(892) + \text{c.c.}$ | seen                           |
| $\Gamma_3$ $a_0(980) \pi$                   | seen                           |
| $\Gamma_4$ $\gamma\gamma$                   | seen                           |
| $\Gamma_5$ $K_S^0 K_S^0 \eta$               | possibly seen                  |
| $\Gamma_6$ $\gamma\phi(1020)$               | possibly seen                  |

NODE=M175215;NODE=M175

DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=4;OUR EST;→ UNCHECKED ←  
DESIG=7;OUR EST;→ UNCHECKED ←  
DESIG=8;OUR EVAL;→ UNCHECKED ←  
DESIG=9

### $\eta(1475)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

| $\Gamma(K \bar{K} \pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | $\Gamma_1 \Gamma_4 / \Gamma$ |
|---------------------------------------------------------------------------|------------------------------|
| VALUE (keV)                                                               | CL% EVTS                     |
| $0.23 \pm 0.05 \pm 0.05$                                                  | 74                           |
| DOCUMENT ID                                                               | TECN                         |
| 1 ACHARD                                                                  | 07 L3                        |
| COMMENT                                                                   |                              |
| 183-209 $e^+ e^- \rightarrow e^+ e^- K_S^0 K^\pm \pi^\mp$                 |                              |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |    |                      |    |      |                                                        |
|---------|----|----------------------|----|------|--------------------------------------------------------|
| < 0.089 | 90 | <sup>2,3</sup> AHOHE | 05 | CLE2 | $10.6 e^+ e^- \rightarrow e^+ e^- K_S^0 K^\pm \pi^\mp$ |
|---------|----|----------------------|----|------|--------------------------------------------------------|

<sup>1</sup> Supersedes ACCIARRI 01G. Using  $B(K_S^0 \rightarrow \pi^+ \pi^-) = 0.6895$ .

<sup>2</sup> Using  $\eta(1475)$  mass of 1481 MeV and width of 48 MeV. The upper limit increases to 0.140 keV if the world average value, 87 MeV, of the width is used.

<sup>3</sup> Assuming three-body phase-space decay to  $K_S^0 K^\pm \pi^\mp$ .

NODE=M175220

NODE=M175G2  
NODE=M175G2

NODE=M175G2;LINKAGE=CH  
NODE=M175G2;LINKAGE=AH

NODE=M175G2;LINKAGE=B3

NODE=M175225

NODE=M175R1  
NODE=M175R1

NODE=M175R;LINKAGE=BL

### $\eta(1475)$ BRANCHING RATIOS

| $\Gamma(K \bar{K}^*(892) + \text{c.c.})/\Gamma(K \bar{K} \pi)$ | $\Gamma_2/\Gamma_1$                               |
|----------------------------------------------------------------|---------------------------------------------------|
| VALUE                                                          | DOCUMENT ID                                       |
| 0.50 $\pm$ 0.10                                                | 3 BAILLON                                         |
| TECN                                                           | COMMENT                                           |
| 67 HBC                                                         | 0.0 $\bar{p} p \rightarrow K \bar{K} \pi \pi \pi$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |                      |    |     |                                                   |
|-----------------|----------------------|----|-----|---------------------------------------------------|
| 0.50 $\pm$ 0.10 | <sup>1</sup> BAILLON | 67 | HBC | 0.0 $\bar{p} p \rightarrow K \bar{K} \pi \pi \pi$ |
|-----------------|----------------------|----|-----|---------------------------------------------------|

<sup>1</sup> Data could also refer to  $\eta(1405)$ .



$$\Gamma(K\bar{K}^*(892) + \text{c.c.}) / [\Gamma(K\bar{K}^*(892) + \text{c.c.}) + \Gamma(a_0(980)\pi)] \quad \Gamma_2/(\Gamma_2+\Gamma_3)$$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |         |     |      |                                           |
|-------|----|---------|-----|------|-------------------------------------------|
| <0.25 | 90 | EDWARDS | 82E | CBAL | $J/\psi \rightarrow K^+ K^- \pi^0 \gamma$ |
|-------|----|---------|-----|------|-------------------------------------------|

$$\Gamma(\gamma\gamma)/\Gamma(K\bar{K}\pi) \quad \Gamma_4/\Gamma_1$$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                        |    |                      |     |      |                                                         |
|------------------------|----|----------------------|-----|------|---------------------------------------------------------|
| $<1.27 \times 10^{-3}$ | 90 | <sup>1</sup> ABLIKIM | 180 | BES3 | $\psi(2S) \rightarrow \pi^+ \pi^- \gamma \gamma \gamma$ |
|------------------------|----|----------------------|-----|------|---------------------------------------------------------|

<sup>1</sup> Using results from BAI 00D.

$$\Gamma(\gamma\phi(1020))/\Gamma_{\text{total}} \quad \Gamma_6/\Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|               |                      |     |      |                                               |
|---------------|----------------------|-----|------|-----------------------------------------------|
| possibly seen | <sup>1</sup> ABLIKIM | 18I | BES3 | $J/\psi \rightarrow \gamma \gamma \phi(1020)$ |
|---------------|----------------------|-----|------|-----------------------------------------------|

<sup>1</sup> Seen as a peak in  $\gamma\phi$  invariant mass. Angular analysis consistent with  $J^{PC} = 0^{-+}$ . Other  $J^{PC}$  not excluded. Also see  $\eta(1405)$ .

## $\eta(1475)$ REFERENCES

|          |     |                |                            |                          |
|----------|-----|----------------|----------------------------|--------------------------|
| ABLIKIM  | 18I | PR D97 051101  | M. Ablikim <i>et al.</i>   | (BESIII Collab.)         |
| ABLIKIM  | 18O | PR D97 072014  | M. Ablikim <i>et al.</i>   | (BESIII Collab.)         |
| ABLIKIM  | 15T | PRL 115 091803 | M. Ablikim <i>et al.</i>   | (BESIII Collab.)         |
| ACHARD   | 07  | JHEP 0703 018  | P. Achard <i>et al.</i>    | (L3 Collab.)             |
| AHOHE    | 05  | PR D71 072001  | R. Ahohe <i>et al.</i>     | (CLEO Collab.)           |
| NICHITIU | 02  | PL B545 261    | F. Nichitiu <i>et al.</i>  | (OBELIX Collab.)         |
| ACCIARRI | 01G | PL B501 1      | M. Acciarri <i>et al.</i>  | (L3 Collab.)             |
| ADAMS    | 01B | PL B516 264    | G.S. Adams <i>et al.</i>   | (BNL E852 Collab.)       |
| BAI      | 00D | PL B476 25     | J.Z. Bai <i>et al.</i>     | (BES Collab.)            |
| CICALO   | 99  | PL B462 453    | C. Cicalo <i>et al.</i>    | (OBELIX Collab.)         |
| BERTIN   | 97  | PL B400 226    | A. Bertin <i>et al.</i>    | (OBELIX Collab.)         |
| BERTIN   | 95  | PL B361 187    | A. Bertin <i>et al.</i>    | (OBELIX Collab.)         |
| AUGUSTIN | 92  | PR D46 1951    | J.E. Augustin, G. Cosme    | (DM2 Collab.)            |
| BAI      | 90C | PRL 65 2507    | Z. Bai <i>et al.</i>       | (Mark III Collab.)       |
| RATH     | 89  | PR D40 693     | M.G. Rath <i>et al.</i>    | (NDAM, BRAN, BNL, CUNY+) |
| EDWARDS  | 82E | PRL 49 259     | C. Edwards <i>et al.</i>   | (CIT, HARV, PRIN+)       |
| BAILLON  | 67  | NC 50A 393     | P.H. Baillon <i>et al.</i> | (CERN, CDEF, IRAD)       |

$f_0(1500)$

$$I^G(J^{PC}) = 0^+(0^{++})$$

See the reviews on "Scalar Mesons below 2 GeV" and on "Non- $q\bar{q}$  Mesons".

## $f_0(1500)$ MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**1506 ± 6 OUR AVERAGE** Error includes scale factor of 1.4. See the ideogram below.

|           |                         |     |      |                                    |
|-----------|-------------------------|-----|------|------------------------------------|
| 1515 ± 12 | <sup>1</sup> BARBERIS   | 00A | 450  | $pp \rightarrow p_f \eta \eta p_s$ |
| 1511 ± 9  | <sup>1,2</sup> BARBERIS | 00C | 450  | $pp \rightarrow p_f 4\pi p_s$      |
| 1510 ± 8  | <sup>1</sup> BARBERIS   | 00E | 450  | $pp \rightarrow p_f \eta \eta p_s$ |
| 1522 ± 25 | <sup>1</sup> BERTIN     | 98  | OBLX | $0.05-0.405 \bar{n} p \rightarrow$ |

|           |                     |     |      |                                                                                       |
|-----------|---------------------|-----|------|---------------------------------------------------------------------------------------|
| 1449 ± 20 | <sup>1</sup> BERTIN | 97C | OBLX | $0.0 \bar{p} p \rightarrow \pi^+ \pi^- \pi^0$                                         |
| 1500 ± 10 | <sup>3</sup> AMSLER | 95D | CBAR | $0.0 \bar{p} p \rightarrow \pi^0 \pi^0 \pi^0,$<br>$\pi^0 \eta \eta, \pi^0 \pi^0 \eta$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                          |                       |      |      |                                                                                   |
|------------------------------------------|-----------------------|------|------|-----------------------------------------------------------------------------------|
| 1496 ± 1.2 <sup>+</sup> <sub>-26.4</sub> | <sup>4</sup> ALBRECHT | 20   | RVUE | $0.9 \bar{p} p \rightarrow \pi^0 \pi^0 \eta,$<br>$\pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| 1465 ± 18                                | <sup>5</sup> ROPERTZ  | 18   | RVUE | $\bar{B}_s^0 \rightarrow$<br>$J/\psi(\pi^+ \pi^- / K^+ K^-)$                      |
| 1447 ± 16 ± 13                           | <sup>6,7</sup> DOBBS  | 15   |      | $J/\psi \rightarrow \gamma \pi^+ \pi^-$                                           |
| 1442 ± 9 ± 4                             | <sup>6,7</sup> DOBBS  | 15   |      | $\psi(2S) \rightarrow \gamma \pi^+ \pi^-$                                         |
| 1460.9 ± 2.9                             | <sup>8</sup> AAIJ     | 14BR | LHCB | $\bar{B}_s^0 \rightarrow J/\psi \pi^+ \pi^-$                                      |

NODE=M175R6  
NODE=M175R6

NODE=M175R01  
NODE=M175R01

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NODE=M175R00  
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REFID=41578  
REFID=40924  
REFID=21314  
REFID=20407

NODE=M152

NODE=M152

NODE=M152M

NODE=M152M

OCCUR=2

|             |                |                 |      |       |               |     |      |                                                              |         |
|-------------|----------------|-----------------|------|-------|---------------|-----|------|--------------------------------------------------------------|---------|
| 1468        | $+14$<br>$-15$ | $+23$<br>$-74$  | 5.5k | 9     | ABLIKIM       | 13N | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$       |         |
| 1486        | $\pm 10$       |                 |      | 1     | ANISOVICH     | 09  | RVUE | $0.0 \bar{p}p, \pi N$                                        |         |
| 1470        | $\pm 60$       |                 | 568  | 10    | KLEMP         | 08  | E791 | $D_s^+ \rightarrow \pi^- \pi^+ \pi^+$                        |         |
| 1470        | $+6$<br>$-7$   | $+72$<br>$-255$ |      | 11    | UEHARA        | 08A | BELL | $10.6 \frac{e^+e^- \rightarrow \pi^0}{e^+e^- \pi^0 \pi^0}$   |         |
| 1466        | $\pm 6$        | $\pm 20$        |      | 12    | ABLIKIM       | 06V | BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$   |         |
| 1495        | $\pm 4$        |                 |      |       | AMSLER        | 06  | CBAR | $0.9 \bar{p}p \rightarrow K^+ K^- \pi^0$                     |         |
| 1539        | $\pm 20$       |                 | 9.9k |       | AUBERT        | 06O | BABR | $B^+ \rightarrow K^+ K^+ K^-$                                |         |
| 1473        | $\pm 5$        |                 | 80k  | 12,13 | UMAN          | 06  | E835 | $5.2 \bar{p}p \rightarrow \eta\eta\pi^0$                     |         |
| 1478        | $\pm 6$        |                 |      |       | VLADIMIRSK... | 06  | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$                       |         |
| 1493        | $\pm 7$        |                 |      | 12    | BINON         | 05  | GAMS | $33 \pi^- p \rightarrow \eta\eta n$                          |         |
| 1524        | $\pm 14$       |                 | 1400 | 14    | GARMASH       | 05  | BELL | $B^+ \rightarrow K^+ K^+ K^-$                                |         |
| 1489        | $+8$<br>$-4$   |                 |      | 15    | ANISOVICH     | 03  | RVUE |                                                              |         |
| 1490        | $\pm 30$       |                 |      | 12    | ABELE         | 01  | CBAR | $0.0 \bar{p}d \rightarrow \pi^- 4\pi^0 p$                    |         |
| 1497        | $\pm 10$       |                 |      | 12    | BARBERIS      | 99  | OMEG | $450 pp \rightarrow p_s p_f K^+ K^-$                         |         |
| 1502        | $\pm 10$       |                 |      | 12    | BARBERIS      | 99B | OMEG | $450 pp \rightarrow p_s p_f \pi^+ \pi^-$                     |         |
| 1502        | $\pm 12$       | $\pm 10$        |      | 16    | BARBERIS      | 99D | OMEG | $450 pp \rightarrow K^+ K^-, \pi^+ \pi^-$                    |         |
| 1530        | $\pm 45$       |                 |      | 12    | BELLAZZINI    | 99  | GAM4 | $450 pp \rightarrow pp\pi^0\pi^0$                            |         |
| 1505        | $\pm 18$       |                 |      | 12    | FRENCH        | 99  |      | $300 pp \rightarrow p_f(K^+ K^-)p_s$                         |         |
| 1447        | $\pm 27$       |                 |      | 17    | KAMINSKI      | 99  | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, \sigma\sigma$          |         |
| 1580        | $\pm 80$       |                 |      | 12    | ALDE          | 98  | GAM4 | $100 \pi^- p \rightarrow \pi^0\pi^0 n$                       |         |
| 1499        | $\pm 8$        |                 |      | 1     | ANISOVICH     | 98B | RVUE | Compilation                                                  |         |
| $\sim 1520$ |                |                 |      |       | REYES         | 98  | SPEC | $800 pp \rightarrow p_s p_f K_S^0 K_S^0$                     |         |
| 1510        | $\pm 20$       |                 |      | 1     | BARBERIS      | 97B | OMEG | $450 pp \rightarrow pp2(\pi^+ \pi^-)$                        |         |
| $\sim 1475$ |                |                 |      |       | FRABETTI      | 97D | E687 | $D_s^\pm \rightarrow \pi^\mp \pi^\pm \pi^\pm$                |         |
| $\sim 1505$ |                |                 |      |       | ABELE         | 96  | CBAR | $0.0 \bar{p}p \rightarrow 5\pi^0$                            |         |
| 1515        | $\pm 20$       |                 |      |       | ABELE         | 96B | CBAR | $0.0 \bar{p}p \rightarrow \pi^0 K_L^0 K_L^0$                 |         |
| 1500        | $\pm 8$        |                 |      | 1     | ABELE         | 96C | RVUE | Compilation                                                  |         |
| 1460        | $\pm 20$       |                 | 120  | 12    | AMELIN        | 96B | VES  | $37 \pi^- A \rightarrow \eta\eta\pi^- A$                     |         |
| 1500        | $\pm 8$        |                 |      |       | BUGG          | 96  | RVUE |                                                              |         |
| 1500        | $\pm 15$       |                 |      | 18    | AMSLER        | 95B | CBAR | $0.0 \bar{p}p \rightarrow 3\pi^0$                            |         |
| 1505        | $\pm 15$       |                 |      | 19    | AMSLER        | 95C | CBAR | $0.0 \bar{p}p \rightarrow \eta\eta\pi^0$                     | OCCUR=2 |
| 1445        | $\pm 5$        |                 |      | 20    | ANTINORI      | 95  | OMEG | $300,450 pp \rightarrow pp2(\pi^+ \pi^-)$                    |         |
| 1497        | $\pm 30$       |                 |      | 12    | ANTINORI      | 95  | OMEG | $300,450 pp \rightarrow pp\pi^+ \pi^-$                       | OCCUR=2 |
| $\sim 1505$ |                |                 |      |       | BUGG          | 95  | MRK3 | $J/\psi \rightarrow \gamma\pi^+ \pi^- \pi^+ \pi^-$           |         |
| 1446        | $\pm 5$        |                 |      | 12    | ABATZIS       | 94  | OMEG | $450 pp \rightarrow pp2(\pi^+ \pi^-)$                        |         |
| 1545        | $\pm 25$       |                 |      | 12    | AMSLER        | 94E | CBAR | $0.0 \bar{p}p \rightarrow \pi^0 \eta\eta'$                   |         |
| 1520        | $\pm 25$       |                 |      | 1,21  | ANISOVICH     | 94  | CBAR | $0.0 \bar{p}p \rightarrow 3\pi^0, \pi^0 \eta\eta$            |         |
| 1505        | $\pm 20$       |                 |      | 1,22  | BUGG          | 94  | RVUE | $\bar{p}p \rightarrow 3\pi^0, \eta\eta\pi^0, \eta\pi^0\pi^0$ |         |
| 1560        | $\pm 25$       |                 |      | 12    | AMSLER        | 92  | CBAR | $0.0 \bar{p}p \rightarrow \pi^0 \eta\eta$                    |         |
| 1550        | $\pm 45$       | $\pm 30$        |      | 12    | BELADIDZE     | 92C | VES  | $36 \pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$  |         |
| 1449        | $\pm 4$        |                 |      | 12    | ARMSTRONG     | 89E | OMEG | $300 pp \rightarrow pp2(\pi^+ \pi^-)$                        |         |
| 1610        | $\pm 20$       |                 |      | 12    | ALDE          | 88  | GAM4 | $300 \pi^- N \rightarrow \pi^- N 2\eta$                      |         |
| $\sim 1525$ |                |                 |      |       | ASTON         | 88D | LASS | $11 K^- p \rightarrow K_S^0 K_S^0 \Lambda$                   |         |
| 1570        | $\pm 20$       |                 | 600  | 12    | ALDE          | 87  | GAM4 | $100 \pi^- p \rightarrow 4\pi^0 n$                           |         |
| 1575        | $\pm 45$       |                 |      | 23    | ALDE          | 86D | GAM4 | $100 \pi^- p \rightarrow 2\eta n$                            |         |
| 1568        | $\pm 33$       |                 |      | 12    | BINON         | 84C | GAM2 | $38 \pi^- p \rightarrow \eta\eta' n$                         |         |
| 1592        | $\pm 25$       |                 |      | 12    | BINON         | 83  | GAM2 | $38 \pi^- p \rightarrow 2\eta n$                             |         |
| 1525        | $\pm 5$        |                 |      | 12    | GRAY          | 83  | DBC  | $0.0 \bar{p}N \rightarrow 3\pi$                              |         |

1 T-matrix pole.

2 Average between  $\pi^+ \pi^- 2\pi^0$  and  $2(\pi^+ \pi^-)$ .

3 T-matrix pole. Coupled-channel analysis of AMSLER 95B, AMSLER 95C, and AMSLER 94D.

4 T-matrix pole, 5 poles, 5 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ), and BINON 84c ( $\eta\eta'$ ).

5 T-matrix pole of 3 channel unitary model fit to data from AAIJ 14BR and AAIJ 17V extracted using Pade approximants.

6 Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M152M;LINKAGE=PP

NODE=M152M;LINKAGE=PC

NODE=M152M;LINKAGE=AB

NODE=M152M;LINKAGE=J

NODE=M152M;LINKAGE=H

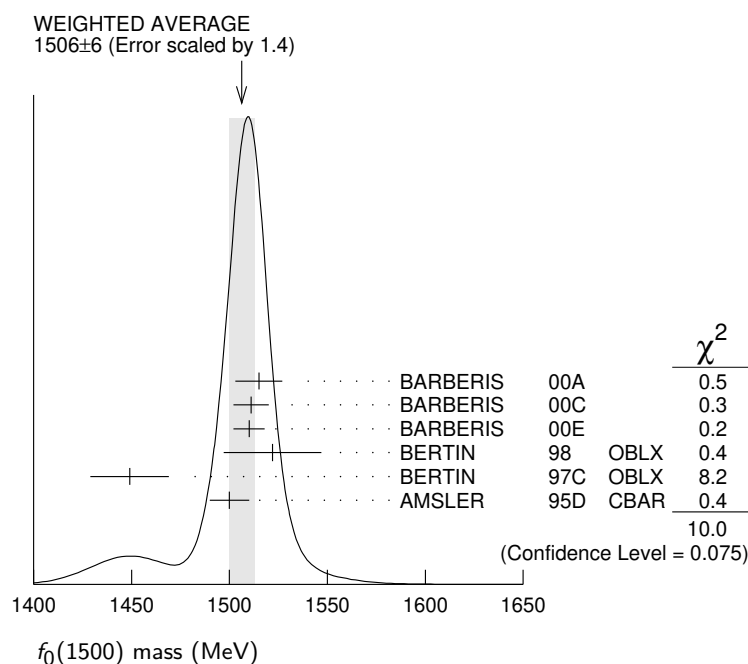
NODE=M152M;LINKAGE=F

- 7 From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 109$  MeV.  
 8 Solution 1, statistical error only.  
 9 From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.  
 10 Reanalysis of AITALA 01A data. This state could also be  $f_0(1370)$ .  
 11 Breit-Wigner mass. May also be the  $f_0(1370)$ .  
 12 Breit-Wigner mass.  
 13 Statistical error only.  
 14 Breit-Wigner, solution 1, PWA ambiguous.  
 15 K-matrix pole from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K \bar{K} n$ ,  $\pi^+ \pi^- \rightarrow \pi^+ \pi^-$ ,  $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \eta \eta$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^0$ ,  $K^+ K_S^0 \pi^-$  at rest,  $\bar{p} n \rightarrow \pi^- \pi^- \pi^+$ ,  $K_S^0 K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^-$  at rest.  
 16 Supersedes BARBERIS 99 and BARBERIS 99B.  
 17 T-matrix pole on sheet  $--+$ .  
 18 T-matrix pole, supersedes ANISOVICH 94.  
 19 T-matrix pole, supersedes ANISOVICH 94 and AMSLER 92.  
 20 Supersedes ABATZIS 94, ARMSTRONG 89E. Breit-Wigner mass.  
 21 From a simultaneous analysis of the annihilations  $\bar{p} p \rightarrow 3\pi^0, \pi^0 \eta \eta$ .  
 22 Reanalysis of ANISOVICH 94 data.  
 23 From central value and spread of two solutions. Breit-Wigner mass.

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 NODE=M152M;LINKAGE=I  
 NODE=M152M;LINKAGE=C

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 NODE=M152M;LINKAGE=UE  
 NODE=M152M;LINKAGE=E  
 NODE=M152M;LINKAGE=ST  
 NODE=M152M;LINKAGE=GA  
 NODE=M152M;LINKAGE=KM

NODE=M152M;LINKAGE=BD  
 NODE=M152M;LINKAGE=TK  
 NODE=M152M;LINKAGE=D  
 NODE=M152M;LINKAGE=D1  
 NODE=M152M;LINKAGE=B  
 NODE=M152M;LINKAGE=A  
 NODE=M152M;LINKAGE=C1  
 NODE=M152M;LINKAGE=AZ



### $f_0(1500)$ WIDTH

NODE=M152W

| VALUE (MeV)                | EVS | DOCUMENT ID  | TECN | COMMENT                                                                          |
|----------------------------|-----|--------------|------|----------------------------------------------------------------------------------|
| <b>112 ± 9 OUR AVERAGE</b> |     |              |      |                                                                                  |
| 110 ± 24                   | 1   | BARBERIS 00A |      | 450 $pp \rightarrow p_f \eta \eta p_s$                                           |
| 102 ± 18                   | 1,2 | BARBERIS 00C |      | 450 $pp \rightarrow p_f 4\pi p_s$                                                |
| 110 ± 16                   | 1   | BARBERIS 00E |      | 450 $pp \rightarrow p_f \eta \eta p_s$                                           |
| 108 ± 33                   | 1   | BERTIN 98    | OBLX | 0.05–0.405 $\bar{n} p \rightarrow \pi^+ \pi^+ \pi^-$                             |
| 114 ± 30                   | 1   | BERTIN 97C   | OBLX | 0.0 $\bar{p} p \rightarrow \pi^+ \pi^- \pi^0$                                    |
| 154 ± 30                   | 3   | AMSLER 95D   | CBAR | 0.0 $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ |

NODE=M152W

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                        |   |             |      |                                                                              |
|----------------------------------------|---|-------------|------|------------------------------------------------------------------------------|
| 80.8 ± 0.6 <sup>+</sup> <sub>5.0</sub> | 4 | ALBRECHT 20 | RVUE | 0.9 $\bar{p} p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| 100 ± 18                               | 5 | ROPERTZ 18  | RVUE | $\bar{B}_s^0 \rightarrow J/\psi (\pi^+ \pi^- / K^+ K^-)$                     |
| 124 ± 7                                | 6 | AAIJ 14BR   | LHCB | $\bar{B}_s^0 \rightarrow J/\psi \pi^+ \pi^-$                                 |

|            |           |          |      |      |               |     |      |                                                                         |         |
|------------|-----------|----------|------|------|---------------|-----|------|-------------------------------------------------------------------------|---------|
| 136        | $\pm 41$  | $\pm 28$ | 5.5k | 7    | ABLIKIM       | 13N | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$                  |         |
| 114        | $\pm 10$  |          |      | 1    | ANISOVICH     | 09  | RVUE | $0.0 \bar{p}p, \pi N$                                                   |         |
| 90         | $\pm 2$   | $\pm 50$ |      | 8    | UEHARA        | 08A | BELL | $10.6 \frac{e^+e^- \rightarrow e^+e^- \pi^0 \pi^0}{e^+e^- \pi^0 \pi^0}$ |         |
| 108        | $\pm 14$  | $\pm 25$ |      | 9    | ABLIKIM       | 06V | BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$                |         |
| 121        | $\pm 8$   |          |      |      | AMSLER        | 06  | CBAR | $0.9 \bar{p}p \rightarrow K^+K^-\pi^0$                                  |         |
| 257        | $\pm 33$  |          | 9.9k |      | AUBERT        | 06O | BABR | $B^+ \rightarrow K^+K^+K^-$                                             |         |
| 108        | $\pm 9$   |          | 80k  | 9,10 | UMAN          | 06  | E835 | $5.2 \bar{p}p \rightarrow \eta\eta\pi^0$                                |         |
| 119        | $\pm 10$  |          |      |      | VLADIMIRSK... | 06  | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$                                  |         |
| 90         | $\pm 15$  |          |      | 9    | BINON         | 05  | GAMS | $33 \pi^- p \rightarrow \eta\eta n$                                     |         |
| 136        | $\pm 23$  |          | 1400 | 11   | GARMASH       | 05  | BELL | $B^+ \rightarrow K^+K^+K^-$                                             |         |
| 102        | $\pm 10$  |          |      | 12   | ANISOVICH     | 03  | RVUE |                                                                         |         |
| 140        | $\pm 40$  |          |      | 9    | ABELE         | 01  | CBAR | $0.0 \bar{p}d \rightarrow \pi^- 4\pi^0 p$                               |         |
| 104        | $\pm 25$  |          |      | 9    | BARBERIS      | 99  | OMEG | $450 pp \rightarrow p_S p_f K^+ K^-$                                    |         |
| 131        | $\pm 15$  |          |      | 9    | BARBERIS      | 99B | OMEG | $450 pp \rightarrow p_S p_f \pi^+ \pi^-$                                |         |
| 98         | $\pm 18$  | $\pm 16$ |      | 13   | BARBERIS      | 99D | OMEG | $450 pp \rightarrow K^+ K^-, \pi^+ \pi^-$                               |         |
| 160        | $\pm 50$  |          |      | 9    | BELLAZZINI    | 99  | GAM4 | $450 pp \rightarrow pp\pi^0\pi^0$                                       |         |
| 100        | $\pm 33$  |          |      | 9    | FRENCH        | 99  |      | $300 pp \rightarrow p_f(K^+K^-)p_S$                                     |         |
| 108        | $\pm 46$  |          |      | 14   | KAMINSKI      | 99  | RVUE | $\pi\pi \rightarrow \pi\pi, K\bar{K}, \sigma\sigma$                     |         |
| 280        | $\pm 100$ |          |      | 9    | ALDE          | 98  | GAM4 | $100 \pi^- p \rightarrow \pi^0\pi^0 n$                                  |         |
| 130        | $\pm 20$  |          |      | 1    | ANISOVICH     | 98B | RVUE | Compilation                                                             |         |
| 120        | $\pm 35$  |          |      | 1    | BARBERIS      | 97B | OMEG | $450 pp \rightarrow pp2(\pi^+\pi^-)$                                    |         |
| $\sim 100$ |           |          |      |      | FRABETTI      | 97D | E687 | $D_S^\pm \rightarrow \pi^\mp \pi^\pm \pi^\pm$                           |         |
| $\sim 169$ |           |          |      |      | ABELE         | 96  | CBAR | $0.0 \bar{p}p \rightarrow 5\pi^0$                                       |         |
| 105        | $\pm 15$  |          |      |      | ABELE         | 96B | CBAR | $0.0 \bar{p}p \rightarrow \pi^0 K_L^0 K_L^0$                            |         |
| 100        | $\pm 30$  |          | 120  | 9    | AMELIN        | 96B | VES  | $37 \pi^- A \rightarrow \eta\eta\pi^- A$                                |         |
| 132        | $\pm 15$  |          |      |      | BUGG          | 96  | RVUE |                                                                         |         |
| 120        | $\pm 25$  |          |      | 15   | AMSLER        | 95B | CBAR | $0.0 \bar{p}p \rightarrow 3\pi^0$                                       |         |
| 120        | $\pm 30$  |          |      | 16   | AMSLER        | 95C | CBAR | $0.0 \bar{p}p \rightarrow \eta\eta\pi^0$                                | OCCUR=2 |
| 65         | $\pm 10$  |          |      | 17   | ANTINORI      | 95  | OMEG | $300,450 pp \rightarrow pp2(\pi^+\pi^-)$                                |         |
| 199        | $\pm 30$  |          |      | 9    | ANTINORI      | 95  | OMEG | $300,450 pp \rightarrow pp\pi^+\pi^-$                                   | OCCUR=2 |
| 56         | $\pm 12$  |          |      | 9    | ABATZIS       | 94  | OMEG | $450 pp \rightarrow pp2(\pi^+\pi^-)$                                    |         |
| 100        | $\pm 40$  |          |      | 9    | AMSLER        | 94E | CBAR | $0.0 \bar{p}p \rightarrow \pi^0\eta\eta'$                               |         |
| 148        | $\pm 20$  |          |      | 1,18 | ANISOVICH     | 94  | CBAR | $0.0 \bar{p}p \rightarrow 3\pi^0, \pi^0\eta\eta$                        |         |
| 150        | $\pm 20$  |          |      | 1,19 | BUGG          | 94  | RVUE | $\bar{p}p \rightarrow 3\pi^0, \eta\eta\pi^0, \eta\pi^0\pi^0$            |         |
| 245        | $\pm 50$  |          |      | 9    | AMSLER        | 92  | CBAR | $0.0 \bar{p}p \rightarrow \pi^0\eta\eta$                                |         |
| 153        | $\pm 67$  | $\pm 50$ |      | 9    | BELADIDZE     | 92C | VES  | $36 \pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$             |         |
| 78         | $\pm 18$  |          |      | 9    | ARMSTRONG     | 89E | OMEG | $300 pp \rightarrow pp2(\pi^+\pi^-)$                                    |         |
| 170        | $\pm 40$  |          |      | 9    | ALDE          | 88  | GAM4 | $300 \pi^- N \rightarrow \pi^- N 2\eta$                                 |         |
| 150        | $\pm 20$  |          | 600  | 9    | ALDE          | 87  | GAM4 | $100 \pi^- p \rightarrow 4\pi^0 n$                                      |         |
| 265        | $\pm 65$  |          |      | 20   | ALDE          | 86D | GAM4 | $100 \pi^- p \rightarrow 2\eta n$                                       |         |
| 260        | $\pm 60$  |          |      | 9    | BINON         | 84C | GAM2 | $38 \pi^- p \rightarrow \eta\eta' n$                                    |         |
| 210        | $\pm 40$  |          |      | 9    | BINON         | 83  | GAM2 | $38 \pi^- p \rightarrow 2\eta n$                                        |         |
| 101        | $\pm 13$  |          |      | 9    | GRAY          | 83  | DBC  | $0.0 \bar{p}N \rightarrow 3\pi$                                         |         |

<sup>1</sup> T-matrix pole.

<sup>2</sup> Average between  $\pi^+\pi^-2\pi^0$  and  $2(\pi^+\pi^-)$ .

<sup>3</sup> T-matrix pole. Coupled-channel analysis of AMSLER 95B, AMSLER 95C, and AMSLER 94D.

<sup>4</sup> T-matrix pole, 5 poles, 5 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ), and BINON 84C ( $\eta\eta'$ ).

<sup>5</sup> T-matrix pole of 3 channel unitary model fit to data from AAIJ 14BR and AAIJ 17V extracted using Pade approximants.

<sup>6</sup> Solution I, statistical error only.

<sup>7</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

<sup>8</sup> Breit-Wigner width. May also be the  $f_0(1370)$ .

<sup>9</sup> Breit-Wigner width.

<sup>10</sup> Statistical error only.

<sup>11</sup> Breit-Wigner, solution 1, PWA ambiguous.

NODE=M152W;LINKAGE=PP

NODE=M152W;LINKAGE=PC

NODE=M152W;LINKAGE=AB

NODE=M152W;LINKAGE=H

NODE=M152W;LINKAGE=F

NODE=M152W;LINKAGE=G

NODE=M152W;LINKAGE=C

NODE=M152W;LINKAGE=UE

NODE=M152W;LINKAGE=E

NODE=M152W;LINKAGE=ST

NODE=M152W;LINKAGE=GA

- <sup>12</sup> K-matrix pole from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K \bar{K} n$ ,  $\pi^+ \pi^- \rightarrow \pi^+ \pi^-$ ,  $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \eta \eta$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^0$ ,  $K^+ K_S^0 \pi^-$  at rest,  $\bar{p} n \rightarrow \pi^- \pi^- \pi^+$ ,  $K_S^0 K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^-$  at rest.
- <sup>13</sup> Supersedes BARBERIS 99 and BARBERIS 99B.
- <sup>14</sup> T-matrix pole on sheet  $--+$ .
- <sup>15</sup> T-matrix pole, supersedes ANISOVICH 94.
- <sup>16</sup> T-matrix pole, supersedes ANISOVICH 94 and AMSLER 92.
- <sup>17</sup> Supersedes ABATZIS 94, ARMSTRONG 89E. Breit-Wigner mass.
- <sup>18</sup> From a simultaneous analysis of the annihilations  $\bar{p} p \rightarrow 3\pi^0, \pi^0 \eta \eta$ .
- <sup>19</sup> Reanalysis of ANISOVICH 94 data.
- <sup>20</sup> From central value and spread of two solutions. Breit-Wigner mass.

NODE=M152W;LINKAGE=KM

NODE=M152W;LINKAGE=BD

NODE=M152W;LINKAGE=TK

NODE=M152W;LINKAGE=D

NODE=M152W;LINKAGE=D1

NODE=M152W;LINKAGE=B

NODE=M152W;LINKAGE=A

NODE=M152W;LINKAGE=C1

NODE=M152W;LINKAGE=AZ

 **$f_0(1500)$  DECAY MODES**

|               | Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) | Scale factor |
|---------------|---------------------------|--------------------------------|--------------|
| $\Gamma_1$    | $\pi \pi$                 | $(34.5 \pm 2.2) \%$            | 1.2          |
| $\Gamma_2$    | $\pi^+ \pi^-$             | seen                           |              |
| $\Gamma_3$    | $2\pi^0$                  | seen                           |              |
| $\Gamma_4$    | $4\pi$                    | $(48.9 \pm 3.3) \%$            | 1.2          |
| $\Gamma_5$    | $4\pi^0$                  | seen                           |              |
| $\Gamma_6$    | $2\pi^+ 2\pi^-$           | seen                           |              |
| $\Gamma_7$    | $2(\pi\pi)_S\text{-wave}$ | seen                           |              |
| $\Gamma_8$    | $\rho\rho$                | seen                           |              |
| $\Gamma_9$    | $\pi(1300)\pi$            | seen                           |              |
| $\Gamma_{10}$ | $a_1(1260)\pi$            | seen                           |              |
| $\Gamma_{11}$ | $\eta\eta$                | $(6.0 \pm 0.9) \%$             | 1.1          |
| $\Gamma_{12}$ | $\eta\eta'(958)$          | $(2.2 \pm 0.8) \%$             | 1.4          |
| $\Gamma_{13}$ | $K\bar{K}$                | $(8.5 \pm 1.0) \%$             | 1.1          |
| $\Gamma_{14}$ | $\gamma\gamma$            | not seen                       |              |

NODE=M152215;NODE=M152

DESIG=8

DESIG=9

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=7

DESIG=5;OUR EST;→ UNCHECKED ←

DESIG=6;OUR EST;→ UNCHECKED ←

DESIG=11;OUR EST;→ UNCHECKED ←

DESIG=12;OUR EST;→ UNCHECKED ←

DESIG=13;OUR EST;→ UNCHECKED ←

DESIG=14;OUR EST;→ UNCHECKED ←

DESIG=1

DESIG=2

DESIG=4

DESIG=10;OUR EST;→ UNCHECKED ←

**CONSTRAINED FIT INFORMATION**

An overall fit to 6 branching ratios uses 10 measurements and one constraint to determine 5 parameters. The overall fit has a  $\chi^2 = 5.6$  for 6 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |          |          |
|----------|-------|-------|----------|----------|
| $x_4$    | −88   |       |          |          |
| $x_{11}$ | 27    | −56   |          |          |
| $x_{12}$ | 3     | −32   | 26       |          |
| $x_{13}$ | 43    | −64   | 20       | 2        |
|          | $x_1$ | $x_4$ | $x_{11}$ | $x_{12}$ |

 **$f_0(1500) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$** 

NODE=M152217

| $\Gamma(\pi\pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$                           |     |                     |          |                                                                                                     | $\Gamma_1 \Gamma_{14} / \Gamma$ |
|------------------------------------------------------------------------------------------------|-----|---------------------|----------|-----------------------------------------------------------------------------------------------------|---------------------------------|
| VALUE (eV)                                                                                     | CL% | DOCUMENT ID         | TECN     | COMMENT                                                                                             |                                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                  |     |                     |          |                                                                                                     |                                 |
| $33^{+12}_{-6} + 1809_{-21}$                                                                   |     | <sup>1</sup> UEHARA | 08A BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$                                                      |                                 |
| not seen                                                                                       |     | ACCIARRI            | 01H L3   | $\gamma\gamma \rightarrow K_S^0 K_S^0, E_{\text{cm}}^{\text{ee}} = 91, 183\text{--}209 \text{ GeV}$ |                                 |
| <460                                                                                           | 95  | BARATE              | 00E ALEP | $\gamma\gamma \rightarrow \pi^+ \pi^-$                                                              |                                 |
| <sup>1</sup> May also be the $f_0(1370)$ . Multiplied by us by 3 to obtain the $\pi\pi$ value. |     |                     |          |                                                                                                     |                                 |

NODE=M152G1

NODE=M152G1

NODE=M152G1;LINKAGE=UE

**$f_0(1500)$  BRANCHING RATIOS**

NODE=M152220

 **$\Gamma(\pi\pi)/\Gamma_{\text{total}}$**  **$\Gamma_1/\Gamma$** NODE=M152R8  
NODE=M152R8

| VALUE | DOCUMENT ID | TECN |
|-------|-------------|------|
|-------|-------------|------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |      |    |      |
|-------------|------|----|------|
| 0.454±0.104 | BUGG | 96 | RVUE |
|-------------|------|----|------|

 **$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$**  **$\Gamma_2/\Gamma$** NODE=M152R10  
NODE=M152R10

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |        |    |                                                        |
|------|--------|----|--------------------------------------------------------|
| seen | BERTIN | 98 | OBLX 0.05–0.405 $\bar{n}p \rightarrow \pi^+\pi^+\pi^-$ |
|------|--------|----|--------------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |          |     |                                                    |
|---------------|----------|-----|----------------------------------------------------|
| possibly seen | FRABETTI | 97D | E687 $D_s^\pm \rightarrow \pi^\mp \pi^\pm \pi^\pm$ |
|---------------|----------|-----|----------------------------------------------------|

 **$\Gamma(4\pi)/\Gamma(\pi\pi)$**  **$\Gamma_4/\Gamma_1$** NODE=M152R6  
NODE=M152R6

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**1.42±0.18 OUR FIT** Error includes scale factor of 1.2.**1.42±0.18 OUR AVERAGE** Error includes scale factor of 1.2.

|           |          |     |                                         |
|-----------|----------|-----|-----------------------------------------|
| 1.37±0.16 | BARBERIS | 00D | 450 $p\bar{p} \rightarrow p_f 4\pi p_s$ |
|-----------|----------|-----|-----------------------------------------|

|          |                     |    |      |
|----------|---------------------|----|------|
| 2.1 ±0.6 | <sup>1</sup> AMSLER | 98 | RVUE |
|----------|---------------------|----|------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |                        |     |                   |
|----------|------------------------|-----|-------------------|
| 2.1 ±0.2 | <sup>2</sup> ANISOVICH | 02D | SPEC Combined fit |
|----------|------------------------|-----|-------------------|

|          |                    |    |                                        |
|----------|--------------------|----|----------------------------------------|
| 3.4 ±0.8 | <sup>1</sup> ABELE | 96 | CBAR 0.0 $\bar{p}p \rightarrow 5\pi^0$ |
|----------|--------------------|----|----------------------------------------|

<sup>1</sup> Excluding  $\rho\rho$  contribution to  $4\pi$ .<sup>2</sup> From a combined K-matrix analysis of Crystal Barrel (0.  $p\bar{p} \rightarrow \pi^0\pi^0\pi^0, \pi^0\eta\eta, \pi^0\pi^0\eta$ ), GAMS ( $\pi p \rightarrow \pi^0\pi^0 n, \eta\eta n, \eta\eta' n$ ), and BNL ( $\pi p \rightarrow K\bar{K} n$ ) data.NODE=M152R6;LINKAGE=C  
NODE=M152R6;LINKAGE=CH **$\Gamma(2(\pi\pi)_{S\text{-wave}})/\Gamma(\pi\pi)$**  **$\Gamma_7/\Gamma_1$** NODE=M152R14  
NODE=M152R14

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |                    |    |                                                |
|-----------|--------------------|----|------------------------------------------------|
| 0.42±0.26 | <sup>1</sup> ABELE | 01 | CBAR 0.0 $\bar{p}d \rightarrow \pi^- 4\pi^0 p$ |
|-----------|--------------------|----|------------------------------------------------|

<sup>1</sup> From the combined data of ABELE 96 and ABELE 96C.

NODE=M152R;LINKAGE=KZ

 **$\Gamma(2(\pi\pi)_{S\text{-wave}})/\Gamma(4\pi)$**  **$\Gamma_7/\Gamma_4$** NODE=M152R15  
NODE=M152R15

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |       |     |                                        |
|-----------|-------|-----|----------------------------------------|
| 0.26±0.07 | ABELE | 01B | CBAR 0.0 $\bar{p}d \rightarrow 5\pi p$ |
|-----------|-------|-----|----------------------------------------|

 **$\Gamma(\rho\rho)/\Gamma(4\pi)$**  **$\Gamma_8/\Gamma_4$** NODE=M152R16  
NODE=M152R16

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |       |     |                                        |
|-----------|-------|-----|----------------------------------------|
| 0.13±0.08 | ABELE | 01B | CBAR 0.0 $\bar{p}d \rightarrow 5\pi p$ |
|-----------|-------|-----|----------------------------------------|

 **$\Gamma(\rho\rho)/\Gamma(2(\pi\pi)_{S\text{-wave}})$**  **$\Gamma_8/\Gamma_7$** NODE=M152R11  
NODE=M152R11

| VALUE | DOCUMENT ID | COMMENT |
|-------|-------------|---------|
|-------|-------------|---------|

**2.87±0.34 OUR AVERAGE** Error includes scale factor of 1.1.

|          |          |     |                                                       |
|----------|----------|-----|-------------------------------------------------------|
| 3.3 ±0.5 | BARBERIS | 00C | 450 $p\bar{p} \rightarrow p_f \pi^+ \pi^- 2\pi^0 p_s$ |
|----------|----------|-----|-------------------------------------------------------|

|          |          |     |                                                   |
|----------|----------|-----|---------------------------------------------------|
| 2.6 ±0.4 | BARBERIS | 00C | 450 $p\bar{p} \rightarrow p_f 2(\pi^+ \pi^-) p_s$ |
|----------|----------|-----|---------------------------------------------------|

OCCUR=2

 **$\Gamma(\pi(1300)\pi)/\Gamma(4\pi)$**  **$\Gamma_9/\Gamma_4$** NODE=M152R17  
NODE=M152R17

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |       |     |                                        |
|-----------|-------|-----|----------------------------------------|
| 0.50±0.25 | ABELE | 01B | CBAR 0.0 $\bar{p}d \rightarrow 5\pi p$ |
|-----------|-------|-----|----------------------------------------|

 **$\Gamma(a_1(1260)\pi)/\Gamma(4\pi)$**  **$\Gamma_{10}/\Gamma_4$** NODE=M152R18  
NODE=M152R18

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |       |     |                                        |
|-----------|-------|-----|----------------------------------------|
| 0.12±0.05 | ABELE | 01B | CBAR 0.0 $\bar{p}d \rightarrow 5\pi p$ |
|-----------|-------|-----|----------------------------------------|

 **$\Gamma(\eta\eta)/\Gamma_{\text{total}}$**  **$\Gamma_{11}/\Gamma$** NODE=M152R1  
NODE=M152R1

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |      |    |                                                |
|-------|------|----|------------------------------------------------|
| large | ALDE | 88 | GAM4 300 $\pi^- N \rightarrow \eta\eta\pi^- N$ |
|-------|------|----|------------------------------------------------|

|       |       |    |                                       |
|-------|-------|----|---------------------------------------|
| large | BINON | 83 | GAM2 38 $\pi^- p \rightarrow 2\eta n$ |
|-------|-------|----|---------------------------------------|

$\Gamma(\eta\eta)/\Gamma(\pi\pi)$  $\Gamma_{11}/\Gamma_1$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.173±0.024 OUR FIT** Error includes scale factor of 1.1.**0.175±0.027 OUR AVERAGE**

|              |                     |          |                                                                                 |
|--------------|---------------------|----------|---------------------------------------------------------------------------------|
| 0.18 ±0.03   | BARBERIS            | 00E      | 450 $p\bar{p} \rightarrow p_f \eta \eta p_s$                                    |
| 0.157 ±0.060 | <sup>1</sup> AMSLER | 95D CBAR | 0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |        |         |                                                               |
|--------------|--------|---------|---------------------------------------------------------------|
| 0.080 ±0.033 | AMSLER | 02 CBAR | 0.9 $\bar{p}p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$ |
|--------------|--------|---------|---------------------------------------------------------------|

|            |                        |          |              |
|------------|------------------------|----------|--------------|
| 0.11 ±0.03 | <sup>2</sup> ANISOVICH | 02D SPEC | Combined fit |
|------------|------------------------|----------|--------------|

|              |                    |          |             |
|--------------|--------------------|----------|-------------|
| 0.078 ±0.013 | <sup>3</sup> ABELE | 96C RVUE | Compilation |
|--------------|--------------------|----------|-------------|

|              |                     |          |                                            |
|--------------|---------------------|----------|--------------------------------------------|
| 0.230 ±0.097 | <sup>4</sup> AMSLER | 95C CBAR | 0.0 $\bar{p}p \rightarrow \eta \eta \pi^0$ |
|--------------|---------------------|----------|--------------------------------------------|

<sup>1</sup> Coupled-channel analysis of AMSLER 95B, AMSLER 95C, and AMSLER 94D.<sup>2</sup> From a combined K-matrix analysis of Crystal Barrel (0.  $p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ ), GAMS ( $\pi p \rightarrow \pi^0 \pi^0 n, \eta \eta n, \eta \eta' n$ ), and BNL ( $\pi p \rightarrow K \bar{K} n$ ) data.<sup>3</sup>  $2\pi$  width determined to be  $60 \pm 12$  MeV.<sup>4</sup> Using AMSLER 95B ( $3\pi^0$ ).NODE=M152R13  
NODE=M152R13NODE=M152R3;LINKAGE=AB  
NODE=M152R;LINKAGE=CHNODE=M152R3;LINKAGE=CM  
NODE=M152R3;LINKAGE=A $\Gamma(4\pi^0)/\Gamma(\eta\eta)$  $\Gamma_5/\Gamma_{11}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |      |         |                                    |
|----------|------|---------|------------------------------------|
| 0.8 ±0.3 | ALDE | 87 GAM4 | 100 $\pi^- p \rightarrow 4\pi^0 n$ |
|----------|------|---------|------------------------------------|

NODE=M152R5  
NODE=M152R5 $\Gamma(\eta\eta'(958))/\Gamma(\pi\pi)$  $\Gamma_{12}/\Gamma_1$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.064±0.022 OUR FIT** Error includes scale factor of 1.4.**0.095±0.026** BARBERIS 00A 450  $p\bar{p} \rightarrow p_f \eta \eta p_s$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |                        |          |              |
|--------------|------------------------|----------|--------------|
| 0.005 ±0.003 | <sup>1</sup> ANISOVICH | 02D SPEC | Combined fit |
|--------------|------------------------|----------|--------------|

<sup>1</sup> From a combined K-matrix analysis of Crystal Barrel (0.  $p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ ), GAMS ( $\pi p \rightarrow \pi^0 \pi^0 n, \eta \eta n, \eta \eta' n$ ), and BNL ( $\pi p \rightarrow K \bar{K} n$ ) data.NODE=M152R12  
NODE=M152R12

NODE=M152R12;LINKAGE=CH

 $\Gamma(\eta\eta'(958))/\Gamma(\eta\eta)$  $\Gamma_{12}/\Gamma_{11}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.37±0.13 OUR FIT** Error includes scale factor of 1.5.**0.29±0.10** <sup>1</sup> AMSLER 95C CBAR 0.0  $\bar{p}p \rightarrow \eta \eta \pi^0$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

|            |                        |          |              |
|------------|------------------------|----------|--------------|
| 0.05 ±0.03 | <sup>2</sup> ANISOVICH | 02D SPEC | Combined fit |
|------------|------------------------|----------|--------------|

|            |       |          |             |
|------------|-------|----------|-------------|
| 0.84 ±0.23 | ABELE | 96C RVUE | Compilation |
|------------|-------|----------|-------------|

|          |       |          |                                       |
|----------|-------|----------|---------------------------------------|
| 2.7 ±0.8 | BINON | 84C GAM2 | 38 $\pi^- p \rightarrow \eta \eta' n$ |
|----------|-------|----------|---------------------------------------|

<sup>1</sup> Using AMSLER 94E ( $\eta \eta' \pi^0$ ).<sup>2</sup> From a combined K-matrix analysis of Crystal Barrel (0.  $p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ ), GAMS ( $\pi p \rightarrow \pi^0 \pi^0 n, \eta \eta n, \eta \eta' n$ ), and BNL ( $\pi p \rightarrow K \bar{K} n$ ) data.NODE=M152R2  
NODE=M152R2NODE=M152R2;LINKAGE=A  
NODE=M152R2;LINKAGE=CH $\Gamma(K\bar{K})/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |      |         |  |
|--------------|------|---------|--|
| 0.044 ±0.021 | BUGG | 96 RVUE |  |
|--------------|------|---------|--|

NODE=M152R9  
NODE=M152R9 $\Gamma(K\bar{K})/\Gamma(\pi\pi)$  $\Gamma_{13}/\Gamma_1$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.246±0.025 OUR FIT****0.236±0.026 OUR AVERAGE**

|            |                        |         |            |
|------------|------------------------|---------|------------|
| 0.25 ±0.03 | <sup>1</sup> BARGIOTTI | 03 OBLX | $\bar{p}p$ |
|------------|------------------------|---------|------------|

|            |                    |         |                                                |
|------------|--------------------|---------|------------------------------------------------|
| 0.19 ±0.07 | <sup>2</sup> ABELE | 98 CBAR | 0.0 $\bar{p}p \rightarrow K_L^0 K^\pm \pi^\mp$ |
|------------|--------------------|---------|------------------------------------------------|

|            |                    |          |                                              |
|------------|--------------------|----------|----------------------------------------------|
| 0.20 ±0.08 | <sup>3</sup> ABELE | 96B CBAR | 0.0 $\bar{p}p \rightarrow \pi^0 K_L^0 K_L^0$ |
|------------|--------------------|----------|----------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|            |                        |          |              |
|------------|------------------------|----------|--------------|
| 0.16 ±0.05 | <sup>4</sup> ANISOVICH | 02D SPEC | Combined fit |
|------------|------------------------|----------|--------------|

|                  |          |          |                                                 |
|------------------|----------|----------|-------------------------------------------------|
| 0.33 ±0.03 ±0.07 | BARBERIS | 99D OMEG | 450 $p\bar{p} \rightarrow K^+ K^-, \pi^+ \pi^-$ |
|------------------|----------|----------|-------------------------------------------------|

<sup>1</sup> Coupled channel analysis of  $\pi^+ \pi^- \pi^0, K^+ K^- \pi^0$ , and  $K^\pm K_S^0 \pi^\mp$ .<sup>2</sup> Using  $\pi^0 \pi^0$  from AMSLER 95B.<sup>3</sup> Using AMSLER 95B ( $3\pi^0$ ), AMSLER 94C ( $2\pi^0 \eta$ ) and SU(3).<sup>4</sup> From a combined K-matrix analysis of Crystal Barrel (0.  $p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ ), GAMS ( $\pi p \rightarrow \pi^0 \pi^0 n, \eta \eta n, \eta \eta' n$ ), and BNL ( $\pi p \rightarrow K \bar{K} n$ ) data.NODE=M152R7  
NODE=M152R7NODE=M152R;LINKAGE=BG  
NODE=M152R7;LINKAGE=A  
NODE=M152R7;LINKAGE=D  
NODE=M152R7;LINKAGE=CH

$\Gamma(K\bar{K})/\Gamma(\eta\eta)$  $\Gamma_{13}/\Gamma_{11}$ 

| VALUE                                                                         | CL%                                 | DOCUMENT ID     | TECN                                         | COMMENT                                     |
|-------------------------------------------------------------------------------|-------------------------------------|-----------------|----------------------------------------------|---------------------------------------------|
| <b>1.43±0.24 OUR FIT</b>                                                      | Error includes scale factor of 1.1. |                 |                                              |                                             |
| <b>1.85±0.41</b>                                                              |                                     | BARBERIS 00E    | 450 $p\bar{p} \rightarrow p_f \eta \eta p_s$ |                                             |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                                     |                 |                                              |                                             |
| 1.5 ±0.6                                                                      |                                     | 1 ANISOVICH 02D | SPEC                                         | Combined fit                                |
| <0.4                                                                          | 90                                  | 2 PROKOSHKIN 91 | GAM4                                         | 300 $\pi^- p \rightarrow \pi^- p \eta \eta$ |
| <0.6                                                                          |                                     | 3 BINON 83      | GAM2                                         | 38 $\pi^- p \rightarrow 2 \eta n$           |

<sup>1</sup> From a combined K-matrix analysis of Crystal Barrel (0.  $p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \eta \eta$ ,  $\pi^0 \pi^0 \eta$ ), GAMS ( $\pi p \rightarrow \pi^0 \pi^0 n$ ,  $\eta \eta n$ ,  $\eta \eta' n$ ), and BNL ( $\pi p \rightarrow K \bar{K} n$ ) data.

<sup>2</sup> Combining results of GAM4 with those of WA76 on  $K \bar{K}$  central production.

<sup>3</sup> Using ETKIN 82B and COHEN 80.

NODE=M152R4  
NODE=M152R4

NODE=M152R4;LINKAGE=CH

NODE=M152R4;LINKAGE=BZ  
NODE=M152R4;LINKAGE=A

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|-------------------------------|---------------|--------------------------------------------|---------------------------|
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| ROPERTZ 18                    | EPJ C78 1000  | S. Ropertz, C. Hanhart, B. Kubis           | (BONN, JULI)              |
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| ANISOVICH 02D                 | PAN 65 1545   | V.V. Anisovich <i>et al.</i>               |                           |
| Translated from YAF 65 1583.  |               |                                            |                           |
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| ALDE 87                       | PL B198 286   | D.M. Alde <i>et al.</i>                    | (LANL, BRUX, SERP, LAPP)  |
| ALDE 86D                      | NP B269 485   | D.M. Alde <i>et al.</i>                    | (BELG, LAPP, SERP, CERN+) |
| LONGACRE 86                   | PL B177 223   | R.S. Longacre <i>et al.</i>                | (BNL, BRAN, CUNY+)        |
| BINON 84C                     | NC 80A 363    | F.G. Binon <i>et al.</i>                   | (BELG, LAPP, SERP+)       |
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| HYAMS 75                      | NP B100 205   | B.D. Hyams <i>et al.</i>                   | (CERN, MPIM)              |

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**$f_1(1510)$** 

$$I^G(J^{PC}) = 0^+(1^{++})$$

OMITTED FROM SUMMARY TABLE

See the minireview under  $\eta(1405)$ .

NODE=M084

NODE=M084

NODE=M084M

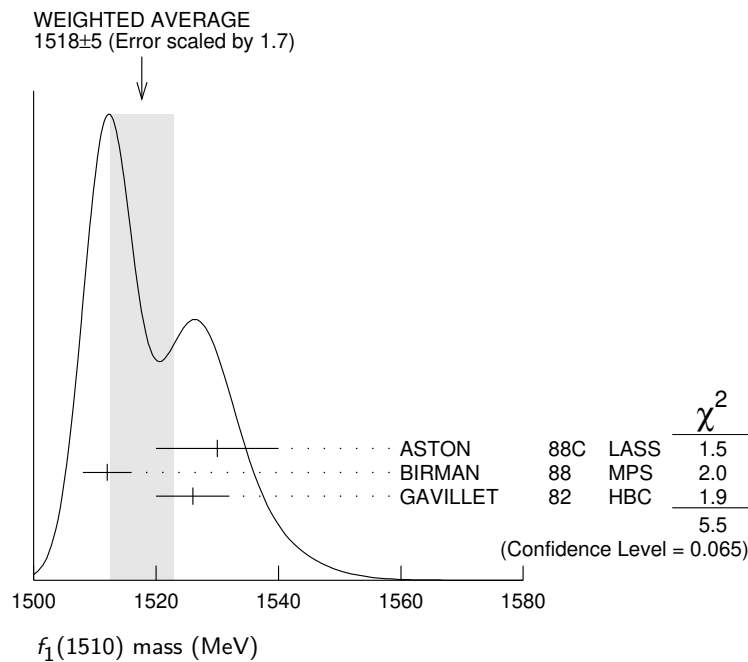
NODE=M084M

 **$f_1(1510)$  MASS**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                              |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|----------|------------------------------------------------------|
| <b>1518<math>\pm</math>5 OUR AVERAGE</b>                                      |      | Error includes scale factor of 1.7. See the ideogram below. |          |                                                      |
| 1530 $\pm$ 10                                                                 |      | ASTON                                                       | 88C LASS | 11 $K^- p \rightarrow K_S^0 K^\pm \pi^\mp \Lambda$   |
| 1512 $\pm$ 4                                                                  | 600  | <sup>1</sup> BIRMAN                                         | 88 MPS   | 8 $\pi^- p \rightarrow K^+ \bar{K}^0 \pi^- n$        |
| 1526 $\pm$ 6                                                                  | 271  | GAVILLET                                                    | 82 HBC   | 4.2 $K^- p \rightarrow \Lambda K K \pi$              |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                             |          |                                                      |
| $\sim 1525$                                                                   |      | <sup>2</sup> BAUER                                          | 93B      | $\gamma\gamma^* \rightarrow \pi^+ \pi^- \pi^0 \pi^0$ |
| <sup>1</sup> From partial wave analysis of $K^+ \bar{K}^0 \pi^-$ state.       |      |                                                             |          |                                                      |
| <sup>2</sup> Not seen by AIHARA 88C in the $K_S^0 K^\pm \pi^\mp$ final state. |      |                                                             |          |                                                      |

NODE=M084M;LINKAGE=A

NODE=M084M;LINKAGE=C

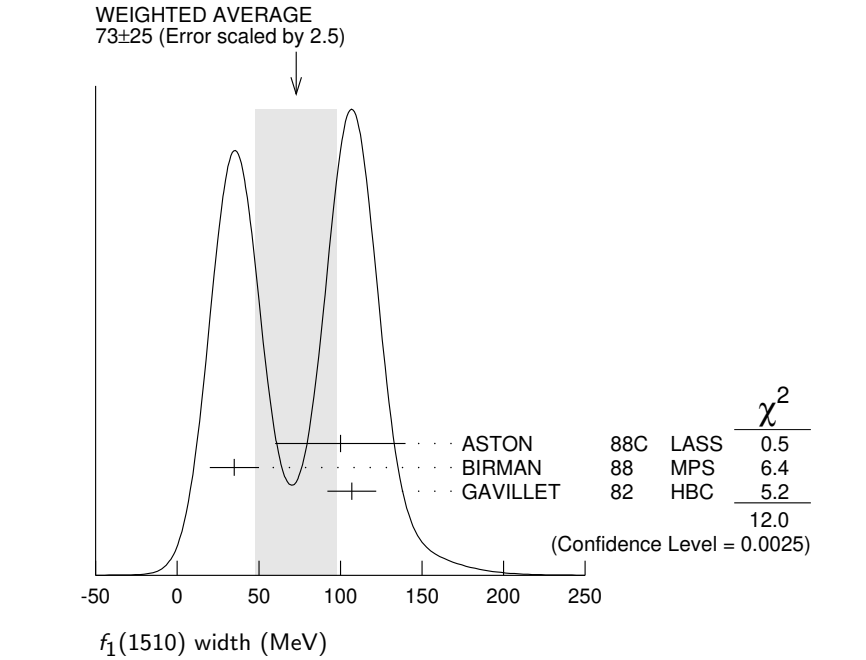
 **$f_1(1510)$  WIDTH**

NODE=M084W

NODE=M084W

| VALUE (MeV)                                                             | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                            |
|-------------------------------------------------------------------------|------|-------------------------------------------------------------|----------|----------------------------------------------------|
| <b>73<math>\pm</math>25 OUR AVERAGE</b>                                 |      | Error includes scale factor of 2.5. See the ideogram below. |          |                                                    |
| 100 $\pm$ 40                                                            |      | ASTON                                                       | 88C LASS | 11 $K^- p \rightarrow K_S^0 K^\pm \pi^\mp \Lambda$ |
| 35 $\pm$ 15                                                             | 600  | <sup>3</sup> BIRMAN                                         | 88 MPS   | 8 $\pi^- p \rightarrow K^+ \bar{K}^0 \pi^- n$      |
| 107 $\pm$ 15                                                            | 271  | GAVILLET                                                    | 82 HBC   | 4.2 $K^- p \rightarrow \Lambda K K \pi$            |
| <sup>3</sup> From partial wave analysis of $K^+ \bar{K}^0 \pi^-$ state. |      |                                                             |          |                                                    |

NODE=M084W;LINKAGE=A



**$f_1(1510)$  DECAY MODES**

NODE=M084215;NODE=M084

| Mode                                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------------------|--------------------------------|
| $\Gamma_1$ $K \bar{K}^*(892) + \text{c.c.}$ | seen                           |
| $\Gamma_2$ $\pi^+ \pi^- \eta'$              | seen                           |

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=2

**$f_1(1510)$  BRANCHING RATIOS**

NODE=M084225

| $\Gamma(\pi^+ \pi^- \eta')/\Gamma_{\text{total}}$ |      |             |          |                                               | $\Gamma_2/\Gamma$ |
|---------------------------------------------------|------|-------------|----------|-----------------------------------------------|-------------------|
| VALUE                                             | EVTS | DOCUMENT ID | TECN     | COMMENT                                       |                   |
| seen                                              | 230  | ABLIKIM     | 11C BES3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |                   |

NODE=M084R01  
NODE=M084R01

**$f_1(1510)$  REFERENCES**

NODE=M084

|          |     |                |                           |                             |
|----------|-----|----------------|---------------------------|-----------------------------|
| ABLIKIM  | 11C | PRL 106 072002 | M. Ablikim <i>et al.</i>  | (BESIII Collab.)            |
| BAUER    | 93B | PR D48 3976    | D.A. Bauer <i>et al.</i>  | (SLAC)                      |
| AIHARA   | 88C | PR D38 1       | H. Aihara <i>et al.</i>   | (TPC-2 $\gamma$ Collab.)    |
| ASTON    | 88C | PL B201 573    | D. Aston <i>et al.</i>    | (SLAC, NAGO, CINC, INUS) JP |
| BIRMAN   | 88  | PRL 61 1557    | A. Birman <i>et al.</i>   | (BNL, FSU, IND, MASD) JP    |
| GAVILLET | 82  | ZPHY C16 119   | P. Gavillet <i>et al.</i> | (CERN, CDEF, PADO+)         |

REFID=53684  
REFID=43678  
REFID=40564  
REFID=40282  
REFID=40568  
REFID=20877

$f'_2(1525)$ 

$$I^G(J^{PC}) = 0^+(2^{++})$$

NODE=M013

 $f'_2(1525)$  MASS

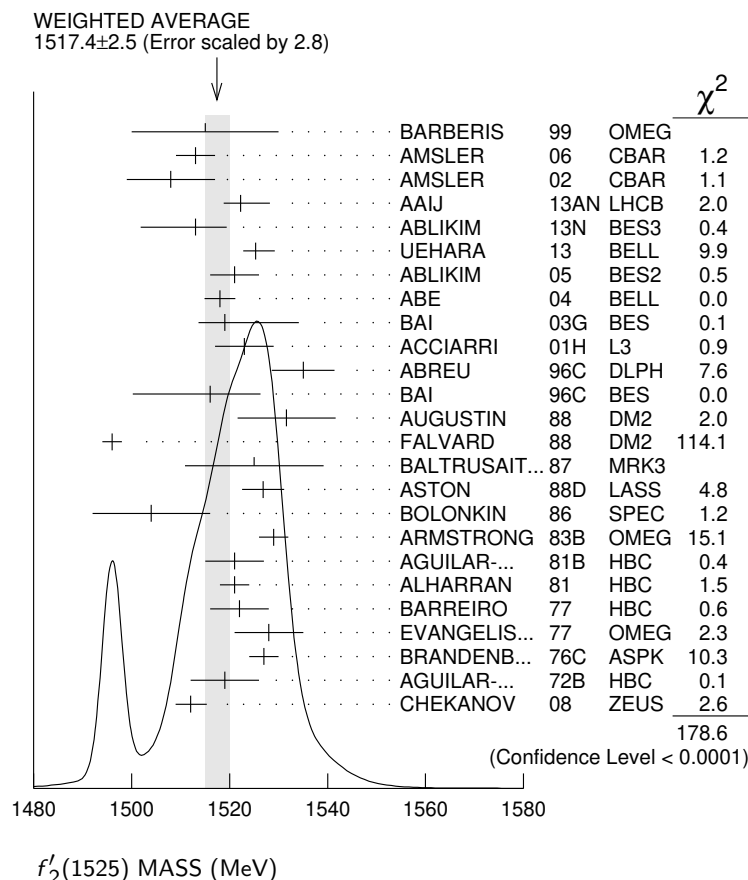
NODE=M013MX

VALUE (MeV)

DOCUMENT ID

**1517.4±2.5 OUR AVERAGE** Includes data from the 6 datablocks that follow this one.  
Error includes scale factor of 2.8. See the ideogram below.

NODE=M013MX



## PRODUCED BY PION BEAM

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

NODE=M013M1  
NODE=M013M1

The data in this block is included in the average printed for a previous datablock.

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                   |                       |    |      |                                                |
|-----------------------------------|-----------------------|----|------|------------------------------------------------|
| 1521±13                           | TIKHOMIROV            | 03 | SPEC | 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| 1547 <sup>+10</sup> <sub>-2</sub> | <sup>1</sup> LONGACRE | 86 | MPS  | 22 $\pi^- p \rightarrow K_S^0 K_S^0 n$         |
| 1496 <sup>+9</sup> <sub>-8</sub>  | <sup>2</sup> CHABAUD  | 81 | ASPK | 6 $\pi^- p \rightarrow K^+ K^- n$              |
| 1497 <sup>+8</sup> <sub>-9</sub>  | CHABAUD               | 81 | ASPK | 18.4 $\pi^- p \rightarrow K^+ K^- n$           |
| 1492±29                           | GORLICH               | 80 | ASPK | 17 $\pi^- p$ polarized $\rightarrow K^+ K^- n$ |
| 1502±25                           | <sup>3</sup> CORDEN   | 79 | OMEG | 12-15 $\pi^- p \rightarrow \pi^+ \pi^- n$      |
| 1480                              | 14 CRENNELL           | 66 | HBC  | 6.0 $\pi^- p \rightarrow K_S^0 K_S^0 n$        |

OCCUR=2

<sup>1</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles.<sup>2</sup> CHABAUD 81 is a reanalysis of PAWLICKI 77 data.<sup>3</sup> From an amplitude analysis where the  $f'_2(1525)$  width and elasticity are in complete disagreement with the values obtained from  $K\bar{K}$  channel, making the solution dubious.NODE=M013M;LINKAGE=L  
NODE=M013M;LINKAGE=D  
NODE=M013M;LINKAGE=N

**PRODUCED BY  $K^\pm$  BEAM**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

The data in this block is included in the average printed for a previous datablock.

NODE=M013M2  
 NODE=M013M2

**1518.1 ± 2.8 OUR AVERAGE** Includes data from the datablock that follows this one. Error includes scale factor of 3.0. See the ideogram below.

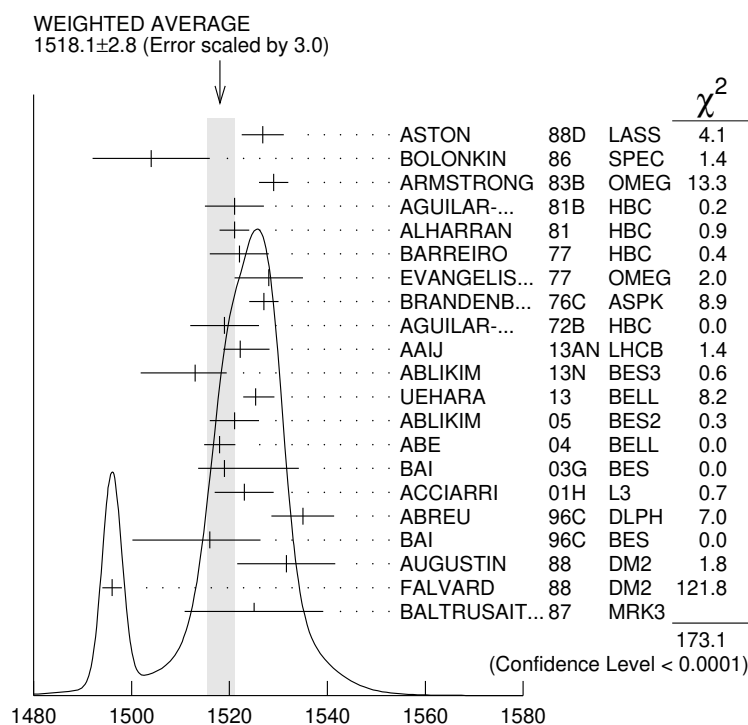
|              |     |              |     |      |          |                                                 |
|--------------|-----|--------------|-----|------|----------|-------------------------------------------------|
| 1526.8 ± 4.3 |     | ASTON        | 88D | LASS | 11       | $K^- p \rightarrow K_S^0 K_S^0 \Lambda$         |
| 1504 ± 12    |     | BOLONKIN     | 86  | SPEC | 40       | $K^- p \rightarrow K_S^0 K_S^0 Y$               |
| 1529 ± 3     |     | ARMSTRONG    | 83B | OMEG | 18.5     | $K^- p \rightarrow K^- K^+ \Lambda$             |
| 1521 ± 6     | 650 | AGUILAR...   | 81B | HBC  | 4.2      | $K^- p \rightarrow \Lambda K^+ K^-$             |
| 1521 ± 3     | 572 | ALHARRAN     | 81  | HBC  | 8.25     | $K^- p \rightarrow \Lambda K \bar{K}$           |
| 1522 ± 6     | 123 | BARREIRO     | 77  | HBC  | 4.15     | $K^- p \rightarrow \Lambda K_S^0 K_S^0$         |
| 1528 ± 7     | 166 | EVANGELIS... | 77  | OMEG | 10       | $K^- p \rightarrow K^+ K^- (\Lambda, \Sigma)$   |
| 1527 ± 3     | 120 | BRANDENB...  | 76C | ASPK | 13       | $K^- p \rightarrow K^+ K^- (\Lambda, \Sigma)$   |
| 1519 ± 7     | 100 | AGUILAR...   | 72B | HBC  | 3.9, 4.6 | $K^- p \rightarrow K \bar{K} (\Lambda, \Sigma)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |    |        |    |      |      |                                                    |
|-----------|----|--------|----|------|------|----------------------------------------------------|
| 1514 ± 8  | 61 | BINON  | 07 | GAMS | 32.5 | $K^- p \rightarrow \eta \eta (\Lambda / \Sigma^0)$ |
| 1513 ± 10 | 1  | BARKOV | 99 | SPEC | 40   | $K^- p \rightarrow K_S^0 K_S^0 y$                  |

<sup>1</sup> Systematic errors not estimated.

NODE=M013M2;LINKAGE=SK

PRODUCED BY  $K^\pm$  BEAM (MeV)**PRODUCED IN  $e^+e^-$  ANNIHILATION AND PARTICLE DECAYS**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

The data in this block is included in the average printed for a previous datablock.

NODE=M013M3  
 NODE=M013M3

**1514  $\pm \frac{5}{4}$  OUR AVERAGE** Error includes scale factor of 3.8. See the ideogram below.

|                                                  |              |                       |      |      |                                                           |
|--------------------------------------------------|--------------|-----------------------|------|------|-----------------------------------------------------------|
| 1522.2 ± 2.8 $\pm \frac{5.3}{2.0}$               |              | AAIJ                  | 13AN | LHCB | $\bar{B}_s^0 \rightarrow J/\psi K^+ K^-$                  |
| 1513 ± 5 $\pm \frac{4}{10}$ 5.5k                 | <sup>1</sup> | ABLIKIM               | 13N  | BES3 | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \eta \eta$ |
| 1525.3 $\pm \frac{1.2}{1.4} \pm \frac{3.7}{2.1}$ |              | UEHARA                | 13   | BELL | $\gamma \gamma \rightarrow K_S^0 K_S^0$                   |
| 1521 ± 5                                         |              | ABLIKIM               | 05   | BES2 | $J/\psi \rightarrow \phi K^+ K^-$                         |
| 1518 ± 1 ± 3                                     |              | ABE                   | 04   | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- K^+ K^-$                |
| 1519 ± 2 $\pm \frac{15}{5}$                      |              | BAI                   | 03G  | BES  | $J/\psi \rightarrow \gamma K \bar{K}$                     |
| 1523 ± 6                                         | 331          | <sup>2</sup> ACCIARRI | 01H  | L3   | 91, 183-209 $e^+ e^- \rightarrow e^+ e^- K_S^0 K_S^0$     |

|                        |                      |      |      |                                     |
|------------------------|----------------------|------|------|-------------------------------------|
| 1535 ± 5 ± 4           | ABREU                | 96C  | DLPH | $Z^0 \rightarrow K^+ K^- + X$       |
| 1516 ± 5 $^{+9}_{-15}$ | BAI                  | 96C  | BES  | $J/\psi \rightarrow \gamma K^+ K^-$ |
| 1531.6 ± 10.0          | AUGUSTIN             | 88   | DM2  | $J/\psi \rightarrow \gamma K^+ K^-$ |
| 1496 ± 2               | <sup>3</sup> FALVARD | 88   | DM2  | $J/\psi \rightarrow \phi K^+ K^-$   |
| 1525 ± 10 ± 10         | BALTRUSAIT...87      | MRK3 |      | $J/\psi \rightarrow \gamma K^+ K^-$ |

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |     |                         |          |                                                  |
|--------------|-----|-------------------------|----------|--------------------------------------------------|
| 1532 ± 3 ± 6 | 644 | <sup>4,5</sup> DOBBS    | 15       | $J/\psi \rightarrow \gamma K^+ K^-$              |
| 1557 ± 9 ± 3 | 113 | <sup>4,5</sup> DOBBS    | 15       | $\psi(2S) \rightarrow \gamma K^+ K^-$            |
| 1526 ± 7     | 29  | <sup>6</sup> LEES       | 14H BABR | $e^+ e^- \rightarrow K_S^0 K_S^0 K^+ K^- \gamma$ |
| 1523 ± 5     | 870 | <sup>7</sup> SCHEGELSKY | 06A RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$           |
| 1515 ± 5     |     | <sup>8</sup> FALVARD    | 88 DM2   | $J/\psi \rightarrow \phi K^+ K^-$                |

OCCUR=2

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

<sup>2</sup> Supersedes ACCIARRI 95J.

<sup>3</sup> From an analysis including interference with  $f_0(1710)$ .

<sup>4</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>5</sup> From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 73$  MeV.

<sup>6</sup> From a fit to a Breit-Wigner line shape plus a second-order polynomial function. Systematic errors not evaluated.

<sup>7</sup> From analysis of L3 data at 91 and 183–209 GeV.

<sup>8</sup> From an analysis ignoring interference with  $f_0(1710)$ .

NODE=M013M3;LINKAGE=A

NODE=M013M;LINKAGE=HA

NODE=M013M;LINKAGE=F2

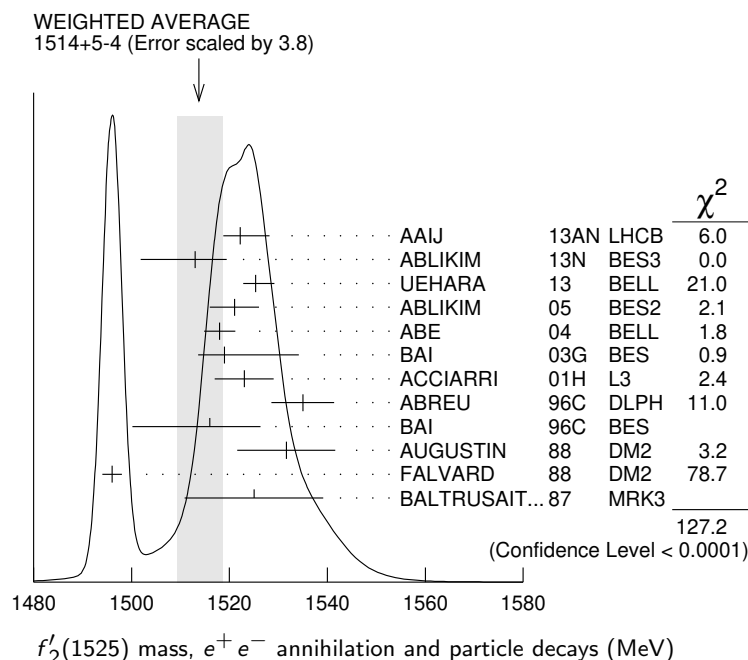
NODE=M013M3;LINKAGE=B

NODE=M013M3;LINKAGE=C

NODE=M013M3;LINKAGE=D

NODE=M013M3;LINKAGE=SC

NODE=M013M;LINKAGE=F1



## PRODUCED IN $\bar{p}p$ ANNIHILATION

VALUE (MeV) DOCUMENT ID TECN COMMENT

The data in this block is included in the average printed for a previous datablock.

### 1512 ± 4 OUR AVERAGE

|          |                     |    |      |                                                               |
|----------|---------------------|----|------|---------------------------------------------------------------|
| 1513 ± 4 | AMSLER              | 06 | CBAR | $0.9 \bar{p}p \rightarrow K^+ K^- \pi^0$                      |
| 1508 ± 9 | <sup>1</sup> AMSLER | 02 | CBAR | $0.9 \bar{p}p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                    |                        |    |      |                                                                             |
|--------------------|------------------------|----|------|-----------------------------------------------------------------------------|
| 1495.0 ± 1.1 ± 8.1 | <sup>2</sup> ALBRECHT  | 20 | RVUE | $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| 1530 ± 12          | <sup>3</sup> ANISOVICH | 09 | RVUE | $0.0 \bar{p}p, \pi N$                                                       |

<sup>1</sup> T-matrix pole.

<sup>2</sup> T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).

<sup>3</sup> 4-poles, 5-channel K matrix fit.

NODE=M013M;LINKAGE=TT

NODE=M013M9;LINKAGE=A

NODE=M013M9;LINKAGE=AN

## CENTRAL PRODUCTION

VALUE (MeV) DOCUMENT ID TECN COMMENT

The data in this block is included in the average printed for a previous datablock.

|           |          |    |          |                                  |
|-----------|----------|----|----------|----------------------------------|
| 1515 ± 15 | BARBERIS | 99 | OMEG 450 | $pp \rightarrow p_s p_f K^+ K^-$ |
|-----------|----------|----|----------|----------------------------------|

NODE=M013M4

NODE=M013M4

**PRODUCED IN  $ep$  COLLISIONS**

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

The data in this block is included in the average printed for a previous datablock.

**$1512 \pm 3^{+1.4}_{-0.5}$**  <sup>1</sup> CHEKANOV 08 ZEUS  $ep \rightarrow K_S^0 K_S^0 X$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$1537^{+9}_{-8}$  84 <sup>2</sup> CHEKANOV 04 ZEUS  $ep \rightarrow K_S^0 K_S^0 X$

<sup>1</sup> In the SU(3) based model with a specific interference pattern of the  $f_2(1270)$ ,  $a_2^0(1320)$ , and  $f_2'(1525)$  mesons incoherently added to the  $f_0(1710)$  and non-resonant background.

<sup>2</sup> Systematic errors not estimated.

NODE=M013M10  
NODE=M013M10

NODE=M013M10;LINKAGE=HE

NODE=M013M10;LINKAGE=CH

 **$f_2'(1525)$  WIDTH**

| VALUE (MeV) | DOCUMENT ID | COMMENT |
|-------------|-------------|---------|
|-------------|-------------|---------|

**$86 \pm 5$  OUR FIT** Error includes scale factor of 2.2.

**$86.9^{+2.3}_{-2.1}$**  PDG 18 Average of width measurements

NODE=M013WX

NODE=M013WX

**PRODUCED BY PION BEAM**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**$86.9^{+2.3}_{-2.1}$  OUR AVERAGE** Includes data from the 5 datablocks that follow this one.

Error includes scale factor of 1.4. See the ideogram below.

• • • We do not use the following data for averages, fits, limits, etc. • • •

102  $\pm 42$  TIKHOMIROV 03 SPEC 40.0  $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$

108  $^{+5}_{-2}$  <sup>1</sup> LONGACRE 86 MPS 22  $\pi^- p \rightarrow K_S^0 K_S^0 n$

69  $^{+22}_{-16}$  <sup>2</sup> CHABAUD 81 ASPK 6  $\pi^- p \rightarrow K^+ K^- n$

137  $^{+23}_{-21}$  CHABAUD 81 ASPK 18.4  $\pi^- p \rightarrow K^+ K^- n$

150  $^{+83}_{-50}$  GORLICH 80 ASPK 17  $\pi^- p$  polarized  $\rightarrow K^+ K^- n$

165  $\pm 42$  <sup>3</sup> CORDEN 79 OMEG 12-15  $\pi^- p \rightarrow \pi^+ \pi^- n$

92  $^{+39}_{-22}$  <sup>4</sup> POLYCHRO... 79 STRC 7  $\pi^- p \rightarrow n K_S^0 K_S^0$

<sup>1</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles.

<sup>2</sup> CHABAUD 81 is a reanalysis of PAWLICKI 77 data.

<sup>3</sup> From an amplitude analysis where the  $f_2'(1525)$  width and elasticity are in complete disagreement with the values obtained from  $K\bar{K}$  channel, making the solution dubious.

<sup>4</sup> From a fit to the  $D$  with  $f_2(1270)$ - $f_2'(1525)$  interference. Mass fixed at 1516 MeV.

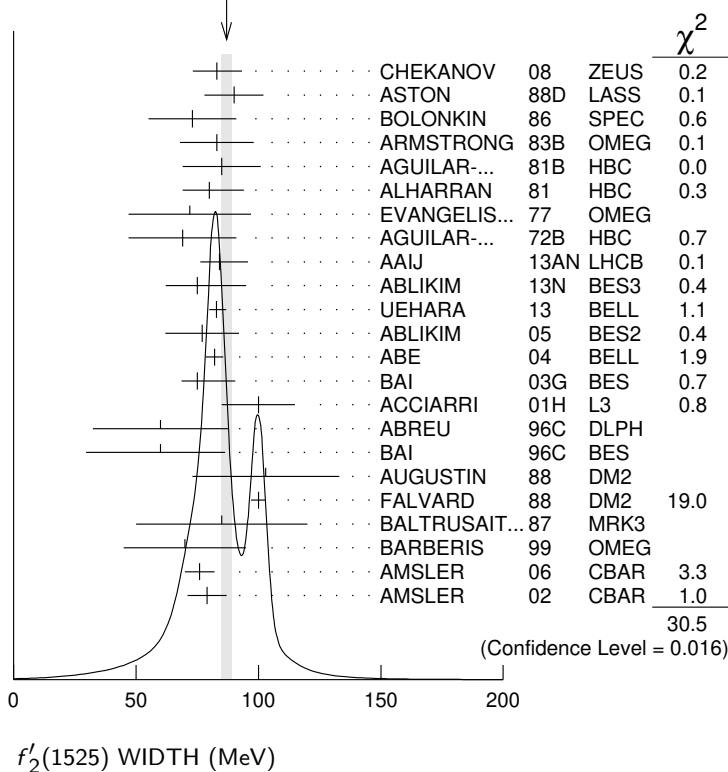
NODE=M013W1  
NODE=M013W1

OCCUR=2

NODE=M013W;LINKAGE=L  
NODE=M013W;LINKAGE=D  
NODE=M013W;LINKAGE=N

NODE=M013W;LINKAGE=M

WEIGHTED AVERAGE  
86.9+2.3-2.1 (Error scaled by 1.4)



### PRODUCED BY $K^\pm$ BEAM

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

The data in this block is included in the average printed for a previous datablock.

NODE=M013W2  
NODE=M013W2

### 82 $\pm$ 6 OUR AVERAGE

|                    |     |              |     |      |         |                                                 |
|--------------------|-----|--------------|-----|------|---------|-------------------------------------------------|
| 90 $\pm$ 12        |     | ASTON        | 88D | LASS | 11      | $K^- p \rightarrow K_S^0 K_S^0 \Lambda$         |
| 73 $\pm$ 18        |     | BOLONKIN     | 86  | SPEC | 40      | $K^- p \rightarrow K_S^0 K_S^0 \gamma$          |
| 83 $\pm$ 15        |     | ARMSTRONG    | 83B | OMEG | 18.5    | $K^- p \rightarrow K^- K^+ \Lambda$             |
| 85 $\pm$ 16        | 650 | AGUILAR-...  | 81B | HBC  | 4.2     | $K^- p \rightarrow \Lambda K^+ K^-$             |
| 80 $\pm$ 14<br>-11 | 572 | ALHARRAN     | 81  | HBC  | 8.25    | $K^- p \rightarrow \Lambda K \bar{K}$           |
| 72 $\pm$ 25        | 166 | EVANGELIS... | 77  | OMEG | 10      | $K^- p \rightarrow K^+ K^- (\Lambda, \Sigma)$   |
| 69 $\pm$ 22        | 100 | AGUILAR-...  | 72B | HBC  | 3.9,4.6 | $K^- p \rightarrow K \bar{K} (\Lambda, \Sigma)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                    |     |                     |     |      |      |                                                    |
|--------------------|-----|---------------------|-----|------|------|----------------------------------------------------|
| 92 $\pm$ 25<br>-16 | 61  | BINON               | 07  | GAMS | 32.5 | $K^- p \rightarrow \eta \eta (\Lambda / \Sigma^0)$ |
| 75 $\pm$ 20        |     | <sup>1</sup> BARKOV | 99  | SPEC | 40   | $K^- p \rightarrow K_S^0 K_S^0 \gamma$             |
| 62 $\pm$ 19<br>-14 | 123 | BARREIRO            | 77  | HBC  | 4.15 | $K^- p \rightarrow \Lambda K_S^0 K_S^0$            |
| 61 $\pm$ 8         | 120 | BRANDENB...         | 76C | ASPK | 13   | $K^- p \rightarrow K^+ K^- (\Lambda, \Sigma)$      |

<sup>1</sup> Systematic errors not estimated.

NODE=M013W2;LINKAGE=SK

### PRODUCED IN $e^+ e^-$ ANNIHILATION AND PARTICLE DECAYS

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

The data in this block is included in the average printed for a previous datablock.

NODE=M013W3  
NODE=M013W3

### 89.2 $\pm$ 3.4 OUR AVERAGE Error includes scale factor of 1.8. See the ideogram below.

|                                       |      |                      |      |      |                                                           |
|---------------------------------------|------|----------------------|------|------|-----------------------------------------------------------|
| 84 $\pm$ 6 $\pm$ 10<br>-5             |      | AAIJ                 | 13AN | LHCB | $\bar{B}_s^0 \rightarrow J/\psi K^+ K^-$                  |
| 75 $\pm$ 12 $\pm$ 16<br>-10 -8        | 5.5k | <sup>1</sup> ABLIKIM | 13N  | BES3 | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \eta \eta$ |
| 82.9 $\pm$ 2.1 $\pm$ 3.3<br>-2.2 -2.0 |      | UEHARA               | 13   | BELL | $\gamma \gamma \rightarrow K_S^0 K_S^0$                   |
| 77 $\pm$ 15                           |      | ABLIKIM              | 05   | BES2 | $J/\psi \rightarrow \phi K^+ K^-$                         |
| 82 $\pm$ 2 $\pm$ 3                    |      | ABE                  | 04   | BELL | 10.6 $e^+ e^- \rightarrow e^+ e^- K^+ K^-$                |
| 75 $\pm$ 4 $\pm$ 15<br>-5             |      | BAI                  | 03G  | BES  | $J/\psi \rightarrow \gamma K \bar{K}$                     |

|                                      |     |                       |          |                                                     |
|--------------------------------------|-----|-----------------------|----------|-----------------------------------------------------|
| 100 ±15                              | 331 | <sup>2</sup> ACCIARRI | 01H L3   | 91, 183–209 $e^+e^- \rightarrow e^+e^- K_S^0 K_S^0$ |
| 60 ±20 ±19                           |     | ABREU                 | 96c DLPH | $Z^0 \rightarrow K^+K^- + X$                        |
| 60 ±23 <sup>+13</sup> <sub>-20</sub> |     | BAI                   | 96c BES  | $J/\psi \rightarrow \gamma K^+K^-$                  |
| 103 ±30                              |     | AUGUSTIN              | 88 DM2   | $J/\psi \rightarrow \gamma K^+K^-$                  |
| 100 ± 3                              |     | <sup>3</sup> FALVARD  | 88 DM2   | $J/\psi \rightarrow \phi K^+K^-$                    |
| 85 ±35                               |     | BALTRUSAIT...87       | MRK3     | $J/\psi \rightarrow \gamma K^+K^-$                  |

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |     |                         |          |                                                |
|---------|-----|-------------------------|----------|------------------------------------------------|
| 37 ±12  | 29  | <sup>4</sup> LEES       | 14H BABR | $e^+e^- \rightarrow K_S^0 K_S^0 K^+K^- \gamma$ |
| 104 ±10 | 870 | <sup>5</sup> SCHEGELSKY | 06A RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$         |
| 62 ±10  |     | <sup>6</sup> FALVARD    | 88 DM2   | $J/\psi \rightarrow \phi K^+K^-$               |

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

<sup>2</sup> Supersedes ACCIARRI 95J.

<sup>3</sup> From an analysis including interference with  $f_0(1710)$ .

<sup>4</sup> From a fit to a Breit-Wigner line shape plus a second-order polynomial function. Systematic errors not evaluated.

<sup>5</sup> From analysis of L3 data at 91 and 183–209 GeV.

<sup>6</sup> From an analysis ignoring interference with  $f_0(1710)$ .

NODE=M013W3;LINKAGE=A

NODE=M013W;LINKAGE=HA

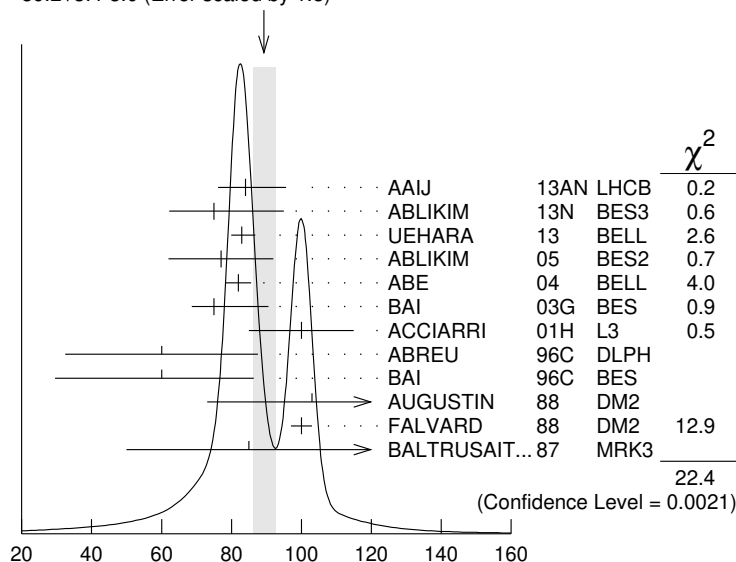
NODE=M013W;LINKAGE=F2

NODE=M013W3;LINKAGE=B

NODE=M013W3;LINKAGE=SC

NODE=M013W;LINKAGE=F1

WEIGHTED AVERAGE  
89.2±3.4-3.0 (Error scaled by 1.8)



$f'_2(1525)$  width,  $e^+e^-$  annihilation and particle decays (MeV)

## PRODUCED IN $\bar{p}p$ ANNIHILATION

VALUE (MeV) DOCUMENT ID TECN COMMENT

The data in this block is included in the average printed for a previous datablock.

### 77 ± 5 OUR AVERAGE

|        |                     |    |      |                                                               |
|--------|---------------------|----|------|---------------------------------------------------------------|
| 76 ± 6 | AMSLER              | 06 | CBAR | 0.9 $\bar{p}p \rightarrow K^+K^- \pi^0$                       |
| 79 ± 8 | <sup>1</sup> AMSLER | 02 | CBAR | 0.9 $\bar{p}p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |                        |    |      |                                                                            |
|-------------------|------------------------|----|------|----------------------------------------------------------------------------|
| 104.8 ± 0.9 ± 9.8 | <sup>2</sup> ALBRECHT  | 20 | RVUE | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+K^-$ |
| 128 ± 20          | <sup>3</sup> ANISOVICH | 09 | RVUE | 0.0 $\bar{p}p, \pi N$                                                      |

<sup>1</sup> T-matrix pole.

<sup>2</sup> T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).

<sup>3</sup> K-matrix, 4-poles, 5-channel fit.

NODE=M013W9;LINKAGE=TT

NODE=M013W9;LINKAGE=A

NODE=M013W9;LINKAGE=AN

## CENTRAL PRODUCTION

VALUE (MeV) DOCUMENT ID TECN COMMENT

The data in this block is included in the average printed for a previous datablock.

|         |          |    |      |                                      |
|---------|----------|----|------|--------------------------------------|
| 70 ± 25 | BARBERIS | 99 | OMEG | 450 $pp \rightarrow p_s p_f K^+ K^-$ |
|---------|----------|----|------|--------------------------------------|

NODE=M013W4

NODE=M013W4



**PRODUCED IN  $ep$  COLLISIONS**

| VALUE (MeV)                                                                         | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------------------------------------------------|------|-------------|------|---------|
| The data in this block is included in the average printed for a previous datablock. |      |             |      |         |

NODE=M013W10  
 NODE=M013W10

**$83 \pm 9^{+5}_{-4}$**  <sup>1</sup>CHEKANOV 08 ZEUS  $ep \rightarrow K_S^0 K_S^0 X$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$50^{+34}_{-22}$  84 <sup>2</sup>CHEKANOV 04 ZEUS  $ep \rightarrow K_S^0 K_S^0 X$

<sup>1</sup>In the SU(3) based model with a specific interference pattern of the  $f_2(1270)$ ,  $a_2^0(1320)$ , and  $f_2'(1525)$  mesons incoherently added to the  $f_0(1710)$  and non-resonant background.

<sup>2</sup>Systematic errors not estimated.

NODE=M013W10;LINKAGE=HE

NODE=M013W10;LINKAGE=CH

 **$f_2'(1525)$  DECAY MODES**

NODE=M013215;NODE=M013

|            | Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) | Scale factor |
|------------|---------------------------------|--------------------------------|--------------|
| $\Gamma_1$ | $K\bar{K}$                      | $(87.6 \pm 2.2) \%$            | 1.1          |
| $\Gamma_2$ | $\eta\eta$                      | $(11.6 \pm 2.2) \%$            | 1.1          |
| $\Gamma_3$ | $\pi\pi$                        | $(8.3 \pm 1.6) \times 10^{-3}$ |              |
| $\Gamma_4$ | $K\bar{K}^*(892) + \text{c.c.}$ |                                |              |
| $\Gamma_5$ | $\pi K\bar{K}$                  |                                |              |
| $\Gamma_6$ | $\pi\pi\eta$                    |                                |              |
| $\Gamma_7$ | $\pi^+\pi^+\pi^-\pi^-$          |                                |              |
| $\Gamma_8$ | $\gamma\gamma$                  | $(9.5 \pm 1.1) \times 10^{-7}$ | 1.1          |

DESIG=2

DESIG=4

DESIG=1

DESIG=3

DESIG=6

DESIG=5

DESIG=7

DESIG=8

**CONSTRAINED FIT INFORMATION**

An overall fit to the total width, 2 partial widths, a combination of partial widths obtained from integrated cross sections, and 3 branching ratios uses 17 measurements and one constraint to determine 5 parameters. The overall fit has a  $\chi^2 = 18.2$  for 13 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |       |       |
|----------|-------|-------|-------|-------|
| $x_2$    | -100  |       |       |       |
| $x_3$    | -6    | -1    |       |       |
| $x_8$    | -19   | 19    | 1     |       |
| $\Gamma$ | -4    | 4     | 0     | -44   |
|          | $x_1$ | $x_2$ | $x_3$ | $x_8$ |

|            | Mode           | Rate (MeV)                     | Scale factor |
|------------|----------------|--------------------------------|--------------|
| $\Gamma_1$ | $K\bar{K}$     | $75 \pm 4$                     | 1.8          |
| $\Gamma_2$ | $\eta\eta$     | $9.9 \pm 1.9$                  | 1.1          |
| $\Gamma_3$ | $\pi\pi$       | $0.71 \pm 0.14$                | 1.1          |
| $\Gamma_8$ | $\gamma\gamma$ | $(8.2 \pm 0.9) \times 10^{-5}$ |              |

DESIG=2

DESIG=4

DESIG=1

DESIG=8

 **$f_2'(1525)$  PARTIAL WIDTHS**

NODE=M013220

**$\Gamma(K\bar{K})$**

**$\Gamma_1$**

| VALUE (MeV)                  | DOCUMENT ID | TECN | COMMENT                             |
|------------------------------|-------------|------|-------------------------------------|
| <b><math>75 \pm 4</math></b> | OUR FIT     |      | Error includes scale factor of 1.8. |

NODE=M013W6

NODE=M013W6

**$63^{+6}_{-5}$**  <sup>1</sup>LONGACRE 86 MPS  $22 \pi^- p \rightarrow K_S^0 K_S^0 n$

<sup>1</sup>From a partial-wave analysis of data using a K-matrix formalism with 5 poles.

NODE=M013PW;LINKAGE=L

$\Gamma(\eta\eta)$  $\Gamma_2$ 

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**9.9±1.9 OUR FIT** Error includes scale factor of 1.1.

• • • We do not use the following data for averages, fits, limits, etc. • • •

5.0±0.8 870 <sup>1</sup> SCHEGELSKY 06A RVUE  $\gamma\gamma \rightarrow K_S^0 K_S^0$ 24  $\begin{smallmatrix} +3 \\ -1 \end{smallmatrix}$  <sup>2</sup> LONGACRE 86 MPS 22  $\pi^- p \rightarrow K_S^0 K_S^0 n$ <sup>1</sup> From analysis of L3 data at 91 and 183–209 GeV, using  $\Gamma(f_2'(1525) \rightarrow K\bar{K}) = 68$  MeV and SU(3) relations.<sup>2</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles.NODE=M013W7  
NODE=M013W7

NODE=M013W7;LINKAGE=SC

NODE=M013PW7;LINKAGE=L

 $\Gamma(\pi\pi)$  $\Gamma_3$ 

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**0.71±0.14 OUR FIT** Error includes scale factor of 1.1.**1.4  $\begin{smallmatrix} +1.0 \\ -0.5 \end{smallmatrix}$**  <sup>1</sup> LONGACRE 86 MPS 22  $\pi^- p \rightarrow K_S^0 K_S^0 n$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.2  $\begin{smallmatrix} +1.0 \\ -0.2 \end{smallmatrix}$  870 <sup>2</sup> SCHEGELSKY 06A RVUE  $\gamma\gamma \rightarrow K_S^0 K_S^0$ <sup>1</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles.<sup>2</sup> From analysis of L3 data at 91 and 183–209 GeV, using  $\Gamma(f_2'(1525) \rightarrow K\bar{K}) = 68$  MeV and SU(3) relations.NODE=M013W5  
NODE=M013W5

NODE=M013PW5;LINKAGE=L

NODE=M013W5;LINKAGE=SC

 $\Gamma(\gamma\gamma)$  $\Gamma_8$ 

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**0.082±0.009 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.13 ±0.03 870 <sup>1</sup> SCHEGELSKY 06A RVUE  $\gamma\gamma \rightarrow K_S^0 K_S^0$ <sup>1</sup> From analysis of L3 data at 91 and 183–209 GeV, using  $\Gamma(f_2'(1525) \rightarrow K\bar{K}) = 68$  MeV and SU(3) relations.NODE=M013W8  
NODE=M013W8

NODE=M013W8;LINKAGE=SC

 $\Gamma(K\bar{K})/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.746±0.002  $\begin{smallmatrix} +0.166 \\ -0.162 \end{smallmatrix}$  <sup>1</sup> ALBRECHT 20 RVUE 0.9  $\bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$ <sup>1</sup> Residue from T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).NODE=M013R00  
NODE=M013R00

NODE=M013R00;LINKAGE=A

 $f_2'(1525) \Gamma(i) \Gamma(\gamma\gamma)/\Gamma(\text{total})$ 

NODE=M013223

 $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_1 \Gamma_8/\Gamma$ 

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**0.072 ±0.007 OUR FIT****0.072 ±0.007 OUR AVERAGE**0.048  $\begin{smallmatrix} +0.067 \\ -0.008 \end{smallmatrix}$   $\begin{smallmatrix} +0.108 \\ -0.012 \end{smallmatrix}$  UEHARA 13 BELL  $\gamma\gamma \rightarrow K_S^0 K_S^0$ 0.0564±0.0048±0.0116 ABE 04 BELL 10.6  $e^+ e^- \rightarrow e^+ e^- K^+ K^-$ 0.076 ±0.006 ±0.011 331 <sup>1</sup> ACCIARRI 01H L3  $e^+ e^- \rightarrow e^+ e^- K_S^0 K_S^0$ 0.067 ±0.008 ±0.015 <sup>2</sup> ALBRECHT 90G ARG  $e^+ e^- \rightarrow e^+ e^- K^+ K^-$ 0.11  $\begin{smallmatrix} +0.03 \\ -0.02 \end{smallmatrix}$  ±0.02 BEHREND 89c CELL  $e^+ e^- \rightarrow e^+ e^- K_S^0 K_S^0$ 0.10  $\begin{smallmatrix} +0.04 \\ -0.03 \end{smallmatrix}$   $\begin{smallmatrix} +0.03 \\ -0.02 \end{smallmatrix}$  BERGER 88 PLUT  $e^+ e^- \rightarrow e^+ e^- K_S^0 K_S^0$ 0.12 ±0.07 ±0.04 <sup>2</sup> AIHARA 86B TPC  $e^+ e^- \rightarrow e^+ e^- K^+ K^-$ 0.11 ±0.02 ±0.04 <sup>2</sup> ALTHOFF 83 TASS  $e^+ e^- \rightarrow e^+ e^- K\bar{K}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.0314±0.0050±0.0077 <sup>3</sup> ALBRECHT 90G ARG  $e^+ e^- \rightarrow e^+ e^- K^+ K^-$ NODE=M013G1  
NODE=M013G1

OCCUR=2

NODE=M013G;LINKAGE=HA  
NODE=M013G1;LINKAGE=A  
NODE=M013G1;LINKAGE=B<sup>1</sup> Supersedes ACCIARRI 95J. From analysis of L3 data at 91 and 183–209 GeV,<sup>2</sup> Using an incoherent background.<sup>3</sup> Using a coherent background.

**$f'_2(1525)$  BRANCHING RATIOS**

NODE=M013225

 **$\Gamma(\eta\eta)/\Gamma_{\text{total}}$**  **$\Gamma_2/\Gamma$** 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                             |                            |      |                                                                             |
|-----------------------------|----------------------------|------|-----------------------------------------------------------------------------|
| $0.059 \pm 0.003 \pm 0.026$ | <sup>1</sup> ALBRECHT 20   | RVUE | $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| seen                        | UEHARA 10A                 | BELL | $10.6 e^+ e^- \rightarrow e^+ e^- \eta \eta$                                |
| $0.10 \pm 0.03$             | <sup>2</sup> PROKOSHKIN 91 | GAM4 | $300 \pi^- p \rightarrow \pi^- p \eta \eta$                                 |

<sup>1</sup> Residue from T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).<sup>2</sup> Combining results of GAM4 with those of WA76 on  $K\bar{K}$  central production and results of CBAL, MRK3 and DM2 on  $J/\psi \rightarrow \gamma \eta \eta$ .

NODE=M013R8;LINKAGE=A

NODE=M013R8;LINKAGE=B

 **$\Gamma(\eta\eta)/\Gamma(K\bar{K})$**  **$\Gamma_2/\Gamma_1$** 

| VALUE | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|-----|------|-------------|------|---------|
|-------|-----|------|-------------|------|---------|

**0.132 $\pm$ 0.028 OUR FIT****0.115 $\pm$ 0.028 OUR AVERAGE**

|                             |    |                            |      |      |                                                         |
|-----------------------------|----|----------------------------|------|------|---------------------------------------------------------|
| $0.119 \pm 0.015 \pm 0.036$ | 61 | <sup>1</sup> BINON         | 07   | GAMS | $32.5 K^- p \rightarrow \eta \eta (\Lambda / \Sigma^0)$ |
| $0.11 \pm 0.04$             |    | <sup>2</sup> PROKOSHKIN 91 | GAM4 | 300  | $\pi^- p \rightarrow \pi^- p \eta \eta$                 |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |    |          |     |     |                                         |
|----------|----|----------|-----|-----|-----------------------------------------|
| $< 0.14$ | 90 | BARBERIS | 00E |     | $450 p p \rightarrow p_f \eta \eta p_s$ |
| $< 0.50$ |    | BARNES   | 67  | HBC | $4.6, 5.0 K^- p$                        |

<sup>1</sup> Using the compilation of the cross sections for  $f'_2(1525)$  production in  $K^- p$  collisions from ASTON 88D.<sup>2</sup> Combining results of GAM4 with those of WA76 on  $K\bar{K}$  central production and results of CBAL, MRK3 and DM2 on  $J/\psi \rightarrow \gamma \eta \eta$ .

NODE=M013R3;LINKAGE=BI

NODE=M013R3;LINKAGE=B

 **$\Gamma(\pi\pi)/\Gamma_{\text{total}}$**  **$\Gamma_3/\Gamma$** 

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

**0.83 $\pm$ 0.16 OUR FIT****0.75 $\pm$ 0.16 OUR AVERAGE**

|                       |    |                       |     |      |                                                                             |
|-----------------------|----|-----------------------|-----|------|-----------------------------------------------------------------------------|
| $0.7 \pm 0.2$         |    | COSTA                 | 80  | OMEG | $10 \pi^- p \rightarrow K^+ K^- n$                                          |
| $2.7^{+7.1}_{-1.3}$   |    | <sup>1</sup> GORLICH  | 80  | ASPK | $17, 18 \pi^- p$                                                            |
| $0.75 \pm 0.25$       |    | <sup>1,2</sup> MARTIN | 79  | RVUE |                                                                             |
| $3.4 \pm 1.5 \pm 1.0$ |    | <sup>3</sup> ALBRECHT | 20  | RVUE | $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$ |
| $< 6$                 | 95 | AGUILAR-...           | 81B | HBC  | $4.2 K^- p \rightarrow \Lambda K^+ K^-$                                     |
| $19 \pm 3$            |    | CORDEN                | 79  | OMEG | $12-15 \pi^- p \rightarrow \pi^+ \pi^- n$                                   |
| $< 4.5$               | 95 | BARREIRO              | 77  | HBC  | $4.15 K^- p \rightarrow \Lambda K_S^0 K_S^0$                                |
| $1.2 \pm 0.4$         |    | <sup>1</sup> PAWLICKI | 77  | SPEC | $6 \pi N \rightarrow K^+ K^- N$                                             |
| $< 6.3$               | 90 | BRANDENB...           | 76C | ASPK | $13 K^- p \rightarrow K^+ K^- (\Lambda, \Sigma)$                            |
| $< 0.86$              |    | <sup>1</sup> BEUSCH   | 75B | OSPK | $8.9 \pi^- p \rightarrow K^0 \bar{K}^0 n$                                   |

<sup>1</sup> Assuming that the  $f'_2(1525)$  is produced by an one-pion exchange production mechanism.<sup>2</sup> MARTIN 79 uses the PAWLICKI 77 data with different input value of the  $f'_2(1525) \rightarrow K\bar{K}$  branching ratio.<sup>3</sup> Residue from T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).

NODE=M013R1;LINKAGE=C

NODE=M013R1;LINKAGE=D

NODE=M013R1;LINKAGE=A

 **$\Gamma(\pi\pi)/\Gamma(K\bar{K})$**  **$\Gamma_3/\Gamma_1$** 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.0094 $\pm$ 0.0018 OUR FIT****0.075  $\pm$ 0.035**AUGUSTIN 87 DM2  $J/\psi \rightarrow \gamma \pi^+ \pi^-$ 

NODE=M013R7

NODE=M013R7

 **$[\Gamma(K\bar{K}^*(892) + \text{c.c.}) + \Gamma(\pi K\bar{K})]/\Gamma(K\bar{K})$**  **$(\Gamma_4 + \Gamma_5)/\Gamma_1$** 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |    |             |     |     |                  |
|----------|----|-------------|-----|-----|------------------|
| $< 0.35$ | 95 | AGUILAR-... | 72B | HBC | $3.9, 4.6 K^- p$ |
| $< 0.4$  | 67 | AMMAR       | 67  | HBC |                  |

NODE=M013R5

NODE=M013R5

$\Gamma(\pi\pi\eta)/\Gamma(K\bar{K})$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |             |     |     |                 |
|-------|----|-------------|-----|-----|-----------------|
| <0.41 | 95 | AGUILAR-... | 72B | HBC | 3.9,4.6 $K^- p$ |
| <0.3  | 67 | AMMAR       | 67  | HBC |                 |

 $\Gamma_6/\Gamma_1$ 

NODE=M013R4  
NODE=M013R4

 $\Gamma(\pi^+\pi^+\pi^-\pi^-)/\Gamma(K\bar{K})$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |             |     |     |                 |
|-------|----|-------------|-----|-----|-----------------|
| <0.32 | 95 | AGUILAR-... | 72B | HBC | 3.9,4.6 $K^- p$ |
|-------|----|-------------|-----|-----|-----------------|

 $\Gamma_7/\Gamma_1$ 

NODE=M013R6  
NODE=M013R6

 $f'_2(1525)$  REFERENCES

NODE=M013

|               |      |                               |                                  |                           |             |
|---------------|------|-------------------------------|----------------------------------|---------------------------|-------------|
| ALBRECHT      | 20   | EPJ C80 453                   | M. Albrecht <i>et al.</i>        | (Crystal Barrel Collab.)  | REFID=60439 |
| PDG           | 18   | PR D98 030001                 | M. Tanabashi <i>et al.</i>       | (PDG Collab.)             | REFID=59304 |
| DOBBS         | 15   | PR D91 052006                 | S. Dobbs <i>et al.</i>           | (NWES)                    | REFID=56805 |
| LEES          | 14H  | PR D89 092002                 | J.P. Lees <i>et al.</i>          | (BABAR Collab.)           | REFID=55940 |
| AAIJ          | 13AN | PR D87 072004                 | R. Aaij <i>et al.</i>            | (LHCb Collab.)            | REFID=55137 |
| ABLIKIM       | 13N  | PR D87 092009                 | Ablikim M. <i>et al.</i>         | (BESIII Collab.)          | REFID=55387 |
| UEHARA        | 13   | PTEP 2013 123C01              | S. Uehara <i>et al.</i>          | (BELLE Collab.)           | REFID=55592 |
| UEHARA        | 10A  | PR D82 114031                 | S. Uehara <i>et al.</i>          | (BELLE Collab.)           | REFID=53641 |
| ANISOVICH     | 09   | IJMP A24 2481                 | V.V. Anisovich, A.V. Sarantsev   |                           | REFID=52719 |
| CHEKANOV      | 08   | PRL 101 112003                | S. Chekanov <i>et al.</i>        | (ZEUS Collab.)            | REFID=52275 |
| BINON         | 07   | PAN 70 1713                   | F. Binon <i>et al.</i>           | (GAMS Collab.)            | REFID=52057 |
| AMSLER        | 06   | Translated from YAF 70 1758.  | C. Amsler <i>et al.</i>          | (Crystal Barrel Collab.)  | REFID=51136 |
| SCHEGELSKY    | 06A  | PL B639 165                   | V.A. Schegelsky <i>et al.</i>    |                           | REFID=51185 |
| ABLIKIM       | 05   | EPJ A27 207                   | M. Ablikim <i>et al.</i>         | (BES Collab.)             | REFID=50450 |
| ABE           | 04   | PL B607 243                   | K. Abe <i>et al.</i>             | (BELLE Collab.)           | REFID=49650 |
| CHEKANOV      | 04   | EPJ C32 323                   | S. Chekanov <i>et al.</i>        | (ZEUS Collab.)            | REFID=49672 |
| BAI           | 03G  | PL B578 33                    | J.Z. Bai <i>et al.</i>           | (BES Collab.)             | REFID=49580 |
| TIKHOMIROV    | 03   | PR D68 052003                 | G.D. Tikhomirov <i>et al.</i>    |                           | REFID=49423 |
| AMSLER        | 02   | PAN 66 828                    | C. Amsler <i>et al.</i>          |                           | REFID=48580 |
| ACCARI        | 01H  | Translated from YAF 66 860.   | M. Acciarri <i>et al.</i>        | (L3 Collab.)              | REFID=48321 |
| BARBERIS      | 00E  | EPJ C23 29                    | D. Barberis <i>et al.</i>        | (WA 102 Collab.)          | REFID=47961 |
| BARBERIS      | 99   | PL B501 173                   | D. Barberis <i>et al.</i>        | (Omega Expt.)             | REFID=46921 |
| BARKOV        | 99   | PL B479 59                    | B.P. Barkov <i>et al.</i>        |                           | REFID=47379 |
| ABREU         | 96C  | JETPL 70 248                  | P. Abreu <i>et al.</i>           | (DELPHI Collab.)          | REFID=44671 |
| BAI           | 96C  | Translated from ZETFP 70 242. | J.Z. Bai <i>et al.</i>           | (BES Collab.)             | REFID=45169 |
| ACCARI        | 95J  | PL B379 309                   | M. Acciarri <i>et al.</i>        | (L3 Collab.)              | REFID=44615 |
| PROKOSHKIN    | 91   | PRL 77 3959                   | Y.D. Prokoshkin                  | (GAM2 and GAM4 Collab.)   | REFID=41719 |
| ALBRECHT      | 90G  | PL B363 118                   | H. Albrecht <i>et al.</i>        | (ARGUS Collab.)           | REFID=41374 |
| BEHREND       | 89C  | SPD 36 155                    | H.J. Behrend <i>et al.</i>       | (CELLO Collab.)           | REFID=40915 |
| ASTON         | 88D  | Translated from DANS 316 900. | D. Aston <i>et al.</i>           | (SLAC, NAGO, CINC, INUS)  | REFID=40330 |
| AUGUSTIN      | 88   | ZPHY C48 183                  | J.E. Augustin <i>et al.</i>      | (DM2 Collab.)             | REFID=40574 |
| BERGER        | 88   | ZPHY C43 91                   | C. Berger <i>et al.</i>          | (PLUTO Collab.)           | REFID=40566 |
| FALVARD       | 88   | NP B301 525                   | A. Falvard <i>et al.</i>         | (CLER, FRAS, LALO+)       | REFID=40576 |
| AUGUSTIN      | 87   | PR D38 2706                   | J.E. Augustin <i>et al.</i>      | (LALO, CLER, FRAS+)       | REFID=40268 |
| BALTRUSAIT... | 87   | ZPHY C36 369                  | R.M. Baltrusaitis <i>et al.</i>  | (Mark III Collab.)        | REFID=40010 |
| AIHARA        | 86B  | PR D35 2077                   | H. Aihara <i>et al.</i>          | (TPC-2 $\gamma$ Collab.)  | REFID=20764 |
| BOLONKIN      | 86   | PRL 57 404                    | B.V. Bolonkin <i>et al.</i>      | (ITEP) JP                 | REFID=44646 |
| LONGACRE      | 86   | SJNP 43 776                   | R.S. Longacre <i>et al.</i>      | (BNL, BRAN, CUNY+)        | REFID=20768 |
| ALTHOFF       | 83   | Translated from YAF 43 1211.  | M. Althoff <i>et al.</i>         | (TASSO Collab.)           | REFID=21408 |
| ARMSTRONG     | 83B  | PL B177 223                   | T.A. Armstrong <i>et al.</i>     | (BARI, BIRM, CERN+)       | REFID=20558 |
| BINON         | 83   | NP B224 193                   | F.G. Binon <i>et al.</i>         | (BELG, LAPP, SERP+)       | REFID=20750 |
| AGUILAR-...   | 81B  | NC 78A 313                    | M. Aguilar-Benitez <i>et al.</i> | (CERN, CDEF+)             | REFID=21104 |
| ALHARRAN      | 81   | ZPHY C8 313                   | S. Al-Harran <i>et al.</i>       | (BIRM, CERN, GLAS+)       | REFID=21403 |
| CHABAUD       | 81   | NP B191 26                    | V. Chabaud <i>et al.</i>         | (CERN, CRAC, MPIM)        | REFID=20742 |
| COSTA         | 80   | APP B12 575                   | G. Costa <i>et al.</i>           | (BARI, BONN, CERN, GLAS+) | REFID=20737 |
| GORLICH       | 80   | NP B175 402                   | L. Gorlich <i>et al.</i>         | (CRAC, MPIM, CERN+)       | REFID=20738 |
| CORDEN        | 79   | NP B174 16                    | M.J. Corden <i>et al.</i>        | (BIRM, RHEL, TELA+) JP    | REFID=20374 |
| MARTIN        | 79   | NP B157 250                   | A.D. Martin, E.N. Ozmutlu        | (DURH)                    | REFID=20377 |
| POLYCHRO...   | 79   | NP B158 520                   | V.A. Polychronakos <i>et al.</i> | (NDAM, ANL)               | REFID=20378 |
| BARREIRO      | 77   | PR D19 1317                   | F. Barreiro <i>et al.</i>        | (CERN, AMST, NIJM+)       | REFID=21392 |
| EVANGELIS...  | 77   | NP B121 237                   | C. Evangelista <i>et al.</i>     | (BARI, BONN, CERN+)       | REFID=20540 |
| PAWLICKI      | 77   | NP B127 384                   | A.J. Pawlicki <i>et al.</i>      | (ANL) IJP                 | REFID=20367 |
| BRANDENB...   | 76C  | PR D15 3196                   | G.W. Brandenbourg <i>et al.</i>  | (SLAC)                    | REFID=20225 |
| BEUSCH        | 75B  | NP B104 413                   | W. Beusch <i>et al.</i>          | (CERN, ETH)               | REFID=21390 |
| HYAMS         | 75   | PL 60B 101                    | B.D. Hyams <i>et al.</i>         | (CERN, MPIM)              | REFID=20355 |
| AGUILAR-...   | 72B  | NP B100 205                   | M. Aguilar-Benitez <i>et al.</i> | (BNL)                     | REFID=20205 |
| AMMAR         | 67   | PR D6 29                      | R. Ammar <i>et al.</i>           | (NWES, ANL) JP            | REFID=21382 |
| BARNES        | 67   | PRL 19 1071                   | V.E. Barnes <i>et al.</i>        | (BNL, SYRA) IJPC          | REFID=21383 |
| CRENNELL      | 66   | PRL 19 964                    | D.J. Crennell <i>et al.</i>      | (BNL) I                   | REFID=20317 |
|               | 66   | PRL 16 1025                   |                                  |                           |             |

**$f_2(1565)$** 

$$I^G(J^{PC}) = 0^+(2^{++})$$

OMITTED FROM SUMMARY TABLE

Seen mostly in antinucleon-nucleon annihilation. Needs confirmation in other channels.

NODE=M123

NODE=M123

 **$f_2(1565)$  MASS**

NODE=M123M

NODE=M123M

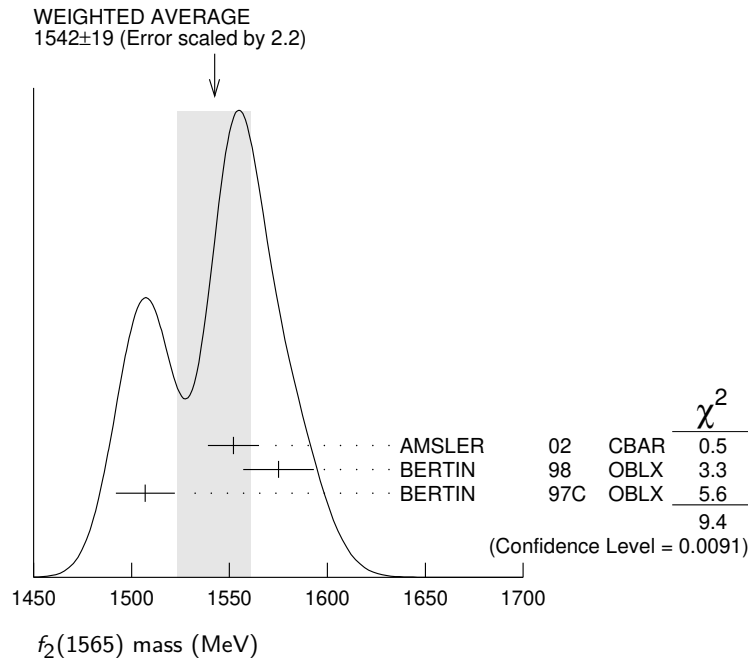
| VALUE (MeV)                                                                   | DOCUMENT ID                                                 | TECN | COMMENT                                                                              |
|-------------------------------------------------------------------------------|-------------------------------------------------------------|------|--------------------------------------------------------------------------------------|
| <b>1542±19 OUR AVERAGE</b>                                                    | Error includes scale factor of 2.2. See the ideogram below. |      |                                                                                      |
| 1552±13                                                                       | <sup>1</sup> AMSLER                                         | 02   | CBAR $0.9 \bar{p}p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$                   |
| 1575±18                                                                       | <sup>1</sup> BERTIN                                         | 98   | OBLX $0.05-0.405 \bar{n}p \rightarrow \pi^+ \pi^+ \pi^-$                             |
| 1507±15                                                                       | <sup>1</sup> BERTIN                                         | 97C  | OBLX $0.0 \bar{p}p \rightarrow \pi^+ \pi^- \pi^0$                                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                             |      |                                                                                      |
| 1560±15                                                                       | <sup>2</sup> ANISOVICH                                      | 09   | RVUE $0.0 \bar{p}p, \pi N$                                                           |
| 1590±10                                                                       | <sup>3,4</sup> AMELIN                                       | 06   | VES $36 \pi^- p \rightarrow \omega \omega n$                                         |
| 1550±10±20                                                                    | <sup>4</sup> AMELIN                                         | 00   | VES $37 \pi^- p \rightarrow \eta \pi^+ \pi^- n$                                      |
| 1598±11±9                                                                     | BAKER                                                       | 99B  | SPEC $0 \bar{p}p \rightarrow \omega \omega \pi^0$                                    |
| 1534±20                                                                       | <sup>5</sup> ABELE                                          | 96C  | RVUE Compilation                                                                     |
| ~ 1552                                                                        | <sup>6</sup> AMSLER                                         | 95D  | CBAR $0.0 \bar{p}p \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ |
| 1598±72                                                                       | BALOSHIN                                                    | 95   | SPEC $40 \pi^- C \rightarrow K_S^0 K_S^0 X$                                          |
| 1566 <sup>+80</sup> <sub>-50</sub>                                            | <sup>7</sup> ANISOVICH                                      | 94   | CBAR $0.0 \bar{p}p \rightarrow 3\pi^0, \eta \eta \pi^0$                              |
| 1502±9                                                                        | ADAMO                                                       | 93   | OBLX $\bar{n}p \rightarrow \pi^+ \pi^+ \pi^-$                                        |
| 1488±10                                                                       | <sup>8</sup> ARMSTRONG                                      | 93C  | E760 $\bar{p}p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$                      |
| 1508±10                                                                       | <sup>8</sup> ARMSTRONG                                      | 93D  | E760 $\bar{p}p \rightarrow 3\pi^0 \rightarrow 6\gamma$                               |
| 1525±10                                                                       | <sup>8</sup> ARMSTRONG                                      | 93D  | E760 $\bar{p}p \rightarrow \eta \pi^0 \pi^0 \rightarrow 6\gamma$                     |
| ~ 1504                                                                        | <sup>9</sup> WEIDENAUER                                     | 93   | ASTE $0.0 \bar{p}N \rightarrow 3\pi^- 2\pi^+$                                        |
| 1540±15                                                                       | <sup>8</sup> ADAMO                                          | 92   | OBLX $\bar{n}p \rightarrow \pi^+ \pi^+ \pi^-$                                        |
| 1515±10                                                                       | <sup>10</sup> AKER                                          | 91   | CBAR $0.0 \bar{p}p \rightarrow 3\pi^0$                                               |
| 1565±20                                                                       | MAY                                                         | 90   | ASTE $0.0 \bar{p}p \rightarrow \pi^+ \pi^- \pi^0$                                    |
| 1477±5                                                                        | BRIDGES                                                     | 86C  | DBC $0.0 \bar{p}N \rightarrow 3\pi^- 2\pi^+$                                         |

<sup>1</sup> T-matrix pole.<sup>2</sup> On sheet II in a two-pole solution.<sup>3</sup> Supersedes the  $\omega\omega$  state of BELADIDZE 92B earlier assigned to the  $f_2(1640)$ .<sup>4</sup> Breit-Wigner width.<sup>5</sup> T-matrix pole, large coupling to  $\rho\rho$  and  $\omega\omega$ , could be  $f_2(1640)$ .<sup>6</sup> Coupled-channel analysis of AMSLER 95B, AMSLER 95C, and AMSLER 94D.<sup>7</sup> From a simultaneous analysis of the annihilations  $\bar{p}p \rightarrow 3\pi^0, \pi^0 \eta \eta$  including AKER 91 data.<sup>8</sup>  $J^P$  not determined, could be partly  $f_0(1500)$ .<sup>9</sup>  $J^P$  not determined.<sup>10</sup> Superseded by AMSLER 95B.

OCCUR=2

NODE=M123M;LINKAGE=G  
 NODE=M123M;LINKAGE=AN  
 NODE=M123M;LINKAGE=AM  
 NODE=M123M;LINKAGE=D  
 NODE=M123M;LINKAGE=AA  
 NODE=M123M;LINKAGE=AB  
 NODE=M123M;LINKAGE=C

NODE=M123M;LINKAGE=E  
 NODE=M123M;LINKAGE=F  
 NODE=M123M;LINKAGE=BA



### $f_2(1565)$ WIDTH

NODE=M123W

NODE=M123W

| VALUE (MeV)                                                                   | DOCUMENT ID              | TECN | COMMENT                                                                              |
|-------------------------------------------------------------------------------|--------------------------|------|--------------------------------------------------------------------------------------|
| <b>122± 13 OUR AVERAGE</b>                                                    |                          |      |                                                                                      |
| 113± 23                                                                       | <sup>11</sup> AMSLER     | 02   | CBAR 0.9 $\bar{p}p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$                   |
| 119± 24                                                                       | <sup>11</sup> BERTIN     | 98   | OBLX 0.05–0.405 $\bar{n}p \rightarrow \pi^+ \pi^+ \pi^-$                             |
| 130± 20                                                                       | <sup>11</sup> BERTIN     | 97C  | OBLX 0.0 $\bar{p}p \rightarrow \pi^+ \pi^- \pi^0$                                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |                                                                                      |
| 280± 40                                                                       | <sup>12</sup> ANISOVICH  | 09   | RVUE 0.0 $\bar{p}p, \pi N$                                                           |
| 140± 11                                                                       | <sup>13,14</sup> AMELIN  | 06   | VES 36 $\pi^- p \rightarrow \omega \omega n$                                         |
| 130± 20±40                                                                    | <sup>14</sup> AMELIN     | 00   | VES 37 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$                                      |
| 180± 60                                                                       | <sup>15</sup> ABELE      | 96C  | RVUE Compilation                                                                     |
| ~ 142                                                                         | <sup>16</sup> AMSLER     | 95D  | CBAR 0.0 $\bar{p}p \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ |
| 263±101                                                                       | BALOSHIN                 | 95   | SPEC 40 $\pi^- C \rightarrow K_S^0 K_S^0 X$                                          |
| 166 <sup>+</sup> <sub>-20</sub>                                               | <sup>17</sup> ANISOVICH  | 94   | CBAR 0.0 $\bar{p}p \rightarrow 3\pi^0, \eta \eta \pi^0$                              |
| 130± 10                                                                       | <sup>18</sup> ADAMO      | 93   | OBLX $\bar{n}p \rightarrow \pi^+ \pi^+ \pi^-$                                        |
| 148± 27                                                                       | <sup>19</sup> ARMSTRONG  | 93C  | E760 $\bar{p}p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$                      |
| 103± 15                                                                       | <sup>19</sup> ARMSTRONG  | 93D  | E760 $\bar{p}p \rightarrow 3\pi^0 \rightarrow 6\gamma$                               |
| 111± 10                                                                       | <sup>19</sup> ARMSTRONG  | 93D  | E760 $\bar{p}p \rightarrow \eta \pi^0 \pi^0 \rightarrow 6\gamma$                     |
| ~ 206                                                                         | <sup>20</sup> WEIDENAUER | 93   | ASTE 0.0 $\bar{p}N \rightarrow 3\pi^- 2\pi^+$                                        |
| 132± 37                                                                       | <sup>19</sup> ADAMO      | 92   | OBLX $\bar{n}p \rightarrow \pi^+ \pi^+ \pi^-$                                        |
| 120± 10                                                                       | <sup>21</sup> AKER       | 91   | CBAR 0.0 $\bar{p}p \rightarrow 3\pi^0$                                               |
| 170± 40                                                                       | MAY                      | 90   | ASTE 0.0 $\bar{p}p \rightarrow \pi^+ \pi^- \pi^0$                                    |
| 116± 9                                                                        | BRIDGES                  | 86C  | DBC 0.0 $\bar{p}N \rightarrow 3\pi^- 2\pi^+$                                         |

OCCUR=2

- <sup>11</sup> T-matrix pole.  
<sup>12</sup> On sheet II in a two-pole solution.  
<sup>13</sup> Supersedes the  $\omega\omega$  state of BELADIDZE 92B earlier assigned to the  $f_2(1640)$ .  
<sup>14</sup> Breit-Wigner width.  
<sup>15</sup> T-matrix pole, large coupling to  $\rho\rho$  and  $\omega\omega$ , could be  $f_2(1640)$ .  
<sup>16</sup> Coupled-channel analysis of AMSLER 95B, AMSLER 95C, and AMSLER 94D.  
<sup>17</sup> From a simultaneous analysis of the annihilations  $\bar{p}p \rightarrow 3\pi^0, \pi^0 \eta \eta$  including AKER 91 data.  
<sup>18</sup> Supersedes ADAMO 92.  
<sup>19</sup>  $J^P$  not determined, could be partly  $f_0(1500)$ .  
<sup>20</sup>  $J^P$  not determined.  
<sup>21</sup> Superseded by AMSLER 95B.

NODE=M123W;LINKAGE=G  
 NODE=M123W;LINKAGE=AN  
 NODE=M123W;LINKAGE=AM  
 NODE=M123W;LINKAGE=H  
 NODE=M123W;LINKAGE=CC  
 NODE=M123W;LINKAGE=AB  
 NODE=M123W;LINKAGE=D

NODE=M123W;LINKAGE=C  
 NODE=M123W;LINKAGE=E  
 NODE=M123W;LINKAGE=F  
 NODE=M123W;LINKAGE=BA

**$f_2(1565)$  DECAY MODES**

NODE=M123215;NODE=M123

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $\pi\pi$       | seen                           |
| $\Gamma_2$ $\pi^+\pi^-$   | seen                           |
| $\Gamma_3$ $\pi^0\pi^0$   | seen                           |
| $\Gamma_4$ $\rho^0\rho^0$ | seen                           |
| $\Gamma_5$ $2\pi^+2\pi^-$ | seen                           |
| $\Gamma_6$ $\eta\eta$     | seen                           |
| $\Gamma_7$ $\omega\omega$ | seen                           |
| $\Gamma_8$ $K\bar{K}$     | seen                           |
| $\Gamma_9$ $\gamma\gamma$ | seen                           |

DESIG=6;OUR EST;→ UNCHECKED ←  
 DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=3;OUR EST;→ UNCHECKED ←  
 DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=7;OUR EST;→ UNCHECKED ←  
 DESIG=9;OUR EST;→ UNCHECKED ←  
 DESIG=10;OUR EST;→ UNCHECKED ←

 **$f_2(1565)$  PARTIAL WIDTHS**

NODE=M123225

| $\Gamma(\eta\eta)$                                                                                                                                                  |      |                              |      |                                        | $\Gamma_6$ |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------|------|----------------------------------------|------------|
| VALUE (MeV)                                                                                                                                                         | EVTS | DOCUMENT ID                  | TECN | COMMENT                                |            |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                       |      |                              |      |                                        |            |
| $1.2 \pm 0.3$                                                                                                                                                       | 870  | <sup>22</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |            |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                       |      |                              |      |                                        |            |
| $2.0 \pm 1.0$                                                                                                                                                       | 870  | <sup>22</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |            |
| $\Gamma(K\bar{K})$                                                                                                                                                  |      |                              |      |                                        | $\Gamma_8$ |
| VALUE (MeV)                                                                                                                                                         | EVTS | DOCUMENT ID                  | TECN | COMMENT                                |            |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                       |      |                              |      |                                        |            |
| $2.0 \pm 1.0$                                                                                                                                                       | 870  | <sup>22</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |            |
| $\Gamma(\gamma\gamma)$                                                                                                                                              |      |                              |      |                                        | $\Gamma_9$ |
| VALUE (keV)                                                                                                                                                         | EVTS | DOCUMENT ID                  | TECN | COMMENT                                |            |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                       |      |                              |      |                                        |            |
| $0.70 \pm 0.14$                                                                                                                                                     | 870  | <sup>22</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |            |
| <sup>22</sup> From analysis of L3 data at 91 and 183–209 GeV, using $f_2(1565)$ mass of 1570 MeV, width of 160 MeV, $\Gamma(\pi\pi) = 25$ MeV, and SU(3) relations. |      |                              |      |                                        |            |

NODE=M123W3  
 NODE=M123W3

NODE=M123W1  
 NODE=M123W1

NODE=M123W2  
 NODE=M123W2

NODE=M123W1;LINKAGE=SC

 **$f_2(1565)$  BRANCHING RATIOS**

NODE=M123220

| $\Gamma(\pi\pi)/\Gamma_{\text{total}}$                                        |                         |      |         | $\Gamma_1/\Gamma$                                         |
|-------------------------------------------------------------------------------|-------------------------|------|---------|-----------------------------------------------------------|
| VALUE                                                                         | DOCUMENT ID             | TECN | COMMENT |                                                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                         |      |         |                                                           |
| seen                                                                          | BAKER                   | 99B  | SPEC    | $0 \bar{p}p \rightarrow \omega\omega\pi^0$                |
| $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$                                    |                         |      |         | $\Gamma_2/\Gamma$                                         |
| VALUE                                                                         | DOCUMENT ID             | TECN | COMMENT |                                                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                         |      |         |                                                           |
| seen                                                                          | BERTIN                  | 98   | OBLX    | $0.05\text{--}0.405 \bar{p}p \rightarrow \pi^+\pi^+\pi^-$ |
| not seen                                                                      | <sup>23</sup> ANISOVICH | 94B  | RVUE    | $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$                    |
| seen                                                                          | MAY                     | 89   | ASTE    | $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$                    |
| <sup>23</sup> ANISOVICH 94B is from a reanalysis of MAY 90.                   |                         |      |         |                                                           |
| $\Gamma(\pi^0\pi^0)/\Gamma_{\text{total}}$                                    |                         |      |         | $\Gamma_3/\Gamma$                                         |
| VALUE                                                                         | DOCUMENT ID             | TECN | COMMENT |                                                           |
| seen                                                                          | AMSLER                  | 95B  | CBAR    | $0.0 \bar{p}p \rightarrow 3\pi^0$                         |
| $\Gamma(\pi^+\pi^-)/\Gamma(\rho^0\rho^0)$                                     |                         |      |         | $\Gamma_2/\Gamma_4$                                       |
| VALUE                                                                         | DOCUMENT ID             | TECN | COMMENT |                                                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                         |      |         |                                                           |
| $0.042 \pm 0.013$                                                             | BRIDGES                 | 86B  | DBC     | $\bar{p}N \rightarrow 3\pi^-2\pi^+$                       |
| $\Gamma(\eta\eta)/\Gamma(\pi^0\pi^0)$                                         |                         |      |         | $\Gamma_6/\Gamma_3$                                       |
| VALUE                                                                         | DOCUMENT ID             | TECN | COMMENT |                                                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                         |      |         |                                                           |
| $0.024 \pm 0.005 \pm 0.012$                                                   | <sup>24</sup> ARMSTRONG | 93C  | E760    | $\bar{p}p \rightarrow \pi^0\eta\eta \rightarrow 6\gamma$  |
| <sup>24</sup> $J^P$ not determined, could be partly $f_0(1500)$ .             |                         |      |         |                                                           |

NODE=M123R5  
 NODE=M123R5

NODE=M123R1  
 NODE=M123R1

NODE=M123R1;LINKAGE=A

NODE=M123R3  
 NODE=M123R3

NODE=M123R2  
 NODE=M123R2

NODE=M123R4  
 NODE=M123R4

NODE=M123R4;LINKAGE=E

$\Gamma(\omega\omega)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

seen

BAKER

99B

SPEC

 $0 \bar{p} p \rightarrow \omega \omega \pi^0$ 

NODE=M123R6  
NODE=M123R6

 $\phi_2(1565)$  REFERENCES

|                             |     |               |                                |                          |
|-----------------------------|-----|---------------|--------------------------------|--------------------------|
| ANISOVICH                   | 09  | IJMP A24 2481 | V.V. Anisovich, A.V. Sarantsev |                          |
| AMELIN                      | 06  | PAN 69 690    | D.V. Amelin <i>et al.</i>      | (VES Collab.)            |
| Translated from YAF 69 715. |     |               |                                |                          |
| SCHEGELSKY                  | 06A | EPJ A27 207   | V.A. Schegelsky <i>et al.</i>  |                          |
| AMSLER                      | 02  | EPJ C23 29    | C. Amsler <i>et al.</i>        |                          |
| AMELIN                      | 00  | NP A668 83    | D. Amelin <i>et al.</i>        | (VES Collab.)            |
| BAKER                       | 99B | PL B467 147   | C.A. Baker <i>et al.</i>       |                          |
| BERTIN                      | 98  | PR D57 55     | A. Bertin <i>et al.</i>        | (OBELIX Collab.)         |
| BERTIN                      | 97C | PL B408 476   | A. Bertin <i>et al.</i>        | (OBELIX Collab.)         |
| ABELE                       | 96C | NP A609 562   | A. Abele <i>et al.</i>         | (Crystal Barrel Collab.) |
| AMSLER                      | 95B | PL B342 433   | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.) |
| AMSLER                      | 95C | PL B353 571   | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.) |
| AMSLER                      | 95D | PL B355 425   | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.) |
| BALOSHIN                    | 95  | PAN 58 46     | O.N. Baloshin <i>et al.</i>    | (ITEP)                   |
| Translated from YAF 58 50.  |     |               |                                |                          |
| AMSLER                      | 94D | PL B333 277   | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.) |
| ANISOVICH                   | 94  | PL B323 233   | V.V. Anisovich <i>et al.</i>   | (Crystal Barrel Collab.) |
| ANISOVICH                   | 94B | PR D50 1972   | V.V. Anisovich <i>et al.</i>   | (LOQM)                   |
| ADAMO                       | 93  | NP A558 13C   | A. Adamo <i>et al.</i>         | (OBELIX Collab.)         |
| ARMSTRONG                   | 93C | PL B307 394   | T.A. Armstrong <i>et al.</i>   | (FNAL, FERR, GENO+)      |
| ARMSTRONG                   | 93D | PL B307 399   | T.A. Armstrong <i>et al.</i>   | (FNAL, FERR, GENO+)      |
| WEIDENAUER                  | 93  | ZPHY C59 387  | P. Weidenauer <i>et al.</i>    | (ASTERIX Collab.)        |
| ADAMO                       | 92  | PL B287 368   | A. Adamo <i>et al.</i>         | (OBELIX Collab.)         |
| BELADIDZE                   | 92B | ZPHY C54 367  | G.M. Beladidze <i>et al.</i>   | (VES Collab.)            |
| AKER                        | 91  | PL B260 249   | E. Aker <i>et al.</i>          | (Crystal Barrel Collab.) |
| MAY                         | 90  | ZPHY C46 203  | B. May <i>et al.</i>           | (ASTERIX Collab.)        |
| MAY                         | 89  | PL B225 450   | B. May <i>et al.</i>           | (ASTERIX Collab.) IJP    |
| BRIDGES                     | 86B | PRL 56 215    | D.L. Bridges <i>et al.</i>     | (SYRA, CASE)             |
| BRIDGES                     | 86C | PRL 57 1534   | D.L. Bridges <i>et al.</i>     | (SYRA)                   |

NODE=M123

REFID=52719  
REFID=51574

REFID=51185  
REFID=48580  
REFID=47432  
REFID=47398  
REFID=45782  
REFID=45701  
REFID=45076  
REFID=44377  
REFID=44440  
REFID=44441  
REFID=44621

REFID=44093  
REFID=43659  
REFID=44071  
REFID=43657  
REFID=43587  
REFID=43596  
REFID=43585  
REFID=42177  
REFID=42172  
REFID=41587  
REFID=41365  
REFID=40921  
REFID=21376  
REFID=21377

 $\rho(1570)$ 

$$I^G(J^{PC}) = 1^+(1^--)$$

OMITTED FROM SUMMARY TABLE

May be an OZI-violating decay mode of  $\rho(1700)$ . See our mini-review under the  $\rho(1700)$ .

NODE=M188

NODE=M188

 $\rho(1570)$  MASS

| VALUE (MeV)           | EVTS | DOCUMENT ID           | TECN     | COMMENT                                      |
|-----------------------|------|-----------------------|----------|----------------------------------------------|
| <b>1570 ± 36 ± 62</b> | 54   | <sup>1</sup> AUBERT   | 08S BABR | 10.6 $e^+ e^- \rightarrow \phi \pi^0 \gamma$ |
| 1585 ± 15             |      | <sup>2</sup> ACHASOV  | 20C SND  | 1.3–2.0 $e^+ e^- \rightarrow K^+ K^- \pi^0$  |
| 1480 ± 40             |      | <sup>3</sup> BITYUKOV | 87 SPEC  | 32.5 $\pi^- p \rightarrow \phi \pi^0 n$      |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<sup>1</sup> From the fit with two resonances.

<sup>2</sup> From a fit using a two resonance model in which the mass and width of the other resonance are fixed at the  $\rho(1700)$  values from PDG 20.

<sup>3</sup> Systematic errors not estimated.

NODE=M188M

NODE=M188M

NODE=M188M;LINKAGE=AU  
NODE=M188M;LINKAGE=A

NODE=M188M;LINKAGE=BI

 $\rho(1570)$  WIDTH

| VALUE (MeV)          | EVTS | DOCUMENT ID           | TECN     | COMMENT                                      |
|----------------------|------|-----------------------|----------|----------------------------------------------|
| <b>144 ± 75 ± 43</b> | 54   | <sup>4</sup> AUBERT   | 08S BABR | 10.6 $e^+ e^- \rightarrow \phi \pi^0 \gamma$ |
| 75 ± 30              |      | <sup>5</sup> ACHASOV  | 20C SND  | 1.3–2.0 $e^+ e^- \rightarrow K^+ K^- \pi^0$  |
| 130 ± 60             |      | <sup>6</sup> BITYUKOV | 87 SPEC  | 32.5 $\pi^- p \rightarrow \phi \pi^0 n$      |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<sup>4</sup> From the fit with two resonances.

<sup>5</sup> From a fit using a two resonance model in which the mass and width of the other resonance are fixed at the  $\rho(1700)$  values from PDG 20.

<sup>6</sup> Systematic errors not estimated.

NODE=M188W

NODE=M188W

NODE=M188W;LINKAGE=AU  
NODE=M188W;LINKAGE=A

NODE=M188W;LINKAGE=BI

 $\rho(1570)$  DECAY MODES

| Mode                    | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------|--------------------------------|
| $\Gamma_1$ $e^+ e^-$    |                                |
| $\Gamma_2$ $\phi \pi$   | not seen                       |
| $\Gamma_3$ $\omega \pi$ |                                |

NODE=M188215;NODE=M188

DESIG=1

DESIG=2

DESIG=3



$\rho(1570) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$ 

| $\Gamma(\phi\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$                 |     |      |                        |          |                                            | $\Gamma_2\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------|-----|------|------------------------|----------|--------------------------------------------|---------------------------|
| VALUE (eV)                                                                    | CL% | EVTs | DOCUMENT ID            | TECN     | COMMENT                                    |                           |
| <b><math>3.5\pm 0.9\pm 0.3</math></b>                                         |     | 54   | <sup>7</sup> AUBERT    | 08S BABR | $10.6\ e^+e^- \rightarrow \phi\pi^0\gamma$ |                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                        |          |                                            |                           |
| <70                                                                           | 90  |      | <sup>8</sup> AULCHENKO | 87B ND   | $e^+e^- \rightarrow K_S^0 K_L^0 \pi^0$     |                           |
| <sup>7</sup> From the fit with two resonances.                                |     |      |                        |          |                                            |                           |
| <sup>8</sup> Using mass and width of BITYUKOV 87.                             |     |      |                        |          |                                            |                           |

NODE=M188225

NODE=M188G01  
NODE=M188G01NODE=M188G01;LINKAGE=AU  
NODE=M188G01;LINKAGE=AL $\rho(1570) \text{ BRANCHING RATIOS}$ 

| $\Gamma(\phi\pi)/\Gamma_{\text{total}}$                                       |                        |      |         | $\Gamma_2/\Gamma$                              |
|-------------------------------------------------------------------------------|------------------------|------|---------|------------------------------------------------|
| VALUE                                                                         | DOCUMENT ID            | TECN | COMMENT |                                                |
| <b>not seen</b>                                                               | ABELE                  | 97H  | CBAR    | $\bar{p}p \rightarrow K_L^0 K_S^0 \pi^0 \pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |         |                                                |
| <0.01                                                                         | <sup>9</sup> DONNACHIE | 91   | RVUE    |                                                |
| <sup>9</sup> Using data from BISELLO 91B, DOLINSKY 86, and ALBRECHT 87L.      |                        |      |         |                                                |

NODE=M188220

NODE=M188R01  
NODE=M188R01

NODE=M188R01;LINKAGE=DO

| $\Gamma(\phi\pi)/\Gamma(\omega\pi)$                                           |     |             |      |         |                                        | $\Gamma_2/\Gamma_3$ |
|-------------------------------------------------------------------------------|-----|-------------|------|---------|----------------------------------------|---------------------|
| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT |                                        |                     |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |             |      |         |                                        |                     |
| >0.5                                                                          | 95  | BITYUKOV    | 87   | SPEC    | 32.5 $\pi^- p \rightarrow \phi\pi^0 n$ |                     |

NODE=M188R02  
NODE=M188R02 $\rho(1570) \text{ REFERENCES}$ 

|           |     |                               |                              |                          |
|-----------|-----|-------------------------------|------------------------------|--------------------------|
| ACHASOV   | 20C | EPJ C80 1139                  | M.N. Achasov <i>et al.</i>   | (SND Collab.)            |
| PDG       | 20  | PTEP 2020 083C01              | P.A. Zyla <i>et al.</i>      | (PDG Collab.)            |
| AUBERT    | 08S | PR D77 092002                 | B. Aubert <i>et al.</i>      | (BABAR Collab.)          |
| ABELE     | 97H | PL B415 280                   | A. Abele <i>et al.</i>       | (Crystal Barrel Collab.) |
| BISELLO   | 91B | NPBPS B21 111                 | D. Bisello                   | (DM2 Collab.)            |
| DONNACHIE | 91  | ZPHY C51 689                  | A. Donnachie, A.B. Clegg     | (MCHS, LANC)             |
| ALBRECHT  | 87L | PL B185 223                   | H. Albrecht <i>et al.</i>    | (ARGUS Collab.)          |
| AULCHENKO | 87B | JETPL 45 145                  | V.M. Aulchenko <i>et al.</i> | (NOVO)                   |
|           |     | Translated from ZETFP 45 118. |                              |                          |
| BITYUKOV  | 87  | PL B188 383                   | S.I. Bitjukov <i>et al.</i>  | (SERP)                   |
| DOLINSKY  | 86  | PL B174 453                   | S.I. Dolinsky <i>et al.</i>  | (NOVO)                   |

NODE=M188

REFID=60935  
REFID=60676  
REFID=52242  
REFID=45765  
REFID=41752  
REFID=41632  
REFID=40418  
REFID=41373  
REFID=40011  
REFID=20246

NODE=M166

 $h_1(1595)$ 

$$I^G(J^{PC}) = 0^-(1^{+-})$$

OMITTED FROM SUMMARY TABLE

Seen in a partial-wave analysis of the  $\omega\eta$  system produced in the reaction  $\pi^- p \rightarrow \omega\eta n$  at 18 GeV/c.

NODE=M166

 $h_1(1595) \text{ MASS}$ 

| VALUE (MeV)                                 | DOCUMENT ID | TECN    | COMMENT                               |
|---------------------------------------------|-------------|---------|---------------------------------------|
| <b><math>1594 \pm 15^{+10}_{-60}</math></b> | EUGENIO     | 01 SPEC | $18 \pi^- p \rightarrow \omega\eta n$ |

NODE=M166M

NODE=M166M

 $h_1(1595) \text{ WIDTH}$ 

| VALUE (MeV)                                 | DOCUMENT ID | TECN    | COMMENT                               |
|---------------------------------------------|-------------|---------|---------------------------------------|
| <b><math>384 \pm 60^{+70}_{-100}</math></b> | EUGENIO     | 01 SPEC | $18 \pi^- p \rightarrow \omega\eta n$ |

NODE=M166W

NODE=M166W

 $h_1(1595) \text{ DECAY MODES}$ 

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1 \quad \omega\eta$ | seen                           |

NODE=M166215;NODE=M166

DESIG=1;OUR EST;→ UNCHECKED ←

 $h_1(1595) \text{ REFERENCES}$ 

|         |    |             |                          |
|---------|----|-------------|--------------------------|
| EUGENIO | 01 | PL B497 190 | P. Eugenio <i>et al.</i> |
|---------|----|-------------|--------------------------|

NODE=M166

REFID=48010

$\pi_1(1600)$ 

$$I^G(J^{PC}) = 1^-(1^--^+)$$

See the review on "Non- $q\bar{q}$  Mesons" and a note in PDG 06, Journal of Physics **G33** 1 (2006).

NODE=M164

NODE=M164

NODE=M164M

NODE=M164M

NEW

### $\pi_1(1600)$ MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**1661 $^{+15}_{-11}$  OUR AVERAGE** Error includes scale factor of 1.2. [1660 $^{+15}_{-11}$  MeV OUR 2020 AVERAGE Scale factor = 1.2]

|                           |      |                       |     |                                                        |
|---------------------------|------|-----------------------|-----|--------------------------------------------------------|
| 1600 $^{+110}_{-60}$      | 46M  | <sup>1</sup> AGHASYAN | 18B | COMP 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$     |
| 1664 $\pm 8 \pm 10$       | 145k | <sup>2</sup> LU       | 05  | B852 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| 1709 $\pm 24 \pm 41$      | 69k  | <sup>3</sup> KUHN     | 04  | B852 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |
| 1597 $\pm 10^{+45}_{-10}$ |      | <sup>3</sup> IVANOV   | 01  | B852 18 $\pi^- p \rightarrow \eta' \pi^- p$            |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |      |                       |     |                                                        |
|--------------------------|------|-----------------------|-----|--------------------------------------------------------|
| 1564 $\pm 24 \pm 86$     |      | <sup>4</sup> RODAS    | 19  | JPAC 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$ |
| 1660 $\pm 10^{+0}_{-64}$ | 420k | <sup>5</sup> ALEKSEEV | 10  | COMP 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$  |
| 1593 $\pm 8^{+29}_{-47}$ |      | <sup>3,6</sup> ADAMS  | 98B | B852 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$    |

<sup>1</sup> Statistical error negligible.

<sup>2</sup> May be a different state: natural and unnatural parity exchanges.

<sup>3</sup> Natural parity exchange.

<sup>4</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15 data. The mass is extracted from the T-matrix pole.

<sup>5</sup> Superseded by AGHASYAN 2018B.

<sup>6</sup> Superseded by DZIERBA 06 excluding this state in a more refined PWA analysis, with 2.6 M events of  $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$  and 3 M events of  $\pi^- p \rightarrow \pi^- \pi^0 \pi^0 p$  of E852 data.

NODE=M164M;LINKAGE=B  
NODE=M164M;LINKAGE=LU  
NODE=M164M;LINKAGE=A  
NODE=M164M;LINKAGE=D

NODE=M164M;LINKAGE=C  
NODE=M164M;LINKAGE=DZ

### $\pi_1(1600)$ WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**240 $\pm 50$  OUR AVERAGE** Error includes scale factor of 1.7. See the ideogram below. [257 $\pm 60$  MeV OUR 2020 AVERAGE Scale factor = 1.9]

|                      |      |                       |     |                                                        |
|----------------------|------|-----------------------|-----|--------------------------------------------------------|
| 580 $^{+100}_{-230}$ | 46M  | <sup>1</sup> AGHASYAN | 18B | COMP 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$     |
| 185 $\pm 25 \pm 28$  | 145k | <sup>2</sup> LU       | 05  | B852 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| 403 $\pm 80 \pm 115$ | 69k  | <sup>3</sup> KUHN     | 04  | B852 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |
| 340 $\pm 40 \pm 50$  |      | <sup>3</sup> IVANOV   | 01  | B852 18 $\pi^- p \rightarrow \eta' \pi^- p$            |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                           |      |                       |     |                                                        |
|---------------------------|------|-----------------------|-----|--------------------------------------------------------|
| 492 $\pm 54 \pm 102$      |      | <sup>4</sup> RODAS    | 19  | JPAC 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$ |
| 269 $\pm 21^{+42}_{-64}$  | 420k | <sup>5</sup> ALEKSEEV | 10  | COMP 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$  |
| 168 $\pm 20^{+150}_{-12}$ |      | <sup>3,6</sup> ADAMS  | 98B | B852 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$    |

<sup>1</sup> Statistical error negligible.

<sup>2</sup> May be a different state: natural and unnatural parity exchanges.

<sup>3</sup> Natural parity exchange.

<sup>4</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15 data. The width is extracted from the T-matrix pole.

<sup>5</sup> Superseded by AGHASYAN 2018B.

<sup>6</sup> Superseded by DZIERBA 06 excluding this state in a more refined PWA analysis, with 2.6 M events of  $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$  and 3 M events of  $\pi^- p \rightarrow \pi^- \pi^0 \pi^0 p$  of E852 data.

NODE=M164W

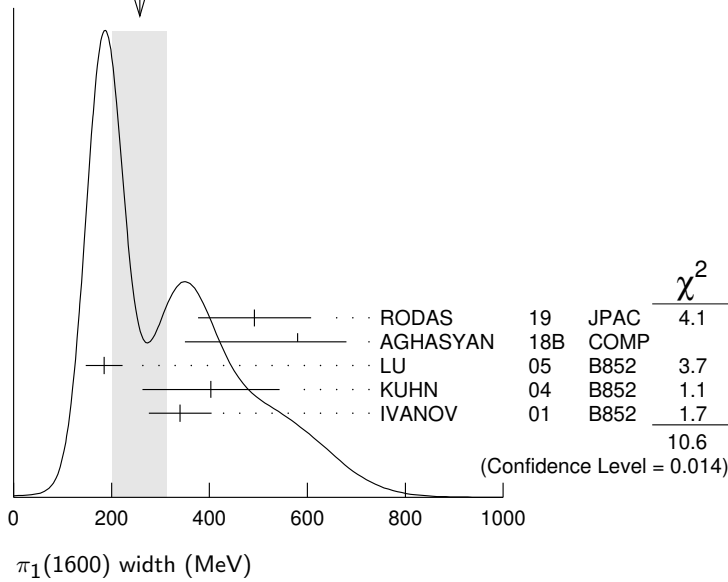
NODE=M164W

NEW

NODE=M164W;LINKAGE=B  
NODE=M164W;LINKAGE=LU  
NODE=M164W;LINKAGE=A  
NODE=M164W;LINKAGE=D

NODE=M164W;LINKAGE=C  
NODE=M164W;LINKAGE=DZ

WEIGHTED AVERAGE  
257±60 (Error scaled by 1.9)



### $\pi_1(1600)$ DECAY MODES

| Mode                         | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------|--------------------------------|
| $\Gamma_1$ $\pi\pi\pi$       | seen                           |
| $\Gamma_2$ $\rho^0\pi^-$     | seen                           |
| $\Gamma_3$ $f_2(1270)\pi^-$  | not seen                       |
| $\Gamma_4$ $b_1(1235)\pi$    | seen                           |
| $\Gamma_5$ $\eta'(958)\pi^-$ | seen                           |
| $\Gamma_6$ $f_1(1285)\pi$    | seen                           |

NODE=M164215;NODE=M164

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=2  
DESIG=4  
DESIG=5  
DESIG=3  
DESIG=6;OUR EST;→ UNCHECKED ←

### $\pi_1(1600)$ BRANCHING RATIOS

| $\Gamma(\rho^0\pi^-)/\Gamma_{\text{total}}$                                                                                                                                           | VALUE                | DOCUMENT ID | TECN | COMMENT                                          | $\Gamma_2/\Gamma$ |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------|------|--------------------------------------------------|-------------------|
| seen                                                                                                                                                                                  | ALEKSEEV             | 10          | COMP | 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$ |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                         |                      |             |      |                                                  |                   |
| not seen                                                                                                                                                                              | NOZAR                | 09          | CLAS | $\gamma p \rightarrow 2\pi^+ \pi^- n$            |                   |
| not seen                                                                                                                                                                              | <sup>1</sup> DZIERBA | 06          | B852 | 18 $\pi^- p$                                     |                   |
| <sup>1</sup> From the PWA analysis of 2.6 M $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$ and 3 M events of $\pi^- p \rightarrow \pi^- \pi^0 \pi^0 p$ of E852 data. Supersedes ADAMS 98B. |                      |             |      |                                                  |                   |

NODE=M164220

NODE=M164R1  
NODE=M164R1

NODE=M164R1;LINKAGE=DZ

| $\Gamma(f_2(1270)\pi^-)/\Gamma_{\text{total}}$                                                                                                                                       | VALUE                | DOCUMENT ID | TECN | COMMENT      | $\Gamma_3/\Gamma$ |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------|------|--------------|-------------------|
| not seen                                                                                                                                                                             | <sup>1</sup> DZIERBA | 06          | B852 | 18 $\pi^- p$ |                   |
| <sup>1</sup> From the PWA analysis of 2.6 M $\pi^- p \rightarrow \pi^- \pi^- \pi^+ p$ and 3 M events of $\pi^- p \rightarrow \pi^- \pi^0 \pi^0 p$ of E852 data. Supersedes CHUNG 02. |                      |             |      |              |                   |

NODE=M164R3  
NODE=M164R3

NODE=M164R3;LINKAGE=DZ

| $\Gamma(b_1(1235)\pi)/\Gamma_{\text{total}}$                                         | VALUE | EVTS               | DOCUMENT ID | TECN | COMMENT                                         | $\Gamma_4/\Gamma$ |
|--------------------------------------------------------------------------------------|-------|--------------------|-------------|------|-------------------------------------------------|-------------------|
| seen                                                                                 | 35280 | <sup>1</sup> BAKER | 03          | SPEC | $\bar{p}p \rightarrow \omega \pi^+ \pi^- \pi^0$ |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • •        |       |                    |             |      |                                                 |                   |
| seen                                                                                 | 145k  | LU                 | 05          | B852 | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$   |                   |
| <sup>1</sup> $B((b_1\pi)_{D\text{-wave}})/B((b_1\pi)_{S\text{-wave}})=0.3 \pm 0.1$ . |       |                    |             |      |                                                 |                   |

NODE=M164R4  
NODE=M164R4

NODE=M164R;LINKAGE=RB

| $\Gamma(\eta'(958)\pi^-)/\Gamma_{\text{total}}$ | VALUE  | DOCUMENT ID | TECN | COMMENT                                | $\Gamma_5/\Gamma$ |
|-------------------------------------------------|--------|-------------|------|----------------------------------------|-------------------|
| seen                                            | IVANOV | 01          | B852 | 18 $\pi^- p \rightarrow \eta' \pi^- p$ |                   |

NODE=M164R2  
NODE=M164R2

$\Gamma(f_1(1285)\pi)/\Gamma(\eta'(958)\pi^-)$ 

| VALUE            | EVTS | DOCUMENT ID       | TECN    | COMMENT                                           |
|------------------|------|-------------------|---------|---------------------------------------------------|
| <b>3.80±0.78</b> | 69k  | <sup>1</sup> KUHN | 04 B852 | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |

<sup>1</sup> Using  $\eta'(958)\pi$  data from IVANOV 01.

NODE=M164R5  
NODE=M164R5

NODE=M164R;LINKAGE=KU

 $\pi_1(1600)$  REFERENCES

|          |     |                |                             |                     |
|----------|-----|----------------|-----------------------------|---------------------|
| RODAS    | 19  | PRL 122 042002 | A. Rodas <i>et al.</i>      | (JPAC Collab.)      |
| AGHASYAN | 18B | PR D98 092003  | M. Aghasyan <i>et al.</i>   | (COMPASS Collab.)   |
| ADOLPH   | 15  | PL B740 303    | M. Adolph <i>et al.</i>     | (COMPASS Collab.)   |
| ALEKSEEV | 10  | PRL 104 241803 | M.G. Alekseev <i>et al.</i> | (COMPASS Collab.)   |
| NOZAR    | 09  | PRL 102 102002 | M. Nozar <i>et al.</i>      | (JLab CLAS Collab.) |
| DZIERBA  | 06  | PR D73 072001  | A.R. Dzierba <i>et al.</i>  | (BNL E852 Collab.)  |
| PDG      | 06  | JP G33 1       | W.-M. Yao <i>et al.</i>     | (PDG Collab.)       |
| LU       | 05  | PRL 94 032002  | M. Lu <i>et al.</i>         | (BNL E852 Collab.)  |
| KUHN     | 04  | PL B595 109    | J. Kuhn <i>et al.</i>       | (BNL E852 Collab.)  |
| BAKER    | 03  | PL B563 140    | C.A. Baker <i>et al.</i>    |                     |
| CHUNG    | 02  | PR D65 072001  | S.U. Chung <i>et al.</i>    | (BNL E852 Collab.)  |
| IVANOV   | 01  | PRL 86 3977    | E.I. Ivanov <i>et al.</i>   | (BNL E852 Collab.)  |
| ADAMS    | 98B | PRL 81 5760    | G.S. Adams <i>et al.</i>    | (BNL E852 Collab.)  |

NODE=M164

REFID=59554  
REFID=59471  
REFID=56385  
REFID=53356  
REFID=52758  
REFID=51077  
REFID=51004  
REFID=50459  
REFID=49773  
REFID=49414  
REFID=48837  
REFID=48317  
REFID=46610

$a_1(1640)$

$$I^G(J^{PC}) = 1^-(1^{++})$$

Possibly seen in the study of the hadronic structure in decay  $\tau \rightarrow 3\pi\nu_\tau$  (ABREU 98G and ASNER 00).

NODE=M161

NODE=M161

 $a_1(1640)$  MASS

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                         | TECN     | COMMENT                                         |
|-------------------------------------------------------------------------------|------|-------------------------------------|----------|-------------------------------------------------|
| <b>1655± 16 OUR AVERAGE</b>                                                   |      | Error includes scale factor of 1.2. |          |                                                 |
| 1700 <sup>+35</sup> <sub>-130</sub>                                           | 46M  | <sup>1</sup> AGHASYAN               | 18B COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$   |
| 1691± 18±30                                                                   |      | DARGENT                             | 17 RVUE  | $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$       |
| 1630± 20                                                                      | 35k  | <sup>2</sup> BAKER                  | 03 SPEC  | $\bar{p}p \rightarrow \omega \pi^+ \pi^- \pi^0$ |
| 1714± 9±36                                                                    |      | CHUNG                               | 02 B852  | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$  |
| 1640± 12±30                                                                   |      | BAKER                               | 99 SPEC  | 1.94 $\bar{p}p \rightarrow 4\pi^0$              |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                     |          |                                                 |
| 1670± 90                                                                      |      | BELLINI                             | 85 SPEC  | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$    |

<sup>1</sup> Statistical error negligible.

<sup>2</sup> Using the  $a_1(1260)$  mass and width results of BOWLER 88.

NODE=M161M

NODE=M161M

NODE=M161M;LINKAGE=A  
NODE=M161M;LINKAGE=KB

 $a_1(1640)$  WIDTH

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                         |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|----------|-------------------------------------------------|
| <b>254± 40 OUR AVERAGE</b>                                                    |      | Error includes scale factor of 1.8. See the ideogram below. |          |                                                 |
| 510 <sup>+170</sup> <sub>-90</sub>                                            | 46M  | <sup>1</sup> AGHASYAN                                       | 18B COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$   |
| 171± 33±40                                                                    |      | DARGENT                                                     | 17 RVUE  | $D^0 \rightarrow \pi^- \pi^+ \pi^- \pi^+$       |
| 225± 30                                                                       | 35k  | <sup>2</sup> BAKER                                          | 03 SPEC  | $\bar{p}p \rightarrow \omega \pi^+ \pi^- \pi^0$ |
| 308± 37±62                                                                    |      | CHUNG                                                       | 02 B852  | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$  |
| 300± 22±40                                                                    |      | BAKER                                                       | 99 SPEC  | 1.94 $\bar{p}p \rightarrow 4\pi^0$              |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                             |          |                                                 |
| 300±100                                                                       |      | BELLINI                                                     | 85 SPEC  | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$    |

<sup>1</sup> Statistical error negligible.

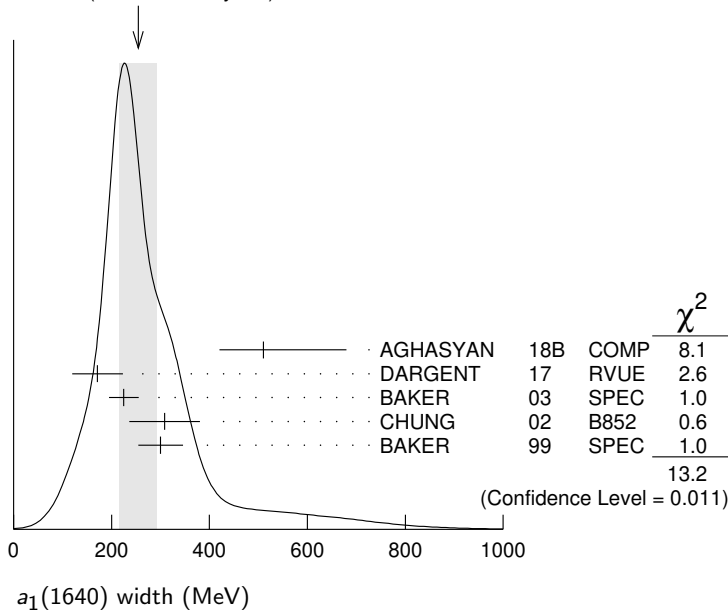
<sup>2</sup> Using the  $a_1(1260)$  mass and width results of BOWLER 88.

NODE=M161W

NODE=M161W

NODE=M161W;LINKAGE=A  
NODE=M161W;LINKAGE=KB

WEIGHTED AVERAGE  
254±40 (Error scaled by 1.8)



### $a_1(1640)$ DECAY MODES

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $\pi\pi\pi$      | seen                           |
| $\Gamma_2$ $f_2(1270)\pi$   | seen                           |
| $\Gamma_3$ $\sigma\pi$      | seen                           |
| $\Gamma_4$ $\rho\pi$ S-wave | seen                           |
| $\Gamma_5$ $\rho\pi$ D-wave | seen                           |
| $\Gamma_6$ $\omega\pi\pi$   | seen                           |
| $\Gamma_7$ $f_1(1285)\pi$   | seen                           |
| $\Gamma_8$ $a_1(1260)\eta$  | not seen                       |

NODE=M161215;NODE=M161

DESIG=3;OUR EST;→ UNCHECKED ←  
 DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=7;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=6;OUR EST;→ UNCHECKED ←  
 DESIG=8

### $a_1(1640)$ BRANCHING RATIOS

| $\Gamma(f_2(1270)\pi)/\Gamma(\sigma\pi)$ | $\Gamma_2/\Gamma_3$                              |
|------------------------------------------|--------------------------------------------------|
| VALUE                                    | DOCUMENT ID TECN COMMENT                         |
| <b>0.24±0.07</b>                         | BAKER 99 SPEC 1.94 $\bar{p}p \rightarrow 4\pi^0$ |

NODE=M161220

NODE=M161R1  
 NODE=M161R1

| $\Gamma(\rho\pi$ D-wave)/ $\Gamma_{\text{total}}$ | $\Gamma_5/\Gamma$        |
|---------------------------------------------------|--------------------------|
| VALUE                                             | DOCUMENT ID TECN COMMENT |

NODE=M161R2  
 NODE=M161R2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |        |     |      |                                                |
|------|--------|-----|------|------------------------------------------------|
| seen | CHUNG  | 02  | B852 | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |
| seen | AMELIN | 95B | VES  | 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$   |

| $\Gamma(\omega\pi\pi)/\Gamma_{\text{total}}$ | $\Gamma_6/\Gamma$             |
|----------------------------------------------|-------------------------------|
| VALUE                                        | EVTS DOCUMENT ID TECN COMMENT |

NODE=M161R3  
 NODE=M161R3

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |       |                    |    |      |                                                |
|------|-------|--------------------|----|------|------------------------------------------------|
| seen | 35280 | <sup>1</sup> BAKER | 03 | SPEC | $\bar{p}p \rightarrow \omega\pi^+ \pi^- \pi^0$ |
|------|-------|--------------------|----|------|------------------------------------------------|

<sup>1</sup> Assuming the  $\omega\rho$  mechanism for the  $\omega\pi\pi$  state.

NODE=M161R;LINKAGE=KB

| $\Gamma(f_1(1285)\pi)/\Gamma_{\text{total}}$ | $\Gamma_7/\Gamma$        |
|----------------------------------------------|--------------------------|
| VALUE                                        | DOCUMENT ID TECN COMMENT |

NODE=M161R4  
 NODE=M161R4

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |      |    |      |                                                      |
|----------|------|----|------|------------------------------------------------------|
| not seen | KUHN | 04 | B852 | 18 $\pi^- p \rightarrow \eta\pi^+ \pi^- \pi^- p$     |
| seen     | LEE  | 94 | MPS2 | 18 $\pi^- p \rightarrow K^+ \bar{K}^0 \pi^- \pi^- p$ |

| $\Gamma(a_1(1260)\eta)/\Gamma_{\text{total}}$ | $\Gamma_8/\Gamma$                                             |
|-----------------------------------------------|---------------------------------------------------------------|
| VALUE                                         | DOCUMENT ID TECN COMMENT                                      |
| <b>not seen</b>                               | KUHN 04 B852 18 $\pi^- p \rightarrow \eta\pi^+ \pi^- \pi^- p$ |

NODE=M161R5  
 NODE=M161R5

**$a_1(1640)$  REFERENCES**

|                              |     |               |                           |                         |
|------------------------------|-----|---------------|---------------------------|-------------------------|
| AGHASYAN                     | 18B | PR D98 092003 | M. Aghasyan <i>et al.</i> | (COMPASS Collab.)       |
| DARGENT                      | 17  | JHEP 1705 143 | P. d'Argent <i>et al.</i> | (HEID, BRIS)            |
| KUHN                         | 04  | PL B595 109   | J. Kuhn <i>et al.</i>     | (BNL E852 Collab.)      |
| BAKER                        | 03  | PL B563 140   | C.A. Baker <i>et al.</i>  |                         |
| CHUNG                        | 02  | PR D65 072001 | S.U. Chung <i>et al.</i>  | (BNL E852 Collab.)      |
| ASNER                        | 00  | PR D61 012002 | D.M. Asner <i>et al.</i>  | (CLEO Collab.)          |
| BAKER                        | 99  | PL B449 114   | C.A. Baker <i>et al.</i>  |                         |
| ABREU                        | 98G | PL B426 411   | P. Abreu <i>et al.</i>    | (DELPHI Collab.)        |
| AMELIN                       | 95B | PL B356 595   | D.V. Amelin <i>et al.</i> | (SERP, TBIL)            |
| LEE                          | 94  | PL B323 227   | J.H. Lee <i>et al.</i>    | (BNL, IND, KYUN, MASD+) |
| BOWLER                       | 88  | PL B209 99    | M.G. Bowler               | (OXF)                   |
| BELLINI                      | 85  | SJNP 41 781   | D. Bellini <i>et al.</i>  |                         |
| Translated from YAF 41 1223. |     |               |                           |                         |

NODE=M161

REFID=59471  
REFID=58121  
REFID=49773  
REFID=49414  
REFID=48837  
REFID=47339  
REFID=46888  
REFID=45909  
REFID=44433  
REFID=44092  
REFID=40578  
REFID=47490

 **$f_2(1640)$** 

$$I^G(J^{PC}) = 0^+(2^{++})$$

NODE=M117

OMITTED FROM SUMMARY TABLE

 **$f_2(1640)$  MASS**

NODE=M117M

| VALUE (MeV)                                                                   | DOCUMENT ID                         | TECN | COMMENT                                                  |
|-------------------------------------------------------------------------------|-------------------------------------|------|----------------------------------------------------------|
| <b><math>1639 \pm 6</math> OUR AVERAGE</b>                                    | Error includes scale factor of 1.2. |      |                                                          |
| $1620 \pm 16$                                                                 | BUGG                                | 95   | MRK3 $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$ |
| $1647 \pm 7$                                                                  | ADAMO                               | 92   | OBLX $\bar{n} p \rightarrow 3 \pi^+ 2 \pi^-$             |
| $1635 \pm 7$                                                                  | ALDE                                | 90   | GAM2 $38 \pi^- p \rightarrow \omega \omega n$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |      |                                                          |
| $1640 \pm 5$                                                                  | AMSLER                              | 06   | CBAR $0.9 \bar{p} p \rightarrow K^+ K^- \pi^0$           |
| $1659 \pm 6$                                                                  | VLADIMIRSK...                       | 06   | SPEC $40 \pi^- p \rightarrow K_S^0 K_S^0 n$              |
| $1643 \pm 7$                                                                  | <sup>1</sup> ALDE                   | 89B  | GAM2 $38 \pi^- p \rightarrow \omega \omega n$            |
| <sup>1</sup> Superseded by ALDE 90.                                           |                                     |      |                                                          |

NODE=M117M

NODE=M117M;LINKAGE=BB

 **$f_2(1640)$  WIDTH**

NODE=M117W

| VALUE (MeV)                                                                   | CL%                                 | DOCUMENT ID   | TECN | COMMENT                                                  |
|-------------------------------------------------------------------------------|-------------------------------------|---------------|------|----------------------------------------------------------|
| <b><math>99^{+60}_{-40}</math> OUR AVERAGE</b>                                | Error includes scale factor of 2.9. |               |      |                                                          |
| $140^{+60}_{-20}$                                                             |                                     | BUGG          | 95   | MRK3 $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$ |
| $58 \pm 20$                                                                   |                                     | ADAMO         | 92   | OBLX $\bar{n} p \rightarrow 3 \pi^+ 2 \pi^-$             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |               |      |                                                          |
| $44 \pm 9$                                                                    |                                     | AMSLER        | 06   | CBAR $0.9 \bar{p} p \rightarrow K^+ K^- \pi^0$           |
| $152 \pm 18$                                                                  |                                     | VLADIMIRSK... | 06   | SPEC $40 \pi^- p \rightarrow K_S^0 K_S^0 n$              |
| $< 70$                                                                        | 90                                  | ALDE          | 90   | GAM2 $38 \pi^- p \rightarrow \omega \omega n$            |

NODE=M117W

 **$f_2(1640)$  DECAY MODES**

NODE=M117215;NODE=M117

| Mode                       | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------|--------------------------------|
| $\Gamma_1$ $\omega \omega$ | seen                           |
| $\Gamma_2$ $4\pi$          | seen                           |
| $\Gamma_3$ $K \bar{K}$     | seen                           |

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=3

 **$f_2(1640)$  BRANCHING RATIOS**

NODE=M117220

| $\Gamma(K\bar{K})/\Gamma_{\text{total}}$ | $\Gamma_3/\Gamma$ |      |         |                                           |
|------------------------------------------|-------------------|------|---------|-------------------------------------------|
| VALUE                                    | DOCUMENT ID       | TECN | COMMENT |                                           |
| seen                                     | AMSLER            | 06   | CBAR    | $0.9 \bar{p} p \rightarrow K^+ K^- \pi^0$ |

NODE=M117R2  
NODE=M117R2

 **$f_2(1640)$  REFERENCES**

NODE=M117

|                             |     |             |                                |                                 |
|-----------------------------|-----|-------------|--------------------------------|---------------------------------|
| AMSLER                      | 06  | PL B639 165 | C. Amsler <i>et al.</i>        | (Crystal Barrel Collab.)        |
| VLADIMIRSK...               | 06  | PAN 69 493  | V.V. Vladimirsky <i>et al.</i> | (ITEP, Moscow)                  |
| Translated from YAF 69 515. |     |             |                                |                                 |
| BUGG                        | 95  | PL B353 378 | D.V. Bugg <i>et al.</i>        | (LOQM, PNPI, WASH) JP           |
| ADAMO                       | 92  | PL B287 368 | A. Adamo <i>et al.</i>         | (OBELIX Collab.)                |
| ALDE                        | 90  | PL B241 600 | D.M. Alde <i>et al.</i>        | (SERP, BELG, LANL, LAPP+)       |
| ALDE                        | 89B | PL B216 451 | D.M. Alde <i>et al.</i>        | (SERP, BELG, LANL, LAPP+) IGJPC |

REFID=51136  
REFID=51191  
REFID=44438  
REFID=42177  
REFID=40935  
REFID=40735

$\eta_2(1645)$ 

$$I^G(J^{PC}) = 0^+(2^-+)$$

NODE=M154

 $\eta_2(1645)$  MASS

NODE=M154M

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN | CHG    | COMMENT                                       |
|-------------------------------------------------------------------------------|-------------|------|--------|-----------------------------------------------|
| <b>1617± 5 OUR AVERAGE</b>                                                    |             |      |        |                                               |
| 1613± 8                                                                       | BARBERIS    | 00B  |        | 450 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$ |
| 1617± 8                                                                       | BARBERIS    | 00C  |        | 450 $pp \rightarrow p_f 4\pi p_s$             |
| 1620±20                                                                       | BARBERIS    | 97B  | OMEG   | 450 $pp \rightarrow pp2(\pi^+ \pi^-)$         |
| 1645±14±15                                                                    | ADOMEIT     | 96   | CBAR 0 | 1.94 $\bar{p}p \rightarrow \eta 3\pi^0$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |        |                                               |
| 1645± 6±20                                                                    | ANISOVICH   | 00E  | SPEC   | 0.9–1.94 $\bar{p}p \rightarrow \eta 3\pi^0$   |

NODE=M154M

 $\eta_2(1645)$  WIDTH

NODE=M154W

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN | CHG    | COMMENT                                       |
|-------------------------------------------------------------------------------|-------------|------|--------|-----------------------------------------------|
| <b>181±11 OUR AVERAGE</b>                                                     |             |      |        |                                               |
| 185±17                                                                        | BARBERIS    | 00B  |        | 450 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$ |
| 177±18                                                                        | BARBERIS    | 00C  |        | 450 $pp \rightarrow p_f 4\pi p_s$             |
| 180±25                                                                        | BARBERIS    | 97B  | OMEG   | 450 $pp \rightarrow pp2(\pi^+ \pi^-)$         |
| 180 <sup>+40</sup> <sub>-21</sub> ±25                                         | ADOMEIT     | 96   | CBAR 0 | 1.94 $\bar{p}p \rightarrow \eta 3\pi^0$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |        |                                               |
| 200±25                                                                        | ANISOVICH   | 00E  | SPEC   | 0.9–1.94 $\bar{p}p \rightarrow \eta 3\pi^0$   |

NODE=M154W

 $\eta_2(1645)$  DECAY MODES

NODE=M154215;NODE=M154

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $a_2(1320)\pi$   | seen                           |
| $\Gamma_2$ $K\bar{K}\pi$    | seen                           |
| $\Gamma_3$ $K^*\bar{K}$     | seen                           |
| $\Gamma_4$ $\eta\pi^+\pi^-$ | seen                           |
| $\Gamma_5$ $a_0(980)\pi$    | seen                           |
| $\Gamma_6$ $f_2(1270)\eta$  | not seen                       |

DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=3;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=6;OUR EST;→ UNCHECKED ←

 $\eta_2(1645)$  BRANCHING RATIOS

NODE=M154220

| $\Gamma(K\bar{K}\pi)/\Gamma(a_2(1320)\pi)$                  | $\Gamma_2/\Gamma_1$   |      |                                              |
|-------------------------------------------------------------|-----------------------|------|----------------------------------------------|
| VALUE                                                       | DOCUMENT ID           | TECN | COMMENT                                      |
| <b>0.07±0.03</b>                                            | <sup>1</sup> BARBERIS | 97C  | OMEG 450 $p p \rightarrow p p K \bar{K} \pi$ |
| <sup>1</sup> Using $2(\pi^+ \pi^-)$ data from BARBERIS 97B. |                       |      |                                              |

NODE=M154R1  
 NODE=M154R1

NODE=M154R1;LINKAGE=A

| $\Gamma(a_2(1320)\pi)/\Gamma(a_0(980)\pi)$               |                        |      |         | $\Gamma_1/\Gamma_5$                           |
|----------------------------------------------------------|------------------------|------|---------|-----------------------------------------------|
| VALUE                                                    | DOCUMENT ID            | TECN | COMMENT |                                               |
| <b>13.1±2.3 OUR AVERAGE</b>                              |                        |      |         |                                               |
| 13.5±4.6                                                 | <sup>2</sup> ANISOVICH | 11   | SPEC    | 0.9–1.94 $p\bar{p}$                           |
| 13.0±2.7                                                 | BARBERIS               | 00B  |         | 450 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$ |
| <sup>2</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E. |                        |      |         |                                               |

NODE=M154R3  
 NODE=M154R3

NODE=M154R3;LINKAGE=AN

| $\Gamma(f_2(1270)\eta)/\Gamma_{\text{total}}$                                 |             |                                                   |  | $\Gamma_6/\Gamma$ |
|-------------------------------------------------------------------------------|-------------|---------------------------------------------------|--|-------------------|
| VALUE                                                                         | DOCUMENT ID | COMMENT                                           |  |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |                                                   |  |                   |
| not seen                                                                      | BARBERIS    | 00B 450 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$ |  |                   |

NODE=M154R4  
 NODE=M154R4

 $\eta_2(1645)$  REFERENCES

NODE=M154

|           |     |              |                              |                          |
|-----------|-----|--------------|------------------------------|--------------------------|
| ANISOVICH | 11  | EPJ C71 1511 | A.V. Anisovich <i>et al.</i> | (LOQM, RAL, PNPI)        |
| ANISOVICH | 00E | PL B477 19   | A.V. Anisovich <i>et al.</i> |                          |
| BARBERIS  | 00B | PL B471 435  | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| BARBERIS  | 00C | PL B471 440  | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| BARBERIS  | 97B | PL B413 217  | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| BARBERIS  | 97C | PL B413 225  | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| ADOMEIT   | 96  | ZPHY C71 227 | J. Adomeit <i>et al.</i>     | (Crystal Barrel Collab.) |

REFID=53631  
 REFID=47945  
 REFID=47958  
 REFID=47959  
 REFID=45758  
 REFID=45759  
 REFID=45202

**$\omega(1650)$** 

$$J^{PC} = 0^-(1^{--})$$

See also the  $\omega(1420)$  particle listing.

NODE=M126

NODE=M126

NODE=M126M

NODE=M126M

→ UNCHECKED ←

 **$\omega(1650)$  MASS**

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID             | TECN      | COMMENT                                                     |
|-------------------------------------------------------------------------------|-------|-------------------------|-----------|-------------------------------------------------------------|
| <b>1670± 30 OUR ESTIMATE</b>                                                  |       |                         |           |                                                             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                         |           |                                                             |
| 1698± 10                                                                      | 267   | <sup>1</sup> ACHASOV    | 20B SND   | $e^+e^- \rightarrow \omega\eta \rightarrow \eta\pi^0\gamma$ |
| 1651± $3^{+16}_{-6}$                                                          | 183k  | <sup>2</sup> ABLIKIM    | 19AQ BES  | $J/\psi \rightarrow K^+K^-\pi^0$                            |
| 1673± $\frac{6}{7}$                                                           |       | ACHASOV                 | 19 SND    | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta$                    |
| 1671± 6±10                                                                    | 824   | <sup>3</sup> AKHMETSHIN | 17A CMD3  | 1.4–2.0 $e^+e^- \rightarrow \omega\eta$                     |
| 1660± 10                                                                      | 898   | <sup>4</sup> ACHASOV    | 16B SND   | 1.34–2.00 $e^+e^- \rightarrow \omega\eta$                   |
| 1680± 10                                                                      | 13.1k | <sup>5</sup> AULCHENKO  | 15A SND   | 1.05–1.80 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$              |
| 1667± 13± 6                                                                   |       | AUBERT                  | 07AU BABR | 10.6 $e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$            |
| 1645± 8                                                                       | 13    | AUBERT                  | 06D BABR  | 10.6 $e^+e^- \rightarrow \omega\eta\gamma$                  |
| 1660± 10± 2                                                                   |       | AUBERT,B                | 04N BABR  | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$             |
| 1770± 50±60                                                                   | 1.2M  | <sup>6</sup> ACHASOV    | 03D RVUE  | 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$              |
| 1619± 5                                                                       |       | <sup>7</sup> HENNER     | 02 RVUE   | 1.2–2.0 $e^+e^- \rightarrow \rho\pi,$<br>$\omega\pi\pi$     |
| 1700± 20                                                                      |       | EUGENIO                 | 01 SPEC   | 18 $\pi^-p \rightarrow \omega\eta n$                        |
| 1705± 26                                                                      | 612   | <sup>8</sup> AKHMETSHIN | 00D CMD2  | $e^+e^- \rightarrow \omega\pi^+\pi^-$                       |
| 1820± $\frac{190}{150}$                                                       |       | <sup>9</sup> ACHASOV    | 98H RVUE  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0$                        |
| 1840± $\frac{100}{70}$                                                        |       | <sup>10</sup> ACHASOV   | 98H RVUE  | $e^+e^- \rightarrow \omega\pi^+\pi^-$                       |
| 1780± $\frac{170}{300}$                                                       |       | <sup>11</sup> ACHASOV   | 98H RVUE  | $e^+e^- \rightarrow K^+K^-$                                 |
| ~ 2100                                                                        |       | <sup>12</sup> ACHASOV   | 98H RVUE  | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$                    |
| 1606± 9                                                                       |       | <sup>13</sup> CLEGG     | 94 RVUE   |                                                             |
| 1662± 13                                                                      | 750   | <sup>14</sup> ANTONELLI | 92 DM2    | 1.34–2.4 $e^+e^- \rightarrow \rho\pi,$<br>$\omega\pi\pi$    |
| 1670± 20                                                                      |       | ATKINSON                | 83B OMEG  | 20–70 $\gamma p \rightarrow 3\pi X$                         |
| 1657± 13                                                                      |       | CORDIER                 | 81 DM1    | $e^+e^- \rightarrow \omega 2\pi$                            |
| 1679± 34                                                                      | 21    | ESPOSITO                | 80 FRAM   | $e^+e^- \rightarrow 3\pi$                                   |
| 1652± 17                                                                      |       | COSME                   | 79 OSPK   | $e^+e^- \rightarrow 3\pi$                                   |

<sup>1</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ . The mass of  $\omega(1420)$  is fixed to the PDG 18 value of 1420 MeV. Fixing also the width of  $\omega(1420)$  to the PDG 18 value of 220 MeV results in  $1694 \pm 9$  MeV measurement.

<sup>2</sup> Could also be  $\rho(1700)$ . Branching ratio  $J/\psi \rightarrow X\pi^0 \rightarrow K^+K^-\pi^0 = (5.3 \pm 0.3^{+0.6}_{-0.5}) \times 10^{-5}$ .

<sup>3</sup> From a fit of the interfering  $\omega(1420)$  and  $\omega(1650)$  with a relative phase of  $\pi$  and other parameters floating.

<sup>4</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ .

<sup>5</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . See ACHASOV 20A for a further analysis of the  $\pi^+\pi^-\pi^0$  data.

<sup>6</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.

<sup>7</sup> Using results of CORDIER 81 and preliminary data of DOLINSKY 91 and ANTONELLI 92.

<sup>8</sup> Using the data of AKHMETSHIN 00D and ANTONELLI 92. The  $\rho\pi$  dominance for the energy dependence of the  $\omega(1420)$  and  $\omega(1650)$  width assumed.

<sup>9</sup> Using data from BARKOV 87, DOLINSKY 91, and ANTONELLI 92.

<sup>10</sup> Using the data from ANTONELLI 92.

<sup>11</sup> Using the data from IVANOV 81 and BISELLO 88B.

<sup>12</sup> Using the data from BISELLO 91C.

<sup>13</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.

<sup>14</sup> From the combined fit of the  $\rho\pi$  and  $\omega\pi\pi$  final states.

NODE=M126M;LINKAGE=H

NODE=M126M;LINKAGE=G

NODE=M126M;LINKAGE=F

NODE=M126M;LINKAGE=E

NODE=M126M;LINKAGE=A

NODE=M126M;LINKAGE=VH

NODE=M126M;LINKAGE=AB

NODE=M126M;LINKAGE=KI

NODE=M126M;LINKAGE=L1

NODE=M126M;LINKAGE=L2

NODE=M126M;LINKAGE=L3

NODE=M126M;LINKAGE=L4

NODE=M126M;LINKAGE=AD

NODE=M126M;LINKAGE=AE

 **$\omega(1650)$  WIDTH**

NODE=M126W



| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**315± 35 OUR ESTIMATE**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                     |       |                         |      |      |                                                             |
|-----------------------------------------------------|-------|-------------------------|------|------|-------------------------------------------------------------|
| 110± 16                                             | 267   | <sup>1</sup> ACHASOV    | 20B  | SND  | $e^+e^- \rightarrow \omega\eta \rightarrow \eta\pi^0\gamma$ |
| 194± 8 <sup>+</sup> <sub>7</sub> <sup>15</sup>      | 183k  | <sup>2</sup> ABLIKIM    | 19AQ | BES  | $J/\psi \rightarrow K^+K^-\pi^0$                            |
| 95± 11                                              |       | ACHASOV                 | 19   | SND  | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta$                    |
| 113± 9± 10                                          | 824   | <sup>3</sup> AKHMETSHIN | 17A  | CMD3 | $1.4-2.0 e^+e^- \rightarrow \omega\eta$                     |
| 110± 20                                             | 898   | <sup>4</sup> ACHASOV    | 16B  | SND  | $1.34-2.00 e^+e^- \rightarrow \omega\eta$                   |
| 310± 30                                             | 13.1k | <sup>5</sup> AULCHENKO  | 15A  | SND  | $1.05-1.80 e^+e^- \rightarrow \pi^+\pi^-\pi^0$              |
| 222± 25± 20                                         |       | AUBERT                  | 07AU | BABR | $10.6 e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$            |
| 114± 14                                             | 13    | AUBERT                  | 06D  | BABR | $10.6 e^+e^- \rightarrow \omega\eta\gamma$                  |
| 230± 30± 20                                         |       | AUBERT,B                | 04N  | BABR | $10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$             |
| 490 <sup>+</sup> <sub>150</sub> <sup>200</sup> ±130 | 1.2M  | <sup>6</sup> ACHASOV    | 03D  | RVUE | $0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$              |
| 250± 14                                             |       | <sup>7</sup> HENNER     | 02   | RVUE | $1.2-2.0 e^+e^- \rightarrow \rho\pi, \omega\pi\pi$          |
| 250± 50                                             |       | EUGENIO                 | 01   | SPEC | $18 \pi^-p \rightarrow \omega\eta n$                        |
| 370± 25                                             | 612   | <sup>8</sup> AKHMETSHIN | 00D  | CMD2 | $e^+e^- \rightarrow \omega\pi^+\pi^-$                       |
| 113± 20                                             |       | <sup>9</sup> CLEGG      | 94   | RVUE |                                                             |
| 280± 24                                             | 750   | <sup>10</sup> ANTONELLI | 92   | DM2  | $1.34-2.4 e^+e^- \rightarrow \rho\pi, \omega\pi\pi$         |
| 160± 20                                             |       | ATKINSON                | 83B  | OMEG | $20-70 \gamma p \rightarrow 3\pi X$                         |
| 136± 46                                             |       | CORDIER                 | 81   | DM1  | $e^+e^- \rightarrow \omega 2\pi$                            |
| 99± 49                                              | 21    | ESPOSITO                | 80   | FRAM | $e^+e^- \rightarrow 3\pi$                                   |
| 42± 17                                              |       | COSME                   | 79   | OSPK | $e^+e^- \rightarrow 3\pi$                                   |

<sup>1</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ . The mass of  $\omega(1420)$  is fixed to the PDG 18 value of 1420 MeV. Fixing also the width of  $\omega(1420)$  to the PDG 18 value of 220 MeV results in  $94 \pm 13$  MeV measurement.

<sup>2</sup> Could also be  $\rho(1700)$ . Branching ratio  $J/\psi \rightarrow X\pi^0 \rightarrow K^+K^-\pi^0 = (5.3 \pm 0.3^{+0.6}_{-0.5}) \times 10^{-5}$ .

<sup>3</sup> From a fit of the interfering  $\omega(1420)$  and  $\omega(1650)$  with a relative phase of  $\pi$  and other parameters floating.

<sup>4</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ .

<sup>5</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . See ACHASOV 20A for a further analysis of the  $\pi^+\pi^-\pi^0$  data.

<sup>6</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.

<sup>7</sup> Using results of CORDIER 81 and preliminary data of DOLINSKY 91 and ANTONELLI 92.

<sup>8</sup> Using the data of AKHMETSHIN 00D and ANTONELLI 92. The  $\rho\pi$  dominance for the energy dependence of the  $\omega(1420)$  and  $\omega(1650)$  width assumed.

<sup>9</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.

<sup>10</sup> From the combined fit of the  $\rho\pi$  and  $\omega\pi\pi$  final states.

NODE=M126W  
→ UNCHECKED ←

OCCUR=2  
OCCUR=5  
OCCUR=4

NODE=M126W;LINKAGE=H

NODE=M126W;LINKAGE=G

NODE=M126W;LINKAGE=F

NODE=M126W;LINKAGE=E  
NODE=M126W;LINKAGE=A

NODE=M126W;LINKAGE=VH

NODE=M126W;LINKAGE=AB

NODE=M126W;LINKAGE=KI

NODE=M126W;LINKAGE=AD

NODE=M126W;LINKAGE=AE

NODE=M126215;NODE=M126

 **$\omega(1650)$  DECAY MODES**

| Mode                       | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------|--------------------------------|
| $\Gamma_1$ $\rho\pi$       | seen                           |
| $\Gamma_2$ $\rho(1450)\pi$ | seen                           |
| $\Gamma_3$ $\omega\pi\pi$  | seen                           |
| $\Gamma_4$ $\omega\eta$    | seen                           |
| $\Gamma_5$ $e^+e^-$        | seen                           |
| $\Gamma_6$ $\pi^0\gamma$   | not seen                       |

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=6  
DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=4;OUR EST;→ UNCHECKED ←  
DESIG=3;OUR EST;→ UNCHECKED ←  
DESIG=5

 **$\omega(1650) \Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$** 

$\Gamma(\rho\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma \times \Gamma_5/\Gamma$

| VALUE (units $10^{-6}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                          |       |                          |     |      |                                                     |
|------------------------------------------|-------|--------------------------|-----|------|-----------------------------------------------------|
| 1.56 ±0.23                               | 13.1k | <sup>1</sup> AULCHENKO   | 15A | SND  | $1.05-1.80 e^+e^- \rightarrow \pi^+\pi^-\pi^0$      |
| 1.3 ±0.1 ±0.1                            |       | AUBERT,B                 | 04N | BABR | $10.6 e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$     |
| 1.2 <sup>+0.4</sup> <sub>-0.1</sub> ±0.8 | 1.2M  | <sup>2,3</sup> ACHASOV   | 03D | RVUE | $0.44-2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$      |
| 0.921±0.230                              |       | <sup>4,5</sup> CLEGG     | 94  | RVUE |                                                     |
| 0.479±0.050                              | 750   | <sup>6,7</sup> ANTONELLI | 92  | DM2  | $1.34-2.4 e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

NODE=M126230

NODE=M126G3  
NODE=M126G3

- <sup>1</sup> From a fit with contributions from  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ , and  $\omega(1650)$ . See ACHASOV 20A for a further analysis of the  $\pi^+\pi^-\pi^0$  data.
- <sup>2</sup> Calculated by us from the cross section at the peak.
- <sup>3</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.
- <sup>4</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.
- <sup>5</sup> From the partial and leptonic width given by the authors.
- <sup>6</sup> From the combined fit of the  $\rho\pi$  and  $\omega\pi\pi$  final states.
- <sup>7</sup> From the product of the leptonic width and partial branching ratio given by the authors.

$$\Gamma(\omega\pi\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_3/\Gamma \times \Gamma_5/\Gamma$$

| VALUE (units $10^{-7}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |      |                             |           |                                                     |
|-----------------------|------|-----------------------------|-----------|-----------------------------------------------------|
| 7.0 $\pm 0.5$         |      | AUBERT                      | 07AU BABR | 10.6 $e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$    |
| 4.1 $\pm 0.9 \pm 1.3$ | 1.2M | <sup>1,2</sup> ACHASOV      | 03D RVUE  | 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$      |
| 5.40 $\pm 0.95$       |      | <sup>3</sup> AKHMETSHIN 00D | CMD2      | 1.2–1.38 $e^+e^- \rightarrow \omega\pi^+\pi^-$      |
| 3.18 $\pm 0.80$       |      | <sup>4,5</sup> CLEGG        | 94 RVUE   |                                                     |
| 6.07 $\pm 0.61$       | 750  | <sup>6,7</sup> ANTONELLI    | 92 DM2    | 1.34–2.4 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

- <sup>1</sup> Calculated by us from the cross section at the peak.
- <sup>2</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.
- <sup>3</sup> Using the data of AKHMETSHIN 00D and ANTONELLI 92. The  $\rho\pi$  dominance for the energy dependence of the  $\omega(1420)$  and  $\omega(1650)$  width assumed.
- <sup>4</sup> From a fit to two Breit-Wigner functions and using the data of DOLINSKY 91 and ANTONELLI 92.
- <sup>5</sup> From the partial and leptonic width given by the authors.
- <sup>6</sup> From the combined fit of the  $\rho\pi$  and  $\omega\pi\pi$  final states.
- <sup>7</sup> From the product of the leptonic width and partial branching ratio given by the authors.

$$\Gamma(\omega\eta)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma \times \Gamma_5/\Gamma$$

| VALUE (units $10^{-7}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                         |     |                             |          |                                                             |
|-------------------------|-----|-----------------------------|----------|-------------------------------------------------------------|
| 6.4 $\pm 0.9$           | 267 | <sup>1</sup> ACHASOV        | 20B SND  | $e^+e^- \rightarrow \omega\eta \rightarrow \eta\pi^0\gamma$ |
| 5.62 $^{+0.45}_{-0.42}$ |     | ACHASOV                     | 19 SND   | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta$                    |
| 4.5 $\pm 0.3 \pm 0.3$   | 824 | <sup>2</sup> AKHMETSHIN 17A | CMD3     | 1.4–2.0 $e^+e^- \rightarrow \omega\eta$                     |
| 4.4 $\pm 0.5$           | 898 | <sup>3</sup> ACHASOV        | 16B SND  | 1.34–2.00 $e^+e^- \rightarrow \omega\eta$                   |
| 5.7 $\pm 0.6$           | 13  | AUBERT                      | 06D BABR | 10.6 $e^+e^- \rightarrow \omega\eta\gamma$                  |
| < 60 at 90% CL          |     | <sup>4</sup> AKHMETSHIN 03B | CMD2     | $e^+e^- \rightarrow \eta\pi^0\gamma$                        |

- <sup>1</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ . The mass of  $\omega(1420)$  is fixed to the PDG 18 value of 1420 MeV. Fixing also the width of  $\omega(1420)$  to the PDG 18 value of 220 MeV results in  $(5.4 \pm 0.6) \times 10^{-7}$  measurement.
- <sup>2</sup> From a fit of the interfering  $\omega(1420)$  and  $\omega(1650)$  with a relative phase of  $\pi$  and other parameters floating. From an alternative fit  $\Gamma(\omega(1650) \rightarrow \omega\eta)/\Gamma_{\text{total}} \times \Gamma(\omega(1650) \rightarrow e^+e^-) = 51 \pm 3$  eV.
- <sup>3</sup> From a fit with contributions from  $\omega(1420)$ ,  $\omega(1650)$ , and  $\phi(1680)$ .
- <sup>4</sup>  $\omega(1650)$  mass and width fixed at 1700 MeV and 250 MeV, respectively.

### $\omega(1650)$ BRANCHING RATIOS

$$\Gamma(\rho\pi)/\Gamma_{\text{total}} \quad \Gamma_1/\Gamma$$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |      |                      |          |                                                    |
|-------------------|------|----------------------|----------|----------------------------------------------------|
| $\sim 0.65$       | 1.2M | <sup>1</sup> ACHASOV | 03D RVUE | 0.44–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$     |
| 0.380 $\pm 0.014$ |      | <sup>2</sup> HENNER  | 02 RVUE  | 1.2–2.0 $e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

- <sup>1</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.
- <sup>2</sup> Assuming that the  $\omega(1650)$  decays into  $\rho\pi$  and  $\omega\pi\pi$  only.

$$\Gamma(\rho(1450)\pi)/\Gamma_{\text{total}} \quad \Gamma_2/\Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |         |         |                                                |
|------|---------|---------|------------------------------------------------|
| seen | ACHASOV | 20A SND | 1.15–2.00 $e^+e^- \rightarrow \pi^+\pi^-\pi^0$ |
|------|---------|---------|------------------------------------------------|

NODE=M126G3;LINKAGE=A

NODE=M126G;LINKAGE=AW  
NODE=M126G;LINKAGE=VH

NODE=M126G;LINKAGE=AD

NODE=M126G;LINKAGE=SE  
NODE=M126G;LINKAGE=AE  
NODE=M126G;LINKAGE=ES

NODE=M126G4  
NODE=M126G4

NODE=M126G4;LINKAGE=AW  
NODE=M126G4;LINKAGE=VH

NODE=M126G4;LINKAGE=KL

NODE=M126G4;LINKAGE=AD

NODE=M126G4;LINKAGE=SE  
NODE=M126G4;LINKAGE=AE  
NODE=M126G4;LINKAGE=ES

NODE=M126G5  
NODE=M126G5

NODE=M126G5;LINKAGE=C

NODE=M126G5;LINKAGE=B

NODE=M126G5;LINKAGE=A  
NODE=M126G5;LINKAGE=KH

NODE=M126225

NODE=M126R3  
NODE=M126R3

NODE=M126R;LINKAGE=VH

NODE=M126R;LINKAGE=AC

NODE=M126R02  
NODE=M126R02

$\Gamma(\omega\pi\pi)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |      |                      |     |                                                                 |
|-------------------|------|----------------------|-----|-----------------------------------------------------------------|
| $\sim 0.35$       | 1.2M | <sup>1</sup> ACHASOV | 03D | RVUE $0.44\text{--}2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$     |
| $0.620 \pm 0.014$ |      | <sup>2</sup> HENNER  | 02  | RVUE $1.2\text{--}2.0 e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

<sup>1</sup> From the combined fit of ANTONELLI 92, ACHASOV 01E, ACHASOV 02E, and ACHASOV 03D data on the  $\pi^+\pi^-\pi^0$  and ANTONELLI 92 on the  $\omega\pi^+\pi^-$  final states. Supersedes ACHASOV 99E and ACHASOV 02E.

<sup>2</sup> Assuming that the  $\omega(1650)$  decays into  $\rho\pi$  and  $\omega\pi\pi$  only.

NODE=M126R2  
NODE=M126R2

NODE=M126R2;LINKAGE=VH

NODE=M126R2;LINKAGE=AC

 $\Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-7}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|            |      |                        |     |                                                                 |
|------------|------|------------------------|-----|-----------------------------------------------------------------|
| $\sim 18$  | 1.2M | <sup>1,2</sup> ACHASOV | 03D | RVUE $0.44\text{--}2.00 e^+e^- \rightarrow \pi^+\pi^-\pi^0$     |
| $32 \pm 1$ |      | <sup>2</sup> HENNER    | 02  | RVUE $1.2\text{--}2.0 e^+e^- \rightarrow \rho\pi, \omega\pi\pi$ |

<sup>1</sup> Calculated by us from the cross section at the peak.

<sup>2</sup> Assuming that the  $\omega(1650)$  decays into  $\rho\pi$  and  $\omega\pi\pi$  only.

NODE=M126R4  
NODE=M126R4

NODE=M126R;LINKAGE=AW  
NODE=M126R4;LINKAGE=AC

 $\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

not seen <sup>1</sup> ACHASOV 10D SND  $1.075\text{--}2.0 e^+e^- \rightarrow \pi^0\gamma$

<sup>1</sup> From a fit of a VMD model with two effective resonances with masses of 1450 MeV and 1700 MeV to describe the excited vector states  $\omega(1420)$ ,  $\rho(1450)$ ,  $\omega(1650)$ , and  $\rho(1700)$ . The width of the highest mass effective resonance is fixed at 315 MeV.

NODE=M126R00  
NODE=M126R00

NODE=M126R00;LINKAGE=A

 $\omega(1650)$  REFERENCES

NODE=M126

|            |      |                               |                                |                             |
|------------|------|-------------------------------|--------------------------------|-----------------------------|
| ACHASOV    | 20A  | EPJ C80 993                   | M.N. Achasov <i>et al.</i>     | (SND Collab.)               |
| ACHASOV    | 20B  | EPJ C80 1008                  | M.N. Achasov <i>et al.</i>     | (SND Collab.)               |
| ABLIKIM    | 19AQ | PR D100 032004                | M. Ablikim <i>et al.</i>       | (BESIII Collab.)            |
| ACHASOV    | 19   | PR D99 112004                 | M.N. Achasov <i>et al.</i>     | (SND Collab.)               |
| PDG        | 18   | PR D98 030001                 | M. Tanabashi <i>et al.</i>     | (PDG Collab.)               |
| AKHMETSHIN | 17A  | PL B773 150                   | R.R. Akhmetshin <i>et al.</i>  | (CMD-3 Collab.)             |
| ACHASOV    | 16B  | PR D94 092002                 | M.N. Achasov <i>et al.</i>     | (SND Collab.)               |
| AULCHENKO  | 15A  | JETP 121 27                   | V.M. Aulchenko <i>et al.</i>   | (SND Collab.)               |
|            |      | Translated from ZETF 148 34.  |                                |                             |
| ACHASOV    | 10D  | PR D98 112001                 | M.N. Achasov <i>et al.</i>     | (SND Collab.)               |
| AUBERT     | 07AU | PR D76 092005                 | B. Aubert <i>et al.</i>        | (BABAR Collab.)             |
| AUBERT     | 06D  | PR D73 052003                 | B. Aubert <i>et al.</i>        | (BABAR Collab.)             |
| AUBERT,B   | 04N  | PR D70 072004                 | B. Aubert <i>et al.</i>        | (BABAR Collab.)             |
| ACHASOV    | 03D  | PR D68 052006                 | M.N. Achasov <i>et al.</i>     | (Novosibirsk SND Collab.)   |
| AKHMETSHIN | 03B  | PL B562 173                   | R.R. Akhmetshin <i>et al.</i>  | (Novosibirsk CMD-2 Collab.) |
| ACHASOV    | 02E  | PR D66 032001                 | M.N. Achasov <i>et al.</i>     | (Novosibirsk SND Collab.)   |
| HENNER     | 02   | EPJ C26 3                     | V.K. Henner <i>et al.</i>      |                             |
| ACHASOV    | 01E  | PR D63 072002                 | M.N. Achasov <i>et al.</i>     | (Novosibirsk SND Collab.)   |
| EUGENIO    | 01   | PL B497 190                   | P. Eugenio <i>et al.</i>       |                             |
| AKHMETSHIN | 00D  | PL B489 125                   | R.R. Akhmetshin <i>et al.</i>  | (Novosibirsk CMD-2 Collab.) |
| ACHASOV    | 99E  | PL B462 365                   | M.N. Achasov <i>et al.</i>     | (Novosibirsk SND Collab.)   |
| ACHASOV    | 98H  | PR D57 4334                   | N.N. Achasov, A.A. Kozhevnikov |                             |
| CLEGG      | 94   | ZPHY C62 455                  | A.B. Clegg, A. Donnachie       | (LANC, MCHS)                |
| ANTONELLI  | 92   | ZPHY C56 15                   | A. Antonelli <i>et al.</i>     | (DM2 Collab.)               |
| BISELLO    | 91C  | ZPHY C52 227                  | D. Bisello <i>et al.</i>       | (DM2 Collab.)               |
| DOLINSKY   | 91   | PRPL 202 99                   | S.I. Dolinsky <i>et al.</i>    | (NOVO)                      |
| BISELLO    | 88B  | ZPHY C39 13                   | D. Bisello <i>et al.</i>       | (PADO, CLER, FRAS+)         |
| BARKOV     | 87   | JETPL 46 164                  | L.M. Barkov <i>et al.</i>      | (NOVO)                      |
|            |      | Translated from ZETFP 46 132. |                                |                             |
| ATKINSON   | 83B  | PL 127B 132                   | M. Atkinson <i>et al.</i>      | (BONN, CERN, GLAS+)         |
| CORDIER    | 81   | PL 106B 155                   | A. Cordier <i>et al.</i>       | (ORSAY)                     |
| IVANOV     | 81   | PL 107B 297                   | P.M. Ivanov <i>et al.</i>      | (NOVO)                      |
| ESPOSITO   | 80   | LNC 28 195                    | B. Esposito <i>et al.</i>      | (FRAS, NAPL, PADO+)         |
| COSME      | 79   | NP B152 215                   | G. Cosme <i>et al.</i>         | (IPN)                       |

REFID=60923  
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REFID=59304  
REFID=58239  
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REFID=21502  
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REFID=20553  
REFID=21584  
REFID=21475

$\omega_3(1670)$ 

$$I^G(J^{PC}) = 0^-(3^{--})$$

NODE=M045

 $\omega_3(1670)$  MASS

NODE=M045M

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID           | TECN     | COMMENT                                      |
|-------------------------------------------------------------------------------|-------|-----------------------|----------|----------------------------------------------|
| <b>1667 ± 4 OUR AVERAGE</b>                                                   |       |                       |          |                                              |
| 1665.3 ± 5.2 ± 4.5                                                            | 23400 | AMELIN                | 96 VES   | $36 \pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$ |
| 1685 ± 20                                                                     | 60    | BAUBILLIER            | 79 HBC   | 8.2 $K^- p$ backward                         |
| 1673 ± 12                                                                     | 430   | <sup>1,2</sup> BALTAY | 78E HBC  | $15 \pi^+ p \rightarrow \Delta 3\pi$         |
| 1650 ± 12                                                                     |       | CORDEN                | 78B OMEG | $8-12 \pi^- p \rightarrow N 3\pi$            |
| 1669 ± 11                                                                     | 600   | <sup>2</sup> WAGNER   | 75 HBC   | $7 \pi^+ p \rightarrow \Delta^{++} 3\pi$     |
| 1678 ± 14                                                                     | 500   | DIAZ                  | 74 DBC   | $6 \pi^+ n \rightarrow p 3\pi^0$             |
| 1660 ± 13                                                                     | 200   | DIAZ                  | 74 DBC   | $6 \pi^+ n \rightarrow p \omega \pi^0 \pi^0$ |
| 1679 ± 17                                                                     | 200   | MATTHEWS              | 71D DBC  | $7.0 \pi^+ n \rightarrow p 3\pi^0$           |
| 1670 ± 20                                                                     |       | KENYON                | 69 DBC   | $8 \pi^+ n \rightarrow p 3\pi^0$             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                       |          |                                              |
| ~ 1700                                                                        | 110   | <sup>1</sup> CERRADA  | 77B HBC  | $4.2 K^- p \rightarrow \Lambda 3\pi$         |
| 1695 ± 20                                                                     |       | BARNES                | 69B HBC  | $4.6 K^- p \rightarrow \omega 2\pi X$        |
| 1636 ± 20                                                                     |       | ARMENISE              | 68B DBC  | $5.1 \pi^+ n \rightarrow p 3\pi^0$           |
| <sup>1</sup> Phase rotation seen for $J^P = 3^- \rho\pi$ wave.                |       |                       |          |                                              |
| <sup>2</sup> From a fit to $I(J^P) = 0(3^-) \rho\pi$ partial wave.            |       |                       |          |                                              |

NODE=M045M

OCCUR=2

NODE=M045M;LINKAGE=E  
NODE=M045M;LINKAGE=P $\omega_3(1670)$  WIDTH

NODE=M045W

| VALUE (MeV)                                                                                             | EVTS  | DOCUMENT ID             | TECN     | COMMENT                                      |
|---------------------------------------------------------------------------------------------------------|-------|-------------------------|----------|----------------------------------------------|
| <b>168 ± 10 OUR AVERAGE</b>                                                                             |       |                         |          |                                              |
| 149 ± 19 ± 7                                                                                            | 23400 | AMELIN                  | 96 VES   | $36 \pi^- p \rightarrow \pi^+ \pi^- \pi^0 n$ |
| 160 ± 80                                                                                                | 60    | <sup>3</sup> BAUBILLIER | 79 HBC   | 8.2 $K^- p$ backward                         |
| 173 ± 16                                                                                                | 430   | <sup>4,5</sup> BALTAY   | 78E HBC  | $15 \pi^+ p \rightarrow \Delta 3\pi$         |
| 253 ± 39                                                                                                |       | CORDEN                  | 78B OMEG | $8-12 \pi^- p \rightarrow N 3\pi$            |
| 173 ± 28                                                                                                | 600   | <sup>3,5</sup> WAGNER   | 75 HBC   | $7 \pi^+ p \rightarrow \Delta^{++} 3\pi$     |
| 167 ± 40                                                                                                | 500   | DIAZ                    | 74 DBC   | $6 \pi^+ n \rightarrow p 3\pi^0$             |
| 122 ± 39                                                                                                | 200   | DIAZ                    | 74 DBC   | $6 \pi^+ n \rightarrow p \omega \pi^0 \pi^0$ |
| 155 ± 40                                                                                                | 200   | <sup>3</sup> MATTHEWS   | 71D DBC  | $7.0 \pi^+ n \rightarrow p 3\pi^0$           |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                           |       |                         |          |                                              |
| 90 ± 20                                                                                                 |       | BARNES                  | 69B HBC  | $4.6 K^- p \rightarrow \omega 2\pi$          |
| 100 ± 40                                                                                                |       | KENYON                  | 69 DBC   | $8 \pi^+ n \rightarrow p 3\pi^0$             |
| 112 ± 60                                                                                                |       | ARMENISE                | 68B DBC  | $5.1 \pi^+ n \rightarrow p 3\pi^0$           |
| <sup>3</sup> Width errors enlarged by us to $4\Gamma/\sqrt{N}$ ; see the note with the $K^*(892)$ mass. |       |                         |          |                                              |
| <sup>4</sup> Phase rotation seen for $J^P = 3^- \rho\pi$ wave.                                          |       |                         |          |                                              |
| <sup>5</sup> From a fit to $I(J^P) = 0(3^-) \rho\pi$ partial wave.                                      |       |                         |          |                                              |

NODE=M045W

OCCUR=2

NODE=M045W;LINKAGE=S  
NODE=M045W;LINKAGE=E  
NODE=M045W;LINKAGE=P $\omega_3(1670)$  DECAY MODES

NODE=M045215;NODE=M045

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad \rho\pi$      | seen                           |
| $\Gamma_2 \quad \omega\pi\pi$ | seen                           |
| $\Gamma_3 \quad b_1(1235)\pi$ | possibly seen                  |

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=3;OUR EST;→ UNCHECKED ← $\omega_3(1670)$  BRANCHING RATIOS

NODE=M045220

| $\Gamma(\omega\pi\pi)/\Gamma(\rho\pi)$                                        |      |             |        |                                  | $\Gamma_2/\Gamma_1$ |
|-------------------------------------------------------------------------------|------|-------------|--------|----------------------------------|---------------------|
| VALUE                                                                         | EVTS | DOCUMENT ID | TECN   | COMMENT                          |                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |        |                                  |                     |
| 0.71 ± 0.27                                                                   | 100  | DIAZ        | 74 DBC | $6 \pi^+ n \rightarrow p 5\pi^0$ |                     |
| $\Gamma(b_1(1235)\pi)/\Gamma(\rho\pi)$                                        |      |             |        |                                  | $\Gamma_3/\Gamma_1$ |
| VALUE                                                                         |      | DOCUMENT ID | TECN   | COMMENT                          |                     |
| possibly seen                                                                 |      | DIAZ        | 74 DBC | $6 \pi^+ n \rightarrow p 5\pi^0$ |                     |

NODE=M045R3  
NODE=M045R3NODE=M045R4  
NODE=M045R4

$\Gamma(b_1(1235)\pi)/\Gamma(\omega\pi\pi)$  $\Gamma_3/\Gamma_2$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |            |    |     |                      |
|-------|----|------------|----|-----|----------------------|
| >0.75 | 68 | BAUBILLIER | 79 | HBC | 8.2 $K^- p$ backward |
|-------|----|------------|----|-----|----------------------|

NODE=M045R5  
 NODE=M045R5

 $\omega_3(1670)$  REFERENCES

|            |     |             |                                     |                        |
|------------|-----|-------------|-------------------------------------|------------------------|
| AMELIN     | 96  | ZPHY C70 71 | D.V. Amelin <i>et al.</i>           | (SERP, TBIL)           |
| BAUBILLIER | 79  | PL 89B 131  | M. Baubillier <i>et al.</i>         | (BIRM, CERN, GLAS+)    |
| BALTAY     | 78E | PRL 40 87   | C. Baltay, C.V. Cautis, M. Kalelkar | (COLU) JP              |
| CORDEN     | 78B | NP B138 235 | M.J. Corden <i>et al.</i>           | (BIRM, RHEL, TELA+)    |
| CERRADA    | 77B | NP B126 241 | M. Cerrada <i>et al.</i>            | (AMST, CERN, NIJM+) JP |
| WAGNER     | 75  | PL 58B 201  | F. Wagner, M. Tabak, D.M. Chew      | (LBL) JP               |
| DIAZ       | 74  | PRL 32 260  | J. Diaz <i>et al.</i>               | (CASE, CMU)            |
| MATTHEWS   | 71D | PR D3 2561  | J.A.J. Matthews <i>et al.</i>       | (TNT0, WISC)           |
| BARNES     | 69B | PRL 23 142  | V.E. Barnes <i>et al.</i>           | (BNL)                  |
| KENYON     | 69  | PRL 23 146  | I.R. Kenyon <i>et al.</i>           | (BNL, UCND, ORNL)      |
| ARMENISE   | 68B | PL 26B 336  | N. Armenise <i>et al.</i>           | (BARI, BGNA, FIRZ+)    |

NODE=M045

REFID=44649  
 REFID=21522  
 REFID=21520  
 REFID=21269  
 REFID=20537  
 REFID=20843  
 REFID=21248  
 REFID=21515  
 REFID=21512  
 REFID=20800  
 REFID=20783

NODE=M034

 $\pi_2(1670)$ 

$$I^G(J^{PC}) = 1^-(2^-+)$$

 $\pi_2(1670)$  MASS

NODE=M034M

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

NODE=M034M

**1670.6<sup>+2.9</sup><sub>-1.2</sub> OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

|      |               |           |                           |     |      |                                                 |                                                              |
|------|---------------|-----------|---------------------------|-----|------|-------------------------------------------------|--------------------------------------------------------------|
| 1642 | $^{+12}_{-1}$ | 46M       | <sup>1</sup> AGHASYAN     | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$   |                                                              |
| 1749 | $\pm 10$      | $\pm 100$ | 145k                      | LU  | 05   | B852                                            | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$                |
| 1676 | $\pm 3$       | $\pm 8$   | <sup>2</sup> CHUNG        | 02  | B852 | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$  |                                                              |
| 1685 | $\pm 10$      | $\pm 30$  | BARBERIS                  | 01  |      | 450 $pp \rightarrow p_f 3\pi^0 p_s$             |                                                              |
| 1687 | $\pm 9$       | $\pm 15$  | AMELIN                    | 99  | VES  | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$ |                                                              |
| 1669 | $\pm 4$       |           | BARBERIS                  | 98B |      | 450 $pp \rightarrow p_f \rho \pi p_s$           |                                                              |
| 1670 | $\pm 4$       |           | BARBERIS                  | 98B |      | 450 $pp \rightarrow p_f f_2(1270) \pi p_s$      |                                                              |
| 1690 | $\pm 14$      |           | <sup>3</sup> BERDNIKOV    | 94  | VES  | 37 $\pi^- A \rightarrow K^+ K^- \pi^- A$        |                                                              |
| 1710 | $\pm 20$      | 700       | ANTIPOV                   | 87  | SIGM | –                                               | 50 $\pi^- \text{Cu} \rightarrow \mu^+ \mu^- \pi^- \text{Cu}$ |
| 1676 | $\pm 6$       |           | <sup>3</sup> EVANGELIS... | 81  | OMEG | –                                               | 12 $\pi^- p \rightarrow 3\pi p$                              |
| 1657 | $\pm 14$      |           | <sup>3,4</sup> DAUM       | 80D | SPEC | –                                               | 63–94 $\pi p \rightarrow 3\pi X$                             |
| 1662 | $\pm 10$      | 2000      | <sup>3</sup> BALTAY       | 77  | HBC  | +                                               | 15 $\pi^+ p \rightarrow p 3\pi$                              |

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |          |               |      |                       |     |      |                                                  |
|------|----------|---------------|------|-----------------------|-----|------|--------------------------------------------------|
| 1658 | $\pm 3$  | $^{+24}_{-8}$ | 420k | <sup>5</sup> ALEKSEEV | 10  | COMP | 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$ |
| 1730 | $\pm 20$ |               |      | <sup>6</sup> AMELIN   | 95B | VES  | 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$     |
| 1742 | $\pm 31$ | $\pm 49$      |      | ANTREASYAN            | 90  | CBAL | $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0 \pi^0$  |
| 1624 | $\pm 21$ |               |      | <sup>2</sup> BELLINI  | 85  | SPEC | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$     |
| 1622 | $\pm 35$ |               |      | <sup>7</sup> BELLINI  | 85  | SPEC | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$     |
| 1693 | $\pm 28$ |               |      | <sup>8</sup> BELLINI  | 85  | SPEC | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$     |
| 1710 | $\pm 20$ |               |      | <sup>9</sup> DAUM     | 81B | SPEC | 63,94 $\pi^- p$                                  |
| 1660 | $\pm 10$ |               |      | <sup>3</sup> ASCOLI   | 73  | HBC  | 5-25 $\pi^- p \rightarrow p \pi_2$               |

OCCUR=2

OCCUR=3

<sup>1</sup> Statistical error negligible.<sup>2</sup> From  $f_2(1270)\pi$  decay.<sup>3</sup> From a fit to  $J^P = 2^- S$ -wave  $f_2(1270)\pi$  partial wave.<sup>4</sup> Clear phase rotation seen in  $2^- S$ ,  $2^- P$ ,  $2^- D$  waves. We quote central value and spread of single-resonance fits to three channels.<sup>5</sup> Superseded by AGHASYAN 2018B.<sup>6</sup>  $J^{PC}$  ambiguous.<sup>7</sup> From  $\rho\pi$  decay.

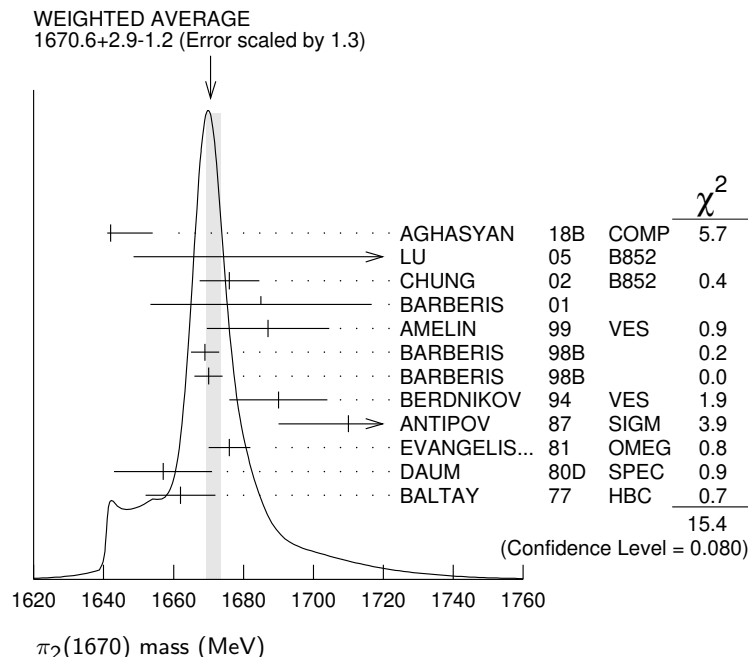
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 NODE=M034M;LINKAGE=P  
 NODE=M034M;LINKAGE=D

NODE=M034M;LINKAGE=B  
 NODE=M034M;LINKAGE=AX  
 NODE=M034M;LINKAGE=R2

<sup>8</sup>From  $\sigma\pi$  decay.<sup>9</sup>From a two-resonance fit to four  $2^-0^+$  waves. This should not be averaged with all the single resonance fits.

NODE=M034M;LINKAGE=S2

NODE=M034M;LINKAGE=L

 **$\pi_2(1670)$  WIDTH**

NODE=M034W

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

NODE=M034W

**258<sup>+</sup><sub>9</sub> OUR AVERAGE**

Error includes scale factor of 1.2.

|                                |      |       |              |          |      |      |                                                 |
|--------------------------------|------|-------|--------------|----------|------|------|-------------------------------------------------|
| 311 <sup>+</sup> <sub>23</sub> | 12   | 46M   | 10           | AGHASYAN | 18B  | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$   |
| 408 $\pm$ 60 $\pm$ 250         | 145k |       |              | LU       | 05   | B852 | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$   |
| 254 $\pm$ 3 $\pm$ 31           |      | 11    | CHUNG        | 02       | B852 |      | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$  |
| 265 $\pm$ 30 $\pm$ 40          |      |       | BARBERIS     | 01       |      |      | 450 $pp \rightarrow p_f 3\pi^0 p_s$             |
| 168 $\pm$ 43 $\pm$ 53          |      |       | AMELIN       | 99       | VES  |      | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$ |
| 268 $\pm$ 15                   |      |       | BARBERIS     | 98B      |      |      | 450 $pp \rightarrow p_f \rho \pi p_s$           |
| 256 $\pm$ 15                   |      |       | BARBERIS     | 98B      |      |      | 450 $pp \rightarrow p_f f_2(1270) \pi p_s$      |
| 190 $\pm$ 50                   |      | 12    | BERDNIKOV    | 94       | VES  |      | 37 $\pi^- A \rightarrow K^+ K^- \pi^- A$        |
| 170 $\pm$ 80                   | 700  |       | ANTIPOV      | 87       | SIGM | -    | 50 $\pi^- Cu \rightarrow \mu^+ \mu^- \pi^- Cu$  |
| 260 $\pm$ 20                   |      | 12    | EVANGELIS... | 81       | OMEG | -    | 12 $\pi^- p \rightarrow 3\pi p$                 |
| 219 $\pm$ 20                   |      | 12,13 | DAUM         | 80D      | SPEC | -    | 63-94 $\pi p \rightarrow 3\pi X$                |
| 285 $\pm$ 60                   | 2000 | 12    | BALTAY       | 77       | HBC  | +    | 15 $\pi^+ p \rightarrow p 3\pi$                 |

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

|                                        |      |    |            |     |      |                                                  |
|----------------------------------------|------|----|------------|-----|------|--------------------------------------------------|
| 271 $\pm$ 9 <sup>+</sup> <sub>24</sub> | 420k | 14 | ALEKSEEV   | 10  | COMP | 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$ |
| 310 $\pm$ 20                           |      | 15 | AMELIN     | 95B | VES  | 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$     |
| 236 $\pm$ 49 $\pm$ 36                  |      |    | ANTREASYAN | 90  | CBAL | $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0 \pi^0$  |
| 304 $\pm$ 22                           |      | 11 | BELLINI    | 85  | SPEC | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$     |
| 404 $\pm$ 108                          |      | 16 | BELLINI    | 85  | SPEC | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$     |
| 330 $\pm$ 90                           |      | 17 | BELLINI    | 85  | SPEC | 40 $\pi^- A \rightarrow \pi^- \pi^+ \pi^- A$     |
| 312 $\pm$ 50                           |      | 18 | DAUM       | 81B | SPEC | - 63,94 $\pi^- p$                                |
| 270 $\pm$ 60                           |      | 12 | ASCOLI     | 73  | HBC  | - 5-25 $\pi^- p \rightarrow p \pi_2$             |

OCCUR=2

OCCUR=2

OCCUR=3

- 10 Statistical error negligible.  
 11 From  $f_2(1270)\pi$  decay.  
 12 From a fit to  $J^P = 2^- f_2(1270)\pi$  partial wave.  
 13 Clear phase rotation seen in  $2^- S$ ,  $2^- P$ ,  $2^- D$  waves. We quote central value and spread of single-resonance fits to three channels.  
 14 Superseded by AGHASYAN 2018B.  
 15  $J^{PC}$  ambiguous.  
 16 From  $\rho\pi$  decay.  
 17 From  $\sigma\pi$  decay.  
 18 From a two-resonance fit to four  $2^- 0^+$  waves. This should not be averaged with all the single resonance fits.

NODE=M034W;LINKAGE=A  
 NODE=M034W;LINKAGE=F2  
 NODE=M034W;LINKAGE=P  
 NODE=M034W;LINKAGE=D

NODE=M034W;LINKAGE=B  
 NODE=M034W;LINKAGE=AX  
 NODE=M034W;LINKAGE=R2  
 NODE=M034W;LINKAGE=S2  
 NODE=M034W;LINKAGE=L

### $\pi_2(1670)$ DECAY MODES

| Mode                                        | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|---------------------------------------------|--------------------------------|------------------|
| $\Gamma_1$ $3\pi$                           | $(95.8 \pm 1.4) \%$            |                  |
| $\Gamma_2$ $\pi^+ \pi^- \pi^0$              |                                |                  |
| $\Gamma_3$ $\pi^0 \pi^0 \pi^0$              |                                |                  |
| $\Gamma_4$ $f_2(1270)\pi$                   | $(56.3 \pm 3.2) \%$            |                  |
| $\Gamma_5$ $\rho\pi$                        | $(31 \pm 4) \%$                |                  |
| $\Gamma_6$ $\sigma\pi$                      | $(10 \pm 4) \%$                |                  |
| $\Gamma_7$ $\pi(\pi\pi)_S\text{-wave}$      | $(8.7 \pm 3.4) \%$             |                  |
| $\Gamma_8$ $\pi^\pm \pi^+ \pi^-$            | $(53 \pm 4) \%$                |                  |
| $\Gamma_9$ $K \bar{K}^*(892) + \text{c.c.}$ | $(4.2 \pm 1.4) \%$             |                  |
| $\Gamma_{10}$ $\omega\rho$                  | $(2.7 \pm 1.1) \%$             |                  |
| $\Gamma_{11}$ $\pi^\pm \gamma$              | $(7.0 \pm 1.2) \times 10^{-4}$ |                  |
| $\Gamma_{12}$ $\gamma\gamma$                | $< 2.8 \times 10^{-7}$         | 90%              |
| $\Gamma_{13}$ $\eta\pi$                     | $< 5 \%$                       |                  |
| $\Gamma_{14}$ $\pi^\pm 2\pi^+ 2\pi^-$       | $< 5 \%$                       |                  |
| $\Gamma_{15}$ $\rho(1450)\pi$               | $< 3.6 \times 10^{-3}$         | 97.7%            |
| $\Gamma_{16}$ $b_1(1235)\pi$                | $< 1.9 \times 10^{-3}$         | 97.7%            |
| $\Gamma_{17}$ $\eta 3\pi$                   |                                |                  |
| $\Gamma_{18}$ $f_1(1285)\pi$                | possibly seen                  |                  |
| $\Gamma_{19}$ $a_2(1320)\pi$                | not seen                       |                  |

NODE=M034215;NODE=M034

DESIG=20  
 DESIG=22  
 DESIG=23  
 DESIG=8  
 DESIG=2  
 DESIG=13  
 DESIG=11  
 DESIG=10  
 DESIG=5  
 DESIG=14  
 DESIG=27  
 DESIG=12  
 DESIG=3  
 DESIG=4  
 DESIG=15  
 DESIG=16  
 DESIG=24  
 DESIG=25  
 DESIG=26

### CONSTRAINED FIT INFORMATION

An overall fit to 4 branching ratios uses 6 measurements and one constraint to determine 4 parameters. The overall fit has a  $\chi^2 = 1.9$  for 3 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|       |       |       |       |
|-------|-------|-------|-------|
| $x_5$ | −53   |       |       |
| $x_7$ | −29   | −59   |       |
| $x_9$ | −8    | −21   | −9    |
|       | $x_4$ | $x_5$ | $x_7$ |

### $\pi_2(1670)$ PARTIAL WIDTHS

$\Gamma(\pi^\pm \gamma)$

| VALUE (keV)                           | DOCUMENT ID | TECN | CHG  | COMMENT | $\Gamma_{11}$                                                  |
|---------------------------------------|-------------|------|------|---------|----------------------------------------------------------------|
| <b><math>181 \pm 11 \pm 27</math></b> | 19 ADOLPH   | 14   | COMP | −       | 190 $\pi^- \text{Pb} \rightarrow \pi^+ \pi^- \pi^- \text{Pb}'$ |

- 19 Primakoff reaction. Assumes incoherent  $f_2(1270)\pi$  contribution to  $3\pi$  final state and uses  $B(\pi_2(1670) \rightarrow f_2\pi) = 56\%$ .

NODE=M034217

NODE=M034W2  
 NODE=M034W2

NODE=M034W2;LINKAGE=AD

$\Gamma(\gamma\gamma)$  $\Gamma_{12}$ 

| VALUE (keV)                                                                   | CL% | DOCUMENT ID | TECN | CHG  | COMMENT                                      |
|-------------------------------------------------------------------------------|-----|-------------|------|------|----------------------------------------------|
| <b>&lt;0.072</b>                                                              | 90  | 20 ACCIARRI | 97T  | L3   | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |      |                                              |
| <0.19                                                                         | 90  | 20 ALBRECHT | 97B  | ARG  | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$   |
| 1.41 $\pm 0.23 \pm 0.28$                                                      |     | ANTREASYAN  | 90   | CBAL | 0 $e^+e^- \rightarrow e^+e^-\pi^0\pi^0\pi^0$ |
| 0.8 $\pm 0.3 \pm 0.12$                                                        |     | 21 BEHREND  | 90C  | CELL | 0 $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$ |
| 1.3 $\pm 0.3 \pm 0.2$                                                         |     | 22 BEHREND  | 90C  | CELL | 0 $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\pi^0$ |

20 Decaying into  $f_2(1270)\pi$  and  $\rho\pi$ .21 Constructive interference between  $f_2(1270)\pi, \rho\pi$  and background.

22 Incoherent Ansatz.

NODE=M034W1  
NODE=M034W1

OCCUR=2

NODE=M034W1;LINKAGE=QQ  
NODE=M034W1;LINKAGE=C  
NODE=M034W1;LINKAGE=G $\pi_2(1670) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$ 

NODE=M034230

 $\Gamma(\pi^+\pi^-\pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_2\Gamma_{12}/\Gamma$ 

| VALUE (keV)                                 | CL% | DOCUMENT ID   | TECN | COMMENT                                         |
|---------------------------------------------|-----|---------------|------|-------------------------------------------------|
| <b>&lt;0.1</b>                              | 95  | 23 SCHEGELSKY | 06   | RVUE $\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$ |
| 23 From analysis of L3 data at 183–209 GeV. |     |               |      |                                                 |

NODE=M034G01  
NODE=M034G01

NODE=M034G01;LINKAGE=SC

 $\pi_2(1670) \text{ BRANCHING RATIOS}$ 

NODE=M034220

 $\Gamma(3\pi)/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma = (\Gamma_4 + \Gamma_5 + \Gamma_7)/\Gamma$ 

| VALUE                                       | DOCUMENT ID |
|---------------------------------------------|-------------|
| <b>0.958 <math>\pm 0.014</math> OUR FIT</b> |             |

NODE=M034R20  
NODE=M034R20 $\Gamma(\pi^0\pi^0\pi^0)/\Gamma(\pi^+\pi^-\pi^0)$  $\Gamma_3/\Gamma_2$ 

| VALUE                                      | DOCUMENT ID | COMMENT                              |
|--------------------------------------------|-------------|--------------------------------------|
| <b>0.29 <math>\pm 0.03 \pm 0.05</math></b> | BARBERIS 01 | 450 $p p \rightarrow p_f 3\pi^0 p_s$ |

NODE=M034R21  
NODE=M034R21 $\Gamma(\rho\pi)/0.565\Gamma(f_2(1270)\pi)$  $\Gamma_5/0.565\Gamma_4$ (With  $f_2(1270) \rightarrow \pi^+\pi^-$ .)

| VALUE                                         | DOCUMENT ID                         | TECN    | COMMENT                                       |
|-----------------------------------------------|-------------------------------------|---------|-----------------------------------------------|
| <b>0.97 <math>\pm 0.09</math> OUR AVERAGE</b> | Error includes scale factor of 1.9. |         |                                               |
| 0.76 $\pm 0.07 \pm 0.10$                      | CHUNG                               | 02 B852 | 18.3 $\pi^- p \rightarrow \pi^+\pi^-\pi^- p$  |
| 1.01 $\pm 0.05$                               | BARBERIS                            | 98B     | 450 $p p \rightarrow p_f \pi^+\pi^-\pi^0 p_s$ |

NODE=M034R16  
NODE=M034R16  
NODE=M034R16 $\Gamma(\sigma\pi)/\Gamma(f_2(1270)\pi)$  $\Gamma_6/\Gamma_4$ 

| VALUE                                                                         | DOCUMENT ID | TECN    | COMMENT                                      |
|-------------------------------------------------------------------------------|-------------|---------|----------------------------------------------|
| <b>0.17 <math>\pm 0.02 \pm 0.07</math></b>                                    | CHUNG       | 02 B852 | 18.3 $\pi^- p \rightarrow \pi^+\pi^-\pi^- p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |         |                                              |
| 0.24 $\pm 0.10$                                                               | 24,25 BAKER | 99 SPEC | 1.94 $\bar{p} p \rightarrow 4\pi^0$          |

NODE=M034R15  
NODE=M034R15 $\frac{1}{2}\Gamma(\rho\pi)/\Gamma(\pi^\pm\pi^+\pi^-)$  $\frac{1}{2}\Gamma_5/\Gamma_8 = \frac{1}{2}\Gamma_5/(\Gamma_4 + \frac{1}{2}\Gamma_5 + 0.624\Gamma_7)$ 

| VALUE                                                                         | DOCUMENT ID | TECN | CHG  | COMMENT                          |
|-------------------------------------------------------------------------------|-------------|------|------|----------------------------------|
| <b>0.29 <math>\pm 0.04</math> OUR FIT</b>                                     |             |      |      |                                  |
| <b>0.29 <math>\pm 0.05</math></b>                                             | 26 DAUM     | 81B  | SPEC | 63,94 $\pi^- p$                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |      |                                  |
| <0.3                                                                          | BARTSCH     | 68   | HBC  | + 8 $\pi^+ p \rightarrow 3\pi p$ |

NODE=M034R2  
NODE=M034R2 $0.565\Gamma(f_2(1270)\pi)/\Gamma(\pi^\pm\pi^+\pi^-)$  $0.565\Gamma_4/\Gamma_8 = 0.565\Gamma_4/(\Gamma_4 + \frac{1}{2}\Gamma_5 + 0.624\Gamma_7)$ (With  $f_2(1270) \rightarrow \pi^+\pi^-$ .)

| VALUE                                                                         | DOCUMENT ID                         | TECN | CHG  | COMMENT                            |
|-------------------------------------------------------------------------------|-------------------------------------|------|------|------------------------------------|
| <b>0.604 <math>\pm 0.035</math> OUR FIT</b>                                   |                                     |      |      |                                    |
| <b>0.60 <math>\pm 0.05</math> OUR AVERAGE</b>                                 | Error includes scale factor of 1.3. |      |      |                                    |
| 0.61 $\pm 0.04$                                                               | 26 DAUM                             | 81B  | SPEC | 63,94 $\pi^- p$                    |
| 0.76 $+0.24$<br>$-0.34$                                                       | ARMENISE                            | 69   | DBC  | + 5.1 $\pi^+ d \rightarrow d 3\pi$ |
| 0.35 $\pm 0.20$                                                               | BALTAY                              | 68   | HBC  | + 7–8.5 $\pi^+ p$                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |      |      |                                    |
| 0.59                                                                          | BARTSCH                             | 68   | HBC  | + 8 $\pi^+ p \rightarrow 3\pi p$   |

NODE=M034R3  
NODE=M034R3  
NODE=M034R3



**$0.624\Gamma(\pi(\pi\pi)_{S\text{-wave}})/\Gamma(\pi^\pm\pi^+\pi^-)$** 

**$0.624\Gamma_7/\Gamma_8 = 0.624\Gamma_7/(0.565\Gamma_4 + \frac{1}{2}\Gamma_5 + 0.624\Gamma_7)$**

(With  $(\pi\pi)_{S\text{-wave}} \rightarrow \pi^+\pi^-$ .)

| VALUE                                     | DOCUMENT ID | TECN     | COMMENT         |
|-------------------------------------------|-------------|----------|-----------------|
| <b><math>0.10 \pm 0.04</math> OUR FIT</b> |             |          |                 |
| <b><math>0.10 \pm 0.05</math></b>         | 26 DAUM     | 81B SPEC | 63,94 $\pi^- p$ |

NODE=M034R11

NODE=M034R11  
NODE=M034R11 **$\Gamma(K\bar{K}^*(892) + \text{c.c.})/\Gamma(f_2(1270)\pi)$**  **$\Gamma_9/\Gamma_4$** 

| VALUE                                       | DOCUMENT ID  | TECN     | CHG | COMMENT                                  |
|---------------------------------------------|--------------|----------|-----|------------------------------------------|
| <b><math>0.075 \pm 0.025</math> OUR FIT</b> |              |          |     |                                          |
| <b><math>0.075 \pm 0.025</math></b>         | 27 ARMSTRONG | 82B OMEG | —   | 16 $\pi^- p \rightarrow K^+ K^- \pi^- p$ |

NODE=M034R13

NODE=M034R13

 **$\Gamma(\omega\rho)/\Gamma_{\text{total}}$**  **$\Gamma_{10}/\Gamma$** 

| VALUE                                         | DOCUMENT ID | TECN   | COMMENT                                         |
|-----------------------------------------------|-------------|--------|-------------------------------------------------|
| <b><math>0.027 \pm 0.004 \pm 0.010</math></b> | 28 AMELIN   | 99 VES | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$ |

NODE=M034R17

NODE=M034R17

 **$\Gamma(\eta\pi)/\Gamma(\pi^\pm\pi^+\pi^-)$** 

**$\Gamma_{13}/\Gamma_8 = \Gamma_{13}/(0.565\Gamma_4 + \frac{1}{2}\Gamma_5 + 0.624\Gamma_7)$**

(All  $\eta$  decays.)

| VALUE                                                                         | DOCUMENT ID | TECN   | CHG | COMMENT                             |
|-------------------------------------------------------------------------------|-------------|--------|-----|-------------------------------------|
| <b><math>&lt;0.09</math></b>                                                  | BALTAY      | 68 HBC | +   | 7-8.5 $\pi^+ p$                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |        |     |                                     |
| $<0.10$                                                                       | CRENNELL    | 70 HBC | —   | 6 $\pi^- p \rightarrow f_2 \pi^- N$ |

NODE=M034R5

NODE=M034R5

NODE=M034R5

 **$\Gamma(\pi^\pm 2\pi^+ 2\pi^-)/\Gamma(\pi^\pm\pi^+\pi^-)$** 

**$\Gamma_{14}/\Gamma_8 = \Gamma_{14}/(0.565\Gamma_4 + \frac{1}{2}\Gamma_5 + 0.624\Gamma_7)$**

| VALUE                                                                         | DOCUMENT ID | TECN   | CHG | COMMENT                             |
|-------------------------------------------------------------------------------|-------------|--------|-----|-------------------------------------|
| <b><math>&lt;0.10</math></b>                                                  | CRENNELL    | 70 HBC | —   | 6 $\pi^- p \rightarrow f_2 \pi^- N$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |        |     |                                     |
| $<0.1$                                                                        | BALTAY      | 68 HBC | +   | 7,8.5 $\pi^+ p$                     |

NODE=M034R6

NODE=M034R6

 **$\Gamma(\rho(1450)\pi)/\Gamma_{\text{total}}$**  **$\Gamma_{15}/\Gamma$** 

| VALUE                          | CL%  | DOCUMENT ID | TECN   | COMMENT                                         |
|--------------------------------|------|-------------|--------|-------------------------------------------------|
| <b><math>&lt;0.0036</math></b> | 97.7 | AMELIN      | 99 VES | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$ |

NODE=M034R18

NODE=M034R18

 **$\Gamma(b_1(1235)\pi)/\Gamma_{\text{total}}$**  **$\Gamma_{16}/\Gamma$** 

| VALUE                          | CL%  | DOCUMENT ID | TECN   | COMMENT                                         |
|--------------------------------|------|-------------|--------|-------------------------------------------------|
| <b><math>&lt;0.0019</math></b> | 97.7 | AMELIN      | 99 VES | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$ |

NODE=M034R19

NODE=M034R19

 **$\Gamma(f_1(1285)\pi)/\Gamma_{\text{total}}$**  **$\Gamma_{18}/\Gamma$** 

| VALUE                | EVTS | DOCUMENT ID | TECN    | COMMENT                                           |
|----------------------|------|-------------|---------|---------------------------------------------------|
| <b>possibly seen</b> | 69k  | KUHN        | 04 B852 | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |

NODE=M034R23

NODE=M034R23

 **$\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$**  **$\Gamma_{19}/\Gamma$** 

| VALUE           | EVTS | DOCUMENT ID | TECN    | COMMENT                                           |
|-----------------|------|-------------|---------|---------------------------------------------------|
| <b>not seen</b> | 69k  | KUHN        | 04 B852 | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |

NODE=M034R24

NODE=M034R24

**D-wave/S-wave RATIO FOR  $\pi_2(1670) \rightarrow f_2(1270)\pi$** 

| VALUE                                                                         | DOCUMENT ID | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------|-------------|----------|-------------------------------------|
| <b><math>-0.18 \pm 0.06</math></b>                                            | 24 BAKER    | 99 SPEC  | 1.94 $\bar{p} p \rightarrow 4\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |          |                                     |
| $0.22 \pm 0.10$                                                               | 26 DAUM     | 81B SPEC | 63,94 $\pi^- p$                     |

NODE=M034R14

NODE=M034R14

**F-wave/P-wave RATIO FOR  $\pi_2(1670) \rightarrow \rho\pi$** 

| VALUE                                       | DOCUMENT ID | TECN    | COMMENT                                        |
|---------------------------------------------|-------------|---------|------------------------------------------------|
| <b><math>-0.72 \pm 0.07 \pm 0.14</math></b> | CHUNG       | 02 B852 | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |

NODE=M034R22

NODE=M034R22

24 Using preliminary CBAR data.

25 With the  $\sigma\pi$  in  $L=2$  and the  $f_2(1270)\pi$  in  $L=0$ .26 From a two-resonance fit to four  $2^-0^+$  waves.27 From a partial-wave analysis of  $K^+ K^- \pi^-$  system.28 Normalized to the  $B(\pi_2(1670) \rightarrow f_2\pi)$ .

NODE=M034R;LINKAGE=BK

NODE=M034R15;LINKAGE=A

NODE=M034R;LINKAGE=L

NODE=M034R13;LINKAGE=M

NODE=M034R;LINKAGE=DM

$\pi_2(1670)$  REFERENCES

|              |     |                              |                                    |                                    |
|--------------|-----|------------------------------|------------------------------------|------------------------------------|
| AGHASYAN     | 18B | PR D98 092003                | M. Aghasyan <i>et al.</i>          | (COMPASS Collab.)                  |
| ADOLPH       | 14  | EPJ A50 79                   | C. Adolph <i>et al.</i>            | (COMPASS Collab.)                  |
| ALEKSEEV     | 10  | PRL 104 241803               | M.G. Alekseev <i>et al.</i>        | (COMPASS Collab.)                  |
| SCHEGELSKY   | 06  | EPJ A27 199                  | V.A. Schegelsky <i>et al.</i>      |                                    |
| LU           | 05  | PRL 94 032002                | M. Lu <i>et al.</i>                | (BNL E852 Collab.)                 |
| KUHN         | 04  | PL B595 109                  | J. Kuhn <i>et al.</i>              | (BNL E852 Collab.)                 |
| CHUNG        | 02  | PR D65 072001                | S.U. Chung <i>et al.</i>           | (BNL E852 Collab.)                 |
| BARBERIS     | 01  | PL B507 14                   | D. Barberis <i>et al.</i>          |                                    |
| AMELIN       | 99  | PAN 62 445                   | D.V. Amelin <i>et al.</i>          | (VES Collab.)                      |
|              |     | Translated from YAF 62 487.  |                                    |                                    |
| BAKER        | 99  | PL B449 114                  | C.A. Baker <i>et al.</i>           |                                    |
| BARBERIS     | 98B | PL B422 399                  | D. Barberis <i>et al.</i>          | (WA 102 Collab.)                   |
| ACCIARRI     | 97T | PL B413 147                  | M. Acciarri <i>et al.</i>          | (L3 Collab.)                       |
| ALBRECHT     | 97B | ZPHY C74 469                 | H. Albrecht <i>et al.</i>          | (ARGUS Collab.)                    |
| AMELIN       | 95B | PL B356 595                  | D.V. Amelin <i>et al.</i>          | (SERP, TBIL)                       |
| BERDNIKOV    | 94  | PL B337 219                  | E.B. Berdnikov <i>et al.</i>       | (SERP, TBIL)                       |
| ANTREASYAN   | 90  | ZPHY C48 561                 | D. Antreasyan <i>et al.</i>        | (Crystal Ball Collab.)             |
| BEHREND      | 90C | ZPHY C46 583                 | H.J. Behrend <i>et al.</i>         | (CELLO Collab.)                    |
| ANTIPOV      | 87  | EPL 4 403                    | Y.M. Antipov <i>et al.</i>         | (SERP, JINR, INRM+)                |
| BELLINI      | 85  | JNP 41 781                   | D. Bellini <i>et al.</i>           |                                    |
|              |     | Translated from YAF 41 1223. |                                    |                                    |
| ARMSTRONG    | 82B | NP B202 1                    | T.A. Armstrong, B. Baccari         | (AACH3, BARI, BONN+)               |
| DAUM         | 81B | NP B182 269                  | C. Daum <i>et al.</i>              | (AMST, CERN, CRAC, MPIM+)          |
| EVANGELIS... | 81  | NP B178 197                  | C. Evangelista <i>et al.</i>       | (BARI, BONN, CERN+)                |
| Also         |     | NP B186 594                  | C. Evangelista                     |                                    |
| DAUM         | 80D | PL B98B 285                  | C. Daum <i>et al.</i>              | (AMST, CERN, CRAC, MPIM+) JP       |
| BALTAY       | 77  | PRL 39 591                   | C. Baltay, C.V. Cautis, M. Kaelkar | (COLU) JP                          |
| ASCOLI       | 73  | PR D7 669                    | G. Ascoli                          | (ILL, TINTO, GENO, HAMB, MILA+) JP |
| CRENNELL     | 70  | PRL 24 781                   | D.J. Crennell <i>et al.</i>        | (BNL)                              |
| ARMENISE     | 69  | LNC 2 501                    | N. Armenise <i>et al.</i>          | (BARI, BGNA, FIRZ)                 |
| BALTAY       | 68  | PRL 20 887                   | C. Baltay <i>et al.</i>            | (COLU, ROCH, RUTG, YALE) I         |
| BARTSCH      | 68  | NP B7 345                    | J. Bartsch <i>et al.</i>           | (AACH, BERL, CERN) JP              |

NODE=M034

REFID=59471  
REFID=55911  
REFID=53356  
REFID=51186  
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REFID=46910

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REFID=21553  
REFID=20805  
REFID=20689  
REFID=21531  
REFID=21532

NODE=M067

 $\phi(1680)$ 

$$I^G(J^{PC}) = 0^-(1^--)$$

 $\phi(1680)$  MASS

NODE=M067205

 $e^+e^-$  PRODUCTION

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

 $1680 \pm 20$  OUR ESTIMATE

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                           |      |                         |     |      |                                                                           |
|---------------------------|------|-------------------------|-----|------|---------------------------------------------------------------------------|
| $1680^{+12}_{-13} \pm 21$ | 1.8k | <sup>1</sup> ABLIKIM    | 20F | BES3 | $\psi(2S) \rightarrow K^+ K^- \eta$                                       |
| $1662 \pm 20$             |      | <sup>2</sup> ACHASOV    | 20C | SND  | $1.3-2.0 e^+ e^- \rightarrow K^+ K^- \pi^0$                               |
| $1641^{+24}_{-18}$        |      | ACHASOV                 | 19  | SND  | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \eta$                              |
| $1667 \pm 5 \pm 11$       | 3k   | <sup>3</sup> IVANOV     | 19A | CMD3 | $1.59-2.007 e^+ e^- \rightarrow K^+ K^- \eta$                             |
| $1700 \pm 23$             | 2k   | <sup>4</sup> ACHASOV    | 18A | SND  | $1.3-2.0 e^+ e^- \rightarrow K_S^0 K_L^0 \pi^0$                           |
| $1674 \pm 12 \pm 6$       | 6.2k | <sup>5</sup> LEES       | 14H | BABR | $e^+ e^- \rightarrow K_S^0 K_L^0 \gamma$                                  |
| $1733 \pm 10 \pm 10$      |      | <sup>6</sup> LEES       | 12F | BABR | $10.6 e^+ e^- \rightarrow \phi \pi^+ \pi^- \gamma$                        |
| $1689 \pm 7 \pm 10$       | 4.8k | <sup>7</sup> SHEN       | 09  | BELL | $10.6 e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$                     |
| $1709 \pm 20 \pm 43$      |      | <sup>8</sup> AUBERT     | 08S | BABR | $10.6 e^+ e^- \rightarrow \text{hadrons}$                                 |
| $1623 \pm 20$             | 948  | <sup>9</sup> AKHMETSHIN | 03  | CMD2 | $1.05-1.38 e^+ e^- \rightarrow K_L^0 K_S^0$                               |
| $\sim 1500$               |      | <sup>10</sup> ACHASOV   | 98H | RVUE | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0, \omega \pi^+ \pi^-,$<br>$K^+ K^-$ |
| $\sim 1900$               |      | <sup>11</sup> ACHASOV   | 98H | RVUE | $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp$                                 |
| $1700 \pm 20$             |      | <sup>12</sup> CLEGG     | 94  | RVUE | $e^+ e^- \rightarrow K^+ K^-, K_S^0 K \pi$                                |
| $1657 \pm 27$             | 367  | BISELLO                 | 91C | DM2  | $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp$                                 |
| $1655 \pm 17$             |      | <sup>13</sup> BISELLO   | 88B | DM2  | $e^+ e^- \rightarrow K^+ K^-$                                             |
| $1680 \pm 10$             |      | <sup>14</sup> BUON      | 82  | DM1  | $e^+ e^- \rightarrow \text{hadrons}$                                      |
| $1677 \pm 12$             |      | <sup>15</sup> MANE      | 82  | DM1  | $e^+ e^- \rightarrow K_S^0 K \pi$                                         |

OCCUR=4

<sup>1</sup> Seen in  $\psi(2S)$  decay with branching ratio  $\psi(2S) \rightarrow X \eta \rightarrow K^+ K^- \eta = (12.0 \pm 1.3^{+6.5}_{-6.9}) \times 10^{-6}$ .

<sup>2</sup> From a fit using a vector meson dominance model with contribution from  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ ,  $\rho(1450)$ .

<sup>3</sup> From a fit with coherent interference of the  $\phi(1680)$  with a non-resonant contribution.

<sup>4</sup> Assuming the  $K \bar{K}^*(892) + \text{c.c.}$  dynamics. Systematic uncertainties not estimated.

<sup>5</sup> Using a vector meson dominance model with contribution from  $\phi(1020)$ ,  $\phi(1680)$ , and higher mass excitations of  $\rho(770)$  and  $\omega(782)$ .

<sup>6</sup> Using events with  $\pi\pi$  invariant mass less than 0.85 GeV.

<sup>7</sup> From a fit with two incoherent Breit-Wigners.

<sup>8</sup> From the simultaneous fit to the  $K \bar{K}^*(892) + \text{c.c.}$  and  $\phi\eta$  data from AUBERT 08S using the results of AUBERT 07AK.

NODE=M067M1;LINKAGE=E

NODE=M067M1;LINKAGE=F

NODE=M067M1;LINKAGE=D

NODE=M067M1;LINKAGE=C

NODE=M067M1;LINKAGE=B

NODE=M067M1;LINKAGE=A

NODE=M067M1;LINKAGE=SH

NODE=M067M1;LINKAGE=AU

- <sup>9</sup> From the combined fit of AKHMETSHIN 03 and MANE 81 also including  $\rho$ ,  $\omega$ , and  $\phi$ . Neither isospin nor flavor structure known.
- <sup>10</sup> Using data from IVANOV 81, BARKOV 87, BISELLO 88B, DOLINSKY 91, and ANTONELLI 92.
- <sup>11</sup> Using the data from BISELLO 91C.
- <sup>12</sup> Using BISELLO 88B and MANE 82 data.
- <sup>13</sup> From global fit including  $\rho$ ,  $\omega$ ,  $\phi$  and  $\rho(1700)$  assume mass 1570 MeV and width 510 MeV for  $\rho$  radial excitation.
- <sup>14</sup> From global fit of  $\rho$ ,  $\omega$ ,  $\phi$  and their radial excitations to channels  $\omega\pi^+\pi^-$ ,  $K^+K^-$ ,  $K_S^0K_L^0$ ,  $K_S^0K^\pm\pi^\mp$ . Assume mass 1570 MeV and width 510 MeV for  $\rho$  radial excitations, mass 1570 and width 500 MeV for  $\omega$  radial excitation.
- <sup>15</sup> Fit to one channel only, neglecting interference with  $\omega$ ,  $\rho(1700)$ .

NODE=M067M;LINKAGE=HK

NODE=M067M1;LINKAGE=L1

NODE=M067M1;LINKAGE=L4

NODE=M067M;LINKAGE=A

NODE=M067M;LINKAGE=E

NODE=M067M;LINKAGE=C

NODE=M067M;LINKAGE=D

NODE=M067M2

NODE=M067M2

**PHOTOPRODUCTION**

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|-----------------------|------|-----------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                       |      |                                               |
| 1753 ± 3                                                                      | <sup>1</sup> LINK     | 02K  | FOCS 20–160 $\gamma p \rightarrow K^+ K^- p$  |
| 1726 ± 22                                                                     | <sup>1</sup> BUSENITZ | 89   | TPS $\gamma p \rightarrow K^+ K^- X$          |
| 1760 ± 20                                                                     | <sup>1</sup> ATKINSON | 85C  | OMEG 20–70 $\gamma p \rightarrow K \bar{K} X$ |
| 1690 ± 10                                                                     | <sup>1</sup> ASTON    | 81F  | OMEG 25–70 $\gamma p \rightarrow K^+ K^- X$   |

<sup>1</sup> We list here a state decaying into  $K^+ K^-$  possibly different from  $\phi(1680)$ .

NODE=M067M2;LINKAGE=LK

 **$p\bar{p}$  ANNIHILATION**

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|---------------------|------|------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                     |      |                                                |
| 1700 ± 8                                                                      | <sup>1</sup> AMSLER | 06   | CBAR 0.9 $\bar{p} p \rightarrow K^+ K^- \pi^0$ |

<sup>1</sup> Could also be  $\rho(1700)$ .

NODE=M067M3

NODE=M067M3

NODE=M067M3;LINKAGE=AM

 **$\phi(1680)$  WIDTH**

NODE=M067210

 **$e^+e^-$  PRODUCTION**

| VALUE (MeV)                                                                                                                                   | EVTS | DOCUMENT ID                | TECN | COMMENT                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------|------|------------------------------------------------------------|
| <b>150 ± 50 OUR ESTIMATE</b> This is only an educated guess; the error given is larger than the error on the average of the published values. |      |                            |      |                                                            |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                                                                 |      |                            |      |                                                            |
| 185 <sup>+30+25</sup> <sub>-26-47</sub>                                                                                                       | 1.8k | <sup>1</sup> ABLIKIM       | 20F  | BES3 $\psi(2S) \rightarrow K^+ K^- \eta$                   |
| 159 ± 32                                                                                                                                      |      | <sup>2</sup> ACHASOV       | 20C  | SND 1.3–2.0 $e^+ e^- \rightarrow K^+ K^- \pi^0$            |
| 103 <sup>+26</sup> <sub>-24</sub>                                                                                                             |      | ACHASOV                    | 19   | SND $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \eta$           |
| 176 ± 23 ± 38                                                                                                                                 | 3k   | <sup>3</sup> IVANOV        | 19A  | CMD3 1.59–2.007 $e^+ e^- \rightarrow K^+ K^- \eta$         |
| 300 ± 50                                                                                                                                      | 2k   | <sup>4</sup> ACHASOV       | 18A  | SND 1.3–2.0 $e^+ e^- \rightarrow K_S^0 K_L^0 \pi^0$        |
| 165 ± 38 ± 70                                                                                                                                 | 6.2k | <sup>5</sup> LEES          | 14H  | BABR $e^+ e^- \rightarrow K_S^0 K_L^0 \gamma$              |
| 300 ± 15 ± 37                                                                                                                                 |      | <sup>6</sup> LEES          | 12F  | BABR 10.6 $e^+ e^- \rightarrow \phi \pi^+ \pi^- \gamma$    |
| 211 ± 14 ± 19                                                                                                                                 | 4.8k | <sup>7</sup> SHEN          | 09   | BELL 10.6 $e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$ |
| 322 ± 77 ± 160                                                                                                                                |      | <sup>8</sup> AUBERT        | 08S  | BABR 10.6 $e^+ e^- \rightarrow \text{hadrons}$             |
| 139 ± 60                                                                                                                                      | 948  | <sup>9</sup> AKHMETSHIN 03 | CMD2 | 1.05–1.38 $e^+ e^- \rightarrow K_L^0 K_S^0$                |
| 300 ± 60                                                                                                                                      |      | <sup>10</sup> CLEGG        | 94   | RVUE $e^+ e^- \rightarrow K^+ K^-, K_S^0 K \pi$            |
| 146 ± 55                                                                                                                                      | 367  | BISELLO                    | 91C  | DM2 $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp$              |
| 207 ± 45                                                                                                                                      |      | <sup>11</sup> BISELLO      | 88B  | DM2 $e^+ e^- \rightarrow K^+ K^-$                          |
| 185 ± 22                                                                                                                                      |      | <sup>12</sup> BUON         | 82   | DM1 $e^+ e^- \rightarrow \text{hadrons}$                   |
| 102 ± 36                                                                                                                                      |      | <sup>13</sup> MANE         | 82   | DM1 $e^+ e^- \rightarrow K_S^0 K \pi$                      |

<sup>1</sup> Seen in  $\psi(2S)$  decay with branching ratio  $\psi(2S) \rightarrow X \eta \rightarrow K^+ K^- \eta = (12.0 \pm 1.3^{+6.5}_{-6.9}) \times 10^{-6}$ .

<sup>2</sup> From a fit using a vector meson dominance model with contribution from  $\rho(770)$ ,  $\omega(782)$ ,  $\phi(1020)$ ,  $\omega(1420)$ ,  $\rho(1450)$ .

<sup>3</sup> From a fit with coherent interference of the  $\phi(1680)$  with a non-resonant contribution.

<sup>4</sup> Assuming the  $K \bar{K}^*(892) + \text{c.c.}$  dynamics. Systematic uncertainties not estimated.

<sup>5</sup> Using a vector meson dominance model with contribution from  $\phi(1020)$ ,  $\phi(1680)$ , and higher mass excitations of  $\rho(770)$  and  $\omega(782)$ .

<sup>6</sup> Using events with  $\pi\pi$  invariant mass less than 0.85 GeV.

<sup>7</sup> From a fit with two incoherent Breit-Wigners.

<sup>8</sup> From the simultaneous fit to the  $K \bar{K}^*(892) + \text{c.c.}$  and  $\phi\eta$  data from AUBERT 08S using the results of AUBERT 07AK.

<sup>9</sup> From the combined fit of AKHMETSHIN 03 and MANE 81 also including  $\rho$ ,  $\omega$ , and  $\phi$ . Neither isospin nor flavor structure known.

<sup>10</sup> Using BISELLO 88B and MANE 82 data.

NODE=M067W1;LINKAGE=E

NODE=M067W1;LINKAGE=F

NODE=M067W1;LINKAGE=D

NODE=M067W1;LINKAGE=C

NODE=M067W1;LINKAGE=B

NODE=M067W1;LINKAGE=A

NODE=M067W1;LINKAGE=SH

NODE=M067W1;LINKAGE=AU

NODE=M067W;LINKAGE=HK

NODE=M067W;LINKAGE=A

<sup>11</sup> From global fit including  $\rho$ ,  $\omega$ ,  $\phi$  and  $\rho(1700)$

<sup>12</sup> From global fit of  $\rho$ ,  $\omega$ ,  $\phi$  and their radial excitations to channels  $\omega\pi^+\pi^-$ ,  $K^+K^-$ ,  $K_S^0 K_L^0$ ,  $K_S^0 K^\pm \pi^\mp$ . Assume mass 1570 MeV and width 510 MeV for  $\rho$  radial excitations, mass 1570 and width 500 MeV for  $\omega$  radial excitation.

<sup>13</sup> Fit to one channel only, neglecting interference with  $\omega$ ,  $\rho(1700)$ .

NODE=M067W;LINKAGE=E

NODE=M067W;LINKAGE=C

NODE=M067W;LINKAGE=D

NODE=M067W2  
NODE=M067W2

## PHOTOPRODUCTION

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |                       |     |      |        |                                    |
|--------|-----------------------|-----|------|--------|------------------------------------|
| 122±63 | <sup>1</sup> LINK     | 02K | FOCS | 20-160 | $\gamma p \rightarrow K^+ K^- p$   |
| 121±47 | <sup>1</sup> BUSENITZ | 89  | TPS  |        | $\gamma p \rightarrow K^+ K^- X$   |
| 80±40  | <sup>1</sup> ATKINSON | 85C | OMEG | 20-70  | $\gamma p \rightarrow K \bar{K} X$ |
| 100±40 | <sup>1</sup> ASTON    | 81F | OMEG | 25-70  | $\gamma p \rightarrow K^+ K^- X$   |

<sup>1</sup> We list here a state decaying into  $K^+ K^-$  possibly different from  $\phi(1680)$ .

NODE=M067W2;LINKAGE=LK

## $p\bar{p}$ ANNIHILATION

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |                     |    |      |     |                                       |
|--------|---------------------|----|------|-----|---------------------------------------|
| 143±24 | <sup>1</sup> AMSLER | 06 | CBAR | 0.9 | $\bar{p} p \rightarrow K^+ K^- \pi^0$ |
|--------|---------------------|----|------|-----|---------------------------------------|

<sup>1</sup> Could also be  $\rho(1700)$ .

NODE=M067W3  
NODE=M067W3

NODE=M067W3;LINKAGE=AM

## $\phi(1680)$ DECAY MODES

NODE=M067215;NODE=M067

| Mode                                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------------------|--------------------------------|
| $\Gamma_1$ $K \bar{K}^*(892) + \text{c.c.}$ | seen                           |
| $\Gamma_2$ $K_S^0 K \pi$                    | seen                           |
| $\Gamma_3$ $K \bar{K}$                      | seen                           |
| $\Gamma_4$ $K_L^0 K_S^0$                    |                                |
| $\Gamma_5$ $e^+ e^-$                        | seen                           |
| $\Gamma_6$ $\omega \pi \pi$                 | not seen                       |
| $\Gamma_7$ $\phi \pi \pi$                   |                                |
| $\Gamma_8$ $K^+ K^- \pi^+ \pi^-$            | seen                           |
| $\Gamma_9$ $\eta \phi$                      | seen                           |
| $\Gamma_{10}$ $K^+ K^- \eta$                |                                |
| $\Gamma_{11}$ $\eta \gamma$                 | seen                           |
| $\Gamma_{12}$ $K^+ K^- \pi^0$               |                                |

DESIG=4;OUR EST;→ UNCHECKED ←

DESIG=5;OUR EST;→ UNCHECKED ←

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=9

DESIG=6;OUR EST;→ UNCHECKED ←

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=11

DESIG=12;OUR EVAL;→ UNCHECKED ←

DESIG=10

DESIG=14

DESIG=13

DESIG=2

## $\phi(1680) \Gamma(i) \Gamma(e^+ e^-) / \Gamma(\text{total})$

NODE=M067220

NODE=M067220

This combination of a partial width with the partial width into  $e^+ e^-$  and with the total width is obtained from the integrated cross section into channel (I) in  $e^+ e^-$  annihilation. We list only data that have not been used to determine the partial width  $\Gamma(I)$  or the branching ratio  $\Gamma(I)/\text{total}$ .

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT | $\Gamma_4 \Gamma_5 / \Gamma$ |
|------------|------|-------------|------|---------|------------------------------|
|------------|------|-------------|------|---------|------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |      |                   |     |      |                                          |
|--------------|------|-------------------|-----|------|------------------------------------------|
| 14.3±2.4±6.2 | 6.2k | <sup>1</sup> LEES | 14H | BABR | $e^+ e^- \rightarrow K_S^0 K_L^0 \gamma$ |
|--------------|------|-------------------|-----|------|------------------------------------------|

<sup>1</sup> Using a vector meson dominance model with contribution from  $\phi(1020)$ ,  $\phi(1680)$ , and higher mass excitations of  $\rho(770)$  and  $\omega(782)$ .

NODE=M067A00  
NODE=M067A00

NODE=M067A00;LINKAGE=A

| VALUE ( $10^{-2}$ keV) | DOCUMENT ID | TECN | COMMENT | $\Gamma_7 \Gamma_5 / \Gamma$ |
|------------------------|-------------|------|---------|------------------------------|
|------------------------|-------------|------|---------|------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |      |     |      |      |                                               |
|-------------|------|-----|------|------|-----------------------------------------------|
| 4.2±0.2±0.3 | LEES | 12F | BABR | 10.6 | $e^+ e^- \rightarrow \phi \pi^+ \pi^- \gamma$ |
|-------------|------|-----|------|------|-----------------------------------------------|

NODE=M067G02  
NODE=M067G02

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT | $\Gamma_9 \Gamma_5 / \Gamma$ |
|------------|------|-------------|------|---------|------------------------------|
|------------|------|-------------|------|---------|------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |    |                     |     |      |                                                 |
|----------|----|---------------------|-----|------|-------------------------------------------------|
| 94±13±15 | 3k | <sup>1</sup> IVANOV | 19A | CMD3 | $1.59-2.007$ $e^+ e^- \rightarrow K^+ K^- \eta$ |
|----------|----|---------------------|-----|------|-------------------------------------------------|

<sup>1</sup> From a fit with coherent interference of the  $\phi(1680)$  with a non-resonant contribution.

NODE=M067R00  
NODE=M067R00

NODE=M067R00;LINKAGE=A

$\phi(1680) \Gamma(i) \Gamma(e^+ e^-) / \Gamma^2(\text{total})$ 

This combination of a branching ratio into channel ( $i$ ) and branching ratio into  $e^+ e^-$  is directly measured and obtained from the cross section at the peak. We list only data that have not been used to determine the branching ratio into ( $i$ ) or  $e^+ e^-$ .

NODE=M067223

NODE=M067223

$$\Gamma(K_L^0 K_S^0) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_4 / \Gamma \times \Gamma_5 / \Gamma$$

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |     |                            |      |                                                     |
|-------------------|-----|----------------------------|------|-----------------------------------------------------|
| $0.131 \pm 0.059$ | 948 | <sup>1</sup> AKHMETSHIN 03 | CMD2 | $1.05\text{--}1.38 e^+ e^- \rightarrow K_L^0 K_S^0$ |
|-------------------|-----|----------------------------|------|-----------------------------------------------------|

<sup>1</sup> From the combined fit of AKHMETSHIN 03 and MANE 81 also including  $\rho$ ,  $\omega$ , and  $\phi$ . Neither isospin nor flavor structure known. Recalculated by us.

NODE=M067G5  
NODE=M067G5

NODE=M067G;LINKAGE=GK

$$\Gamma(K \bar{K}^*(892) + \text{c.c.}) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_1 / \Gamma \times \Gamma_5 / \Gamma$$

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |  |                         |      |                                                                  |
|--------------------------|--|-------------------------|------|------------------------------------------------------------------|
| $1.15 \pm 0.16 \pm 0.01$ |  | <sup>1</sup> AUBERT 08S | BABR | $10.6 e^+ e^- \rightarrow K \bar{K}^*(892) \gamma + \text{c.c.}$ |
|--------------------------|--|-------------------------|------|------------------------------------------------------------------|

|                 |     |                          |     |                                                             |
|-----------------|-----|--------------------------|-----|-------------------------------------------------------------|
| $3.29 \pm 1.57$ | 367 | <sup>2</sup> BISELLO 91C | DM2 | $1.35\text{--}2.40 e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp$ |
|-----------------|-----|--------------------------|-----|-------------------------------------------------------------|

<sup>1</sup> From the simultaneous fit to the  $K \bar{K}^*(892) + \text{c.c.}$  and  $\phi \eta$  data from AUBERT 08S using the results of AUBERT 07AK.

<sup>2</sup> Recalculated by us with the published value of  $B(K \bar{K}^*(892) + \text{c.c.}) \times \Gamma(e^+ e^-)$ .

NODE=M067G6  
NODE=M067G6

NODE=M067G6;LINKAGE=AU

NODE=M067G;LINKAGE=GL

$$\Gamma(\phi \pi \pi) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_7 / \Gamma \times \Gamma_5 / \Gamma$$

| VALUE (units $10^{-7}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |      |                      |      |                                                       |
|--------------------------|------|----------------------|------|-------------------------------------------------------|
| $1.86 \pm 0.14 \pm 0.21$ | 4.8k | <sup>1</sup> SHEN 09 | BELL | $10.6 e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$ |
|--------------------------|------|----------------------|------|-------------------------------------------------------|

<sup>1</sup> Multiplied by 3/2 to take into account the  $\phi \pi^0 \pi^0$  mode. Using  $B(\phi \rightarrow K^+ K^-) = (49.2 \pm 0.6)\%$ .

NODE=M067G01  
NODE=M067G01

NODE=M067G01;LINKAGE=SH

$$\Gamma(\eta \phi) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_9 / \Gamma \times \Gamma_5 / \Gamma$$

| VALUE (units $10^{-7}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                        |  |            |     |                                              |
|------------------------|--|------------|-----|----------------------------------------------|
| $5.64^{+1.74}_{-1.80}$ |  | ACHASOV 19 | SND | $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \eta$ |
|------------------------|--|------------|-----|----------------------------------------------|

|                       |    |                         |      |                                                       |
|-----------------------|----|-------------------------|------|-------------------------------------------------------|
| $5.3 \pm 0.6 \pm 0.9$ | 3k | <sup>1</sup> IVANOV 19A | CMD3 | $1.59\text{--}2.007 e^+ e^- \rightarrow K^+ K^- \eta$ |
|-----------------------|----|-------------------------|------|-------------------------------------------------------|

|                       |  |                         |      |                                             |
|-----------------------|--|-------------------------|------|---------------------------------------------|
| $4.3 \pm 1.0 \pm 0.9$ |  | <sup>2</sup> AUBERT 08S | BABR | $10.6 e^+ e^- \rightarrow \phi \eta \gamma$ |
|-----------------------|--|-------------------------|------|---------------------------------------------|

<sup>1</sup> From a fit with coherent interference of the  $\phi(1680)$  with a non-resonant contribution.

<sup>2</sup> From the simultaneous fit to the  $K \bar{K}^*(892) + \text{c.c.}$  and  $\phi \eta$  data from AUBERT 08S using the results of AUBERT 07AK.

NODE=M067G7  
NODE=M067G7

NODE=M067G7;LINKAGE=A

NODE=M067G7;LINKAGE=AU

 $\phi(1680)$  BRANCHING RATIOS

NODE=M067225

$$\Gamma(K \bar{K}^*(892) + \text{c.c.}) / \Gamma(K_S^0 K \pi) \quad \Gamma_1 / \Gamma_2$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|          |         |     |                                           |
|----------|---------|-----|-------------------------------------------|
| dominant | MANE 82 | DM1 | $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp$ |
|----------|---------|-----|-------------------------------------------|

NODE=M067R3  
NODE=M067R3

$$\Gamma(K \bar{K}) / \Gamma(K \bar{K}^*(892) + \text{c.c.}) \quad \Gamma_3 / \Gamma_1$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |         |     |           |
|-----------------|---------|-----|-----------|
| $0.07 \pm 0.01$ | BUON 82 | DM1 | $e^+ e^-$ |
|-----------------|---------|-----|-----------|

NODE=M067R2  
NODE=M067R2

$$\Gamma(\omega \pi \pi) / \Gamma(K \bar{K}^*(892) + \text{c.c.}) \quad \Gamma_6 / \Gamma_1$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|          |         |     |           |
|----------|---------|-----|-----------|
| $< 0.10$ | BUON 82 | DM1 | $e^+ e^-$ |
|----------|---------|-----|-----------|

NODE=M067R1  
NODE=M067R1

$$\Gamma(\eta \phi) / \Gamma_{\text{total}} \quad \Gamma_9 / \Gamma$$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

|      |    |                         |     |                                                     |
|------|----|-------------------------|-----|-----------------------------------------------------|
| seen | 35 | <sup>1</sup> ACHASOV 14 | SND | $1.15\text{--}2.00 e^+ e^- \rightarrow \eta \gamma$ |
|------|----|-------------------------|-----|-----------------------------------------------------|

<sup>1</sup> From a phenomenological model based on vector meson dominance with  $\rho(1450)$  and  $\phi(1680)$  masses and widths from the PDG 12.

NODE=M067R01  
NODE=M067R01

NODE=M067R01;LINKAGE=A

$\Gamma(\eta\phi)/\Gamma(K\bar{K}^*(892)+c.c.)$  $\Gamma_9/\Gamma_1$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

$\approx 0.37$  <sup>1</sup> AUBERT 08S BABR  $10.6 e^+ e^- \rightarrow \text{hadrons}$

<sup>1</sup> From the fit including data from AUBERT 07AK.

NODE=M067R5  
NODE=M067R5

NODE=M067R5;LINKAGE=AU

 $\Gamma(\eta\gamma)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**seen** 35 <sup>1</sup> ACHASOV 14 SND  $1.15\text{--}2.00 e^+ e^- \rightarrow \eta\gamma$

<sup>1</sup> From a phenomenological model based on vector meson dominance with  $\rho(1450)$  and  $\phi(1680)$  masses and widths from the PDG 12.

NODE=M067R02  
NODE=M067R02

NODE=M067R02;LINKAGE=A

### $\phi(1680)$ REFERENCES

NODE=M067

|            |      |                |                                                |                                 |
|------------|------|----------------|------------------------------------------------|---------------------------------|
| ABLIKIM    | 20F  | PR D101 032008 | M. Ablikim <i>et al.</i>                       | (BESIII Collab.)                |
| ACHASOV    | 20C  | EPJ C80 1139   | M.N. Achasov <i>et al.</i>                     | (SND Collab.)                   |
| ACHASOV    | 19   | PR D99 112004  | M.N. Achasov <i>et al.</i>                     | (SND Collab.)                   |
| IVANOV     | 19A  | PL B798 134946 | V.L. Ivanov <i>et al.</i>                      | (CMD-3 Collab.)                 |
| ACHASOV    | 18A  | PR D97 032011  | M.N. Achasov <i>et al.</i>                     | (SND Collab.)                   |
| ACHASOV    | 14   | PR D90 032002  | M.N. Achasov <i>et al.</i>                     | (SND Collab.)                   |
| LEES       | 14H  | PR D89 092002  | J.P. Lees <i>et al.</i>                        | (BABAR Collab.)                 |
| LEES       | 12F  | PR D86 012008  | J.P. Lees <i>et al.</i>                        | (BABAR Collab.)                 |
| PDG        | 12   | PR D86 010001  | J. Beringer <i>et al.</i>                      | (PDG Collab.)                   |
| SHEN       | 09   | PR D80 031101  | C.P. Shen <i>et al.</i>                        | (BELLE Collab.)                 |
| AUBERT     | 08S  | PR D77 092002  | B. Aubert <i>et al.</i>                        | (BABAR Collab.)                 |
| AUBERT     | 07AK | PR D76 012008  | B. Aubert <i>et al.</i>                        | (BABAR Collab.)                 |
| AMSLER     | 06   | PL B639 165    | C. Amsler <i>et al.</i>                        | (Crystal Barrel Collab.)        |
| AKHMETSHIN | 03   | PL B551 27     | R.R. Akhmetshin <i>et al.</i>                  | (Novosibirsk CMD-2 Collab.)     |
| Also       |      | PAN 65 1222    | E.V. Anashkin, V.M. Aulchenko, R.R. Akhmetshin |                                 |
| LINK       | 02K  | PL B545 50     | J.M. Link <i>et al.</i>                        | (FNAL FOCUS Collab.)            |
| ACHASOV    | 98H  | PR D57 4334    | N.N. Achasov, A.A. Kozhevnikov                 |                                 |
| CLEGG      | 94   | ZPHY C62 455   | A.B. Clegg, A. Donnachie                       | (LANC, MCHS)                    |
| ANTONELLI  | 92   | ZPHY C56 15    | A. Antonelli <i>et al.</i>                     | (DM2 Collab.)                   |
| BISELLO    | 91C  | ZPHY C52 227   | D. Bisello <i>et al.</i>                       | (DM2 Collab.)                   |
| DOLINSKY   | 91   | PRPL 202 99    | S.I. Dolinsky <i>et al.</i>                    | (NOVO)                          |
| BUSENITZ   | 89   | PR D40 1       | J.K. Busenitz <i>et al.</i>                    | (ILL, FNAL)                     |
| BISELLO    | 88B  | ZPHY C39 13    | D. Bisello <i>et al.</i>                       | (PADO, CLER, FRAS+)             |
| BARKOV     | 87   | JETPL 46 164   | L.M. Barkov <i>et al.</i>                      | (NOVO)                          |
| ATKINSON   | 85C  | ZPHY C27 233   | M. Atkinson <i>et al.</i>                      | (BONN, CERN, GLAS+)             |
| BUON       | 82   | PL 118B 221    | J. Buon <i>et al.</i>                          | (LALO, MONP)                    |
| MANE       | 82   | PL 112B 178    | F. Mane <i>et al.</i>                          | (LALO)                          |
| ASTON      | 81F  | PL 104B 231    | D. Aston                                       | (BONN, CERN, EPOL, GLAS, LANC+) |
| IVANOV     | 81   | PL 107B 297    | P.M. Ivanov <i>et al.</i>                      | (NOVO)                          |
| MANE       | 81   | PL 99B 261     | F. Mane <i>et al.</i>                          | (ORSAY)                         |

REFID=60256  
REFID=60935  
REFID=59887  
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REFID=41867  
REFID=41369  
REFID=40927  
REFID=40581  
REFID=40280

REFID=21596  
REFID=21494  
REFID=21590  
REFID=21585  
REFID=20553  
REFID=21588

$\rho_3(1690)$ 

$$I^G(J^{PC}) = 1^+(3^{--})$$

NODE=M015

 **$\rho_3(1690)$  MASS**

NODE=M015205

VALUE (MeV)

DOCUMENT ID

**1688.8±2.1 OUR AVERAGE**

Includes data from the 5 datablocks that follow this one.

NODE=M015M

**2 $\pi$  MODE**

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

CHG

COMMENT

The data in this block is included in the average printed for a previous datablock.

NODE=M015M1

NODE=M015M1

**1686± 4 OUR AVERAGE**

|                                                                               |     |                           |     |      |   |                                        |
|-------------------------------------------------------------------------------|-----|---------------------------|-----|------|---|----------------------------------------|
| 1677±14                                                                       |     | EVANGELIS...              | 81  | OMEG | — | 12 $\pi^- p \rightarrow 2\pi p$        |
| 1679±11                                                                       | 476 | BALTAY                    | 78B | HBC  | 0 | 15 $\pi^+ p \rightarrow \pi^+ \pi^- n$ |
| 1678±12                                                                       | 175 | <sup>1</sup> ANTIPOV      | 77  | CIBS | 0 | 25 $\pi^- p \rightarrow p 3\pi$        |
| 1690± 7                                                                       | 600 | <sup>1</sup> ENGLER       | 74  | DBC  | 0 | 6 $\pi^+ n \rightarrow \pi^+ \pi^- p$  |
| 1693± 8                                                                       |     | <sup>2</sup> GRAYER       | 74  | ASPK | 0 | 17 $\pi^- p \rightarrow \pi^+ \pi^- n$ |
| 1678±12                                                                       |     | MATTHEWS                  | 71C | DBC  | 0 | 7 $\pi^+ N$                            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                           |     |      |   |                                        |
| 1734±10                                                                       |     | <sup>3</sup> CORDEN       | 79  | OMEG |   | 12–15 $\pi^- p \rightarrow n 2\pi$     |
| 1692±12                                                                       |     | <sup>2,4</sup> ESTABROOKS | 75  | RVUE |   | 17 $\pi^- p \rightarrow \pi^+ \pi^- n$ |
| 1737±23                                                                       |     | ARMENISE                  | 70  | DBC  | 0 | 9 $\pi^+ N$                            |
| 1650±35                                                                       | 122 | BARTSCH                   | 70B | HBC  | + | 8 $\pi^+ p \rightarrow N 2\pi$         |
| 1687±21                                                                       |     | STUNTEBECK                | 70  | HDBC | 0 | 8 $\pi^- p, 5.4 \pi^+ d$               |
| 1683±13                                                                       |     | ARMENISE                  | 68  | DBC  | 0 | 5.1 $\pi^+ d$                          |
| 1670±30                                                                       |     | GOLDBERG                  | 65  | HBC  | 0 | 6 $\pi^+ d, 8 \pi^- p$                 |

<sup>1</sup> Mass errors enlarged by us to  $\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.<sup>2</sup> Uses same data as HYAMS 75.<sup>3</sup> From a phase shift solution containing a  $f_2'(1525)$  width two times larger than the  $K\bar{K}$  result.<sup>4</sup> From phase-shift analysis. Error takes account of spread of different phase-shift solutions.

NODE=M015M1;LINKAGE=E

NODE=M015M1;LINKAGE=G

NODE=M015M1;LINKAGE=M

NODE=M015M1;LINKAGE=I

 **$K\bar{K}$  AND  $K\bar{K}\pi$  MODES**

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

CHG

COMMENT

The data in this block is included in the average printed for a previous datablock.

NODE=M015M2

NODE=M015M2

**1696± 4 OUR AVERAGE**

|         |    |                       |     |      |   |                                      |
|---------|----|-----------------------|-----|------|---|--------------------------------------|
| 1699± 5 |    | ALPER                 | 80  | CNTR | 0 | 62 $\pi^- p \rightarrow K^+ K^- n$   |
| 1698±12 | 6k | <sup>5,6</sup> MARTIN | 78D | SPEC |   | 10 $\pi p \rightarrow K_S^0 K^- p$   |
| 1692± 6 |    | BLUM                  | 75  | ASPK | 0 | 18.4 $\pi^- p \rightarrow n K^+ K^-$ |
| 1690±16 |    | ADERHOLZ              | 69  | HBC  | + | 8 $\pi^+ p \rightarrow K\bar{K}\pi$  |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |  |                    |    |      |  |                                    |
|---------|--|--------------------|----|------|--|------------------------------------|
| 1694± 8 |  | <sup>7</sup> COSTA | 80 | OMEG |  | 10 $\pi^- p \rightarrow K^+ K^- n$ |
|---------|--|--------------------|----|------|--|------------------------------------|

<sup>5</sup> From a fit to  $J^P = 3^-$  partial wave.<sup>6</sup> Systematic error on mass scale subtracted.<sup>7</sup> They cannot distinguish between  $\rho_3(1690)$  and  $\omega_3(1670)$ .

NODE=M015M2;LINKAGE=P

NODE=M015M2;LINKAGE=S

NODE=M015M2;LINKAGE=L

**(4 $\pi$ ) $^\pm$  MODE**

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

CHG

COMMENT

The data in this block is included in the average printed for a previous datablock.

NODE=M015M3

NODE=M015M3

**1686± 5 OUR AVERAGE** Error includes scale factor of 1.1.

|         |     |                           |     |      |   |                                        |
|---------|-----|---------------------------|-----|------|---|----------------------------------------|
| 1694± 6 |     | <sup>8</sup> EVANGELIS... | 81  | OMEG | — | 12 $\pi^- p \rightarrow p 4\pi$        |
| 1665±15 | 177 | BALTAY                    | 78B | HBC  | + | 15 $\pi^+ p \rightarrow p 4\pi$        |
| 1670±10 |     | THOMPSON                  | 74  | HBC  | + | 13 $\pi^+ p$                           |
| 1687±20 |     | CASON                     | 73  | HBC  | — | 8,18.5 $\pi^- p$                       |
| 1685±14 |     | <sup>9</sup> CASON        | 73  | HBC  | — | 8,18.5 $\pi^- p$                       |
| 1680±40 | 144 | BARTSCH                   | 70B | HBC  | + | 8 $\pi^+ p \rightarrow N 4\pi$         |
| 1689±20 | 102 | <sup>9</sup> BARTSCH      | 70B | HBC  | + | 8 $\pi^+ p \rightarrow N 2p$           |
| 1705±21 |     | CASO                      | 70  | HBC  | — | 11.2 $\pi^- p \rightarrow n \rho 2\pi$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |    |                            |    |      |   |                                  |
|---------|----|----------------------------|----|------|---|----------------------------------|
| 1718±10 |    | <sup>10</sup> EVANGELIS... | 81 | OMEG | — | 12 $\pi^- p \rightarrow p 4\pi$  |
| 1673± 9 |    | <sup>11</sup> EVANGELIS... | 81 | OMEG | — | 12 $\pi^- p \rightarrow p 4\pi$  |
| 1733± 9 | 66 | <sup>9</sup> KLIGER        | 74 | HBC  | — | 4.5 $\pi^- p \rightarrow p 4\pi$ |
| 1630±15 |    | HOLMES                     | 72 | HBC  | + | 10–12 $K^+ p$                    |
| 1720±15 |    | BALTAY                     | 68 | HBC  | + | 7, 8.5 $\pi^+ p$                 |

OCCUR=2

OCCUR=3

OCCUR=2

OCCUR=3

<sup>8</sup> From  $\rho^- \rho^0$  mode, not independent of the other two EVANGELISTA 81 entries.

<sup>9</sup> From  $\rho^\pm \rho^0$  mode.

<sup>10</sup> From  $a_2(1320)^- \pi^0$  mode, not independent of the other two EVANGELISTA 81 entries.

<sup>11</sup> From  $a_2(1320)^0 \pi^-$  mode, not independent of the other two EVANGELISTA 81 entries.

### $\omega\pi$ MODE

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

### 1681 ± 7 OUR AVERAGE

|                                                                               |                    |    |      |                                         |
|-------------------------------------------------------------------------------|--------------------|----|------|-----------------------------------------|
| 1670 ± 25                                                                     | <sup>12</sup> ALDE | 95 | GAM2 | 38 $\pi^- p \rightarrow \omega \pi^0 n$ |
| 1690 ± 15                                                                     | EVANGELIS...       | 81 | OMEG | 12 $\pi^- p \rightarrow \omega \pi p$   |
| 1666 ± 14                                                                     | GESSAROLI          | 77 | HBC  | 11 $\pi^- p \rightarrow \omega \pi p$   |
| 1686 ± 9                                                                      | THOMPSON           | 74 | HBC  | 13 $\pi^+ p$                            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |    |      |                                         |
| 1654 ± 24                                                                     | BARNHAM            | 70 | HBC  | 10 $K^+ p \rightarrow \omega \pi X$     |

<sup>12</sup> Supersedes ALDE 92C.

### $\eta\pi^+\pi^-$ MODE

(For difficulties with MMS experiments, see the  $a_2(1320)$  mini-review in the 1973 edition.)

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

### 1682 ± 12 OUR AVERAGE

|                                                                               |                          |    |      |                                                 |
|-------------------------------------------------------------------------------|--------------------------|----|------|-------------------------------------------------|
| 1685 ± 10 ± 20                                                                | AMELIN                   | 00 | VES  | 37 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$     |
| 1680 ± 15                                                                     | FUKUI                    | 88 | SPEC | 0 8.95 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |    |      |                                                 |
| 1700 ± 47                                                                     | <sup>13</sup> ANDERSON   | 69 | MMS  | 16 $\pi^- p$ backward                           |
| 1632 ± 15                                                                     | <sup>13,14</sup> FOCACCI | 66 | MMS  | 7-12 $\pi^- p \rightarrow pMM$                  |
| 1700 ± 15                                                                     | <sup>13,14</sup> FOCACCI | 66 | MMS  | 7-12 $\pi^- p \rightarrow pMM$                  |
| 1748 ± 15                                                                     | <sup>13,14</sup> FOCACCI | 66 | MMS  | 7-12 $\pi^- p \rightarrow pMM$                  |

<sup>13</sup> Seen in 2.5-3 GeV/c  $\bar{p}p$ .  $2\pi^+ 2\pi^-$ , with 0, 1, 2  $\pi^+ \pi^-$  pairs in  $\rho$  band not seen by OREN 74 (2.3 GeV/c  $\bar{p}p$ ) with more statistics. (Jan. 1976)

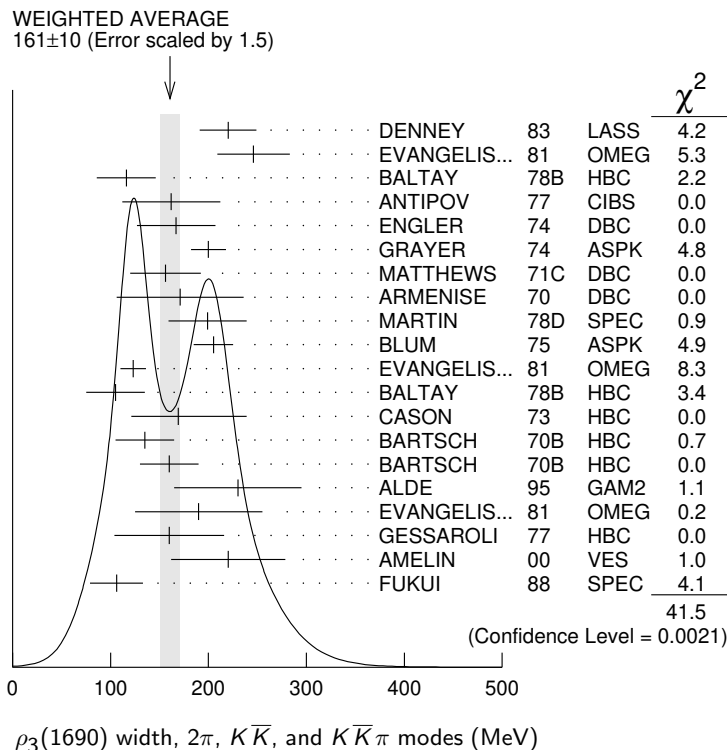
<sup>14</sup> Not seen by BOWEN 72.

### $\rho_3(1690)$ WIDTH

### $2\pi, K\bar{K},$ AND $K\bar{K}\pi$ MODES

| VALUE (MeV) | DOCUMENT ID |
|-------------|-------------|
|-------------|-------------|

**161 ± 10 OUR AVERAGE** Includes data from the 5 datablocks that follow this one. Error includes scale factor of 1.5. See the ideogram below.



NODE=M015M3;LINKAGE=A  
NODE=M015M3;LINKAGE=F  
NODE=M015M3;LINKAGE=B  
NODE=M015M3;LINKAGE=C

NODE=M015M5  
NODE=M015M5

NODE=M015M5;LINKAGE=A

NODE=M015M6  
NODE=M015M6

NODE=M015M6

OCCUR=2  
OCCUR=3

NODE=M015M6;LINKAGE=R

NODE=M015M6;LINKAGE=N

NODE=M015210

NODE=M015W  
NODE=M015W



**2 $\pi$  MODE**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

NODE=M015W1  
NODE=M015W1

**186 $\pm$ 14 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

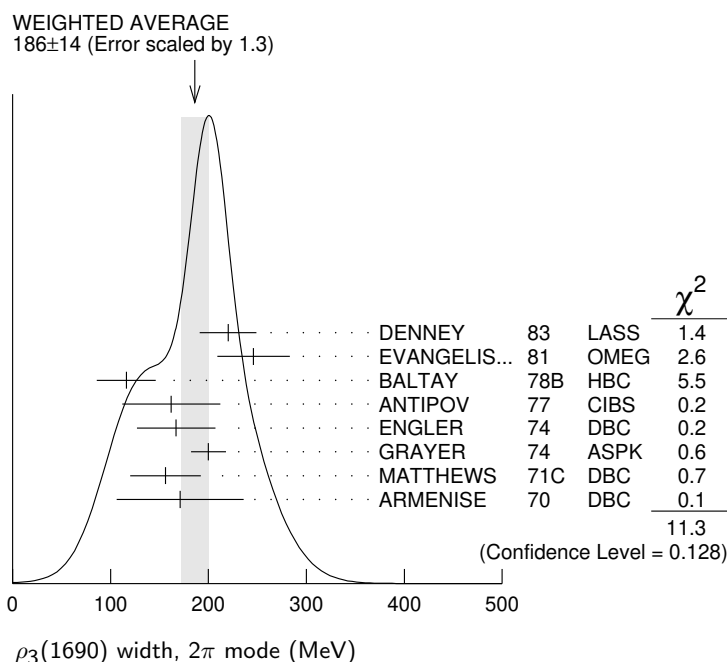
|              |     |              |     |      |                                          |
|--------------|-----|--------------|-----|------|------------------------------------------|
| 220 $\pm$ 29 |     | DENNEY       | 83  | LASS | 10 $\pi^+ N$                             |
| 246 $\pm$ 37 |     | EVANGELIS... | 81  | OMEG | 12 $\pi^- p \rightarrow 2\pi p$          |
| 116 $\pm$ 30 | 476 | BALTAY       | 78B | HBC  | 0 15 $\pi^+ p \rightarrow \pi^+ \pi^- n$ |
| 162 $\pm$ 50 | 175 | 15 ANTIPOV   | 77  | CIBS | 0 25 $\pi^- p \rightarrow p3\pi$         |
| 167 $\pm$ 40 | 600 | ENGLER       | 74  | DBC  | 0 6 $\pi^+ n \rightarrow \pi^+ \pi^- p$  |
| 200 $\pm$ 18 |     | 16 GRAYER    | 74  | ASPK | 0 17 $\pi^- p \rightarrow \pi^+ \pi^- n$ |
| 156 $\pm$ 36 |     | MATTHEWS     | 71C | DBC  | 0 7 $\pi^+ N$                            |
| 171 $\pm$ 65 |     | ARMENISE     | 70  | DBC  | 0 9 $\pi^+ d$                            |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                     |     |                  |     |      |                                        |
|---------------------|-----|------------------|-----|------|----------------------------------------|
| 322 $\pm$ 35        |     | 17 CORDEN        | 79  | OMEG | 12-15 $\pi^- p \rightarrow n2\pi$      |
| 240 $\pm$ 30        |     | 16,18 ESTABROOKS | 75  | RVUE | 17 $\pi^- p \rightarrow \pi^+ \pi^- n$ |
| 180 $\pm$ 30        | 122 | BARTSCH          | 70B | HBC  | + 8 $\pi^+ p \rightarrow N2\pi$        |
| 267 $\pm$ 72<br>-46 |     | STUNTEBECK       | 70  | HDBC | 0 8 $\pi^- p, 5.4 \pi^+ d$             |
| 188 $\pm$ 49        |     | ARMENISE         | 68  | DBC  | 0 5.1 $\pi^+ d$                        |
| 180 $\pm$ 40        |     | GOLDBERG         | 65  | HBC  | 0 6 $\pi^+ d, 8 \pi^- p$               |

<sup>15</sup> Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.<sup>16</sup> Uses same data as HYAMS 75 and BECKER 79.<sup>17</sup> From a phase shift solution containing a  $f'_2(1525)$  width two times larger than the  $K\bar{K}$  result.<sup>18</sup> From phase-shift analysis. Error takes account of spread of different phase-shift solutions.

NODE=M015W1;LINKAGE=T  
NODE=M015W1;LINKAGE=G  
NODE=M015W1;LINKAGE=M  
NODE=M015W1;LINKAGE=L

 **$K\bar{K}$  AND  $K\bar{K}\pi$  MODES**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

NODE=M015W2  
NODE=M015W2

**204 $\pm$ 18 OUR AVERAGE**

|              |      |           |     |      |                                       |
|--------------|------|-----------|-----|------|---------------------------------------|
| 199 $\pm$ 40 | 6000 | 19 MARTIN | 78D | SPEC | 10 $\pi p \rightarrow K_S^0 K^- p$    |
| 205 $\pm$ 20 |      | BLUM      | 75  | ASPK | 0 18.4 $\pi^- p \rightarrow nK^+ K^-$ |
| 219 $\pm$ 4  |      | ALPER     | 80  | CNTR | 0 62 $\pi^- p \rightarrow K^+ K^- n$  |
| 186 $\pm$ 11 |      | 20 COSTA  | 80  | OMEG | 10 $\pi^- p \rightarrow K^+ K^- n$    |
| 112 $\pm$ 60 |      | ADERHOLZ  | 69  | HBC  | + 8 $\pi^+ p \rightarrow K\bar{K}\pi$ |

<sup>19</sup> From a fit to  $J^P = 3^-$  partial wave.<sup>20</sup> They cannot distinguish between  $\rho_3(1690)$  and  $\omega_3(1670)$ .

NODE=M015W2;LINKAGE=P  
NODE=M015W2;LINKAGE=L

**(4 $\pi$ ) $^\pm$  MODE**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

NODE=M015W3  
 NODE=M015W3

**129 $\pm$ 10 OUR AVERAGE**

|                                                                               |     |    |              |     |      |   |                                 |         |
|-------------------------------------------------------------------------------|-----|----|--------------|-----|------|---|---------------------------------|---------|
| 123 $\pm$ 13                                                                  |     | 21 | EVANGELIS... | 81  | OMEG | — | 12 $\pi^- p \rightarrow p4\pi$  |         |
| 105 $\pm$ 30                                                                  | 177 |    | BALTAY       | 78B | HBC  | + | 15 $\pi^+ p \rightarrow p4\pi$  |         |
| 169 $^{+70}_{-48}$                                                            |     |    | CASON        | 73  | HBC  | — | 8,18.5 $\pi^- p$                |         |
| 135 $\pm$ 30                                                                  | 144 |    | BARTSCH      | 70B | HBC  | + | 8 $\pi^+ p \rightarrow N4\pi$   |         |
| 160 $\pm$ 30                                                                  | 102 |    | BARTSCH      | 70B | HBC  | + | 8 $\pi^+ p \rightarrow N2\rho$  |         |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |    |              |     |      |   |                                 |         |
| 230 $\pm$ 28                                                                  |     | 22 | EVANGELIS... | 81  | OMEG | — | 12 $\pi^- p \rightarrow p4\pi$  | OCCUR=2 |
| 184 $\pm$ 33                                                                  |     | 23 | EVANGELIS... | 81  | OMEG | — | 12 $\pi^- p \rightarrow p4\pi$  | OCCUR=3 |
| 150                                                                           | 66  | 24 | KLIGER       | 74  | HBC  | — | 4.5 $\pi^- p \rightarrow p4\pi$ |         |
| 106 $\pm$ 25                                                                  |     |    | THOMPSON     | 74  | HBC  | + | 13 $\pi^+ p$                    |         |
| 125 $^{+83}_{-35}$                                                            |     | 24 | CASON        | 73  | HBC  | — | 8,18.5 $\pi^- p$                | OCCUR=2 |
| 130 $\pm$ 30                                                                  |     |    | HOLMES       | 72  | HBC  | + | 10–12 $K^+ p$                   |         |
| 180 $\pm$ 30                                                                  | 90  | 24 | BARTSCH      | 70B | HBC  | + | 8 $\pi^+ p \rightarrow Na_2\pi$ | OCCUR=2 |
| 100 $\pm$ 35                                                                  |     |    | BALTAY       | 68  | HBC  | + | 7, 8.5 $\pi^+ p$                |         |

21 From  $\rho^- \rho^0$  mode, not independent of the other two EVANGELISTA 81 entries.22 From  $a_2(1320)^- \pi^0$  mode, not independent of the other two EVANGELISTA 81 entries.23 From  $a_2(1320)^0 \pi^-$  mode, not independent of the other two EVANGELISTA 81 entries.24 From  $\rho^\pm \rho^0$  mode.

OCCUR=3

OCCUR=2

OCCUR=3

OCCUR=2

OCCUR=2

NODE=M015W3;LINKAGE=A

NODE=M015W3;LINKAGE=B

NODE=M015W3;LINKAGE=C

NODE=M015W3;LINKAGE=F

 **$\omega\pi$  MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

NODE=M015W5  
 NODE=M015W5

**190 $\pm$ 40 OUR AVERAGE**

|                                                                               |  |    |              |    |      |   |                                        |  |
|-------------------------------------------------------------------------------|--|----|--------------|----|------|---|----------------------------------------|--|
| 230 $\pm$ 65                                                                  |  | 25 | ALDE         | 95 | GAM2 |   | 38 $\pi^- p \rightarrow \omega\pi^0 n$ |  |
| 190 $\pm$ 65                                                                  |  |    | EVANGELIS... | 81 | OMEG | — | 12 $\pi^- p \rightarrow \omega\pi p$   |  |
| 160 $\pm$ 56                                                                  |  |    | GESSAROLI    | 77 | HBC  |   | 11 $\pi^- p \rightarrow \omega\pi p$   |  |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |  |    |              |    |      |   |                                        |  |
| 89 $\pm$ 25                                                                   |  |    | THOMPSON     | 74 | HBC  | + | 13 $\pi^+ p$                           |  |
| 130 $^{+73}_{-43}$                                                            |  |    | BARNHAM      | 70 | HBC  | + | 10 $K^+ p \rightarrow \omega\pi X$     |  |

25 Supersedes ALDE 92C.

NODE=M015W5;LINKAGE=A

 **$\eta\pi^+\pi^-$  MODE**(For difficulties with MMS experiments, see the  $a_2(1320)$  mini-review in the 1973 edition.)

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

NODE=M015W6

NODE=M015W6

NODE=M015W6

**126 $\pm$ 40 OUR AVERAGE** Error includes scale factor of 1.8.

|                                                                               |        |          |      |     |                                             |                                |
|-------------------------------------------------------------------------------|--------|----------|------|-----|---------------------------------------------|--------------------------------|
| 220 $\pm$ 30 $\pm$ 50                                                         | AMELIN | 00       | VES  |     | 37 $\pi^- p \rightarrow \eta\pi^+\pi^- n$   |                                |
| 106 $\pm$ 27                                                                  | FUKUI  | 88       | SPEC | 0   | 8.95 $\pi^- p \rightarrow \eta\pi^+\pi^- n$ |                                |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |        |          |      |     |                                             |                                |
| 195                                                                           | 26     | ANDERSON | 69   | MMS | —                                           | 16 $\pi^- p$ backward          |
| < 21                                                                          | 26,27  | FOCACCI  | 66   | MMS | —                                           | 7–12 $\pi^- p \rightarrow pMM$ |
| < 30                                                                          | 26,27  | FOCACCI  | 66   | MMS | —                                           | 7–12 $\pi^- p \rightarrow pMM$ |
| < 38                                                                          | 26,27  | FOCACCI  | 66   | MMS | —                                           | 7–12 $\pi^- p \rightarrow pMM$ |

OCCUR=2

OCCUR=3

26 Seen in 2.5–3 GeV/c  $\bar{p}p$ .  $2\pi^+2\pi^-$ , with 0, 1, 2  $\pi^+\pi^-$  pairs in  $\rho^0$  band not seen by OREN 74 (2.3 GeV/c  $\bar{p}p$ ) with more statistics. (Jan. 1979)

27 Not seen by BOWEN 72.

NODE=M015W6;LINKAGE=R

NODE=M015W6;LINKAGE=N

**$\rho_3(1690)$  DECAY MODES**

NODE=M015215;NODE=M015

|               | Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) | Scale factor |
|---------------|-------------------------------|--------------------------------|--------------|
| $\Gamma_1$    | $4\pi$                        | (71.1 $\pm$ 1.9 ) %            |              |
| $\Gamma_2$    | $\pi^\pm \pi^+ \pi^- \pi^0$   | (67 $\pm$ 22 ) %               |              |
| $\Gamma_3$    | $\omega \pi$                  | (16 $\pm$ 6 ) %                |              |
| $\Gamma_4$    | $\pi \pi$                     | (23.6 $\pm$ 1.3 ) %            |              |
| $\Gamma_5$    | $K \bar{K} \pi$               | ( 3.8 $\pm$ 1.2 ) %            |              |
| $\Gamma_6$    | $K \bar{K}$                   | ( 1.58 $\pm$ 0.26 ) %          | 1.2          |
| $\Gamma_7$    | $\eta \pi^+ \pi^-$            | seen                           |              |
| $\Gamma_8$    | $\rho(770) \eta$              | seen                           |              |
| $\Gamma_9$    | $\pi \pi \rho$                | seen                           |              |
| $\Gamma_{10}$ | $a_2(1320) \pi$               | seen                           |              |
| $\Gamma_{11}$ | $\rho \rho$                   | seen                           |              |
| $\Gamma_{12}$ | $\phi \pi$                    |                                |              |
| $\Gamma_{13}$ | $\eta \pi$                    |                                |              |
| $\Gamma_{14}$ | $\pi^\pm 2\pi^+ 2\pi^- \pi^0$ |                                |              |

DESIG=2  
DESIG=11  
DESIG=7  
DESIG=1  
DESIG=3  
DESIG=4  
DESIG=13  
DESIG=14;OUR EST;→ UNCHECKED ←  
DESIG=5;OUR EST;→ UNCHECKED ←  
DESIG=6;OUR EST;→ UNCHECKED ←  
DESIG=8;OUR EST;→ UNCHECKED ←  
DESIG=9  
DESIG=10  
DESIG=12

**CONSTRAINED FIT INFORMATION**

An overall fit to 5 branching ratios uses 10 measurements and one constraint to determine 4 parameters. The overall fit has a  $\chi^2 = 14.7$  for 7 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|       |       |       |       |
|-------|-------|-------|-------|
| $x_4$ | -77   |       |       |
| $x_5$ | -74   | 17    |       |
| $x_6$ | -15   | 2     | 0     |
|       | $x_1$ | $x_4$ | $x_5$ |

 **$\rho_3(1690)$  BRANCHING RATIOS**

NODE=M015220

| $\Gamma(\pi\pi)/\Gamma_{\text{total}}$                                        |                          |      |      |         |                                        | $\Gamma_4/\Gamma$ |
|-------------------------------------------------------------------------------|--------------------------|------|------|---------|----------------------------------------|-------------------|
| VALUE                                                                         | DOCUMENT ID              | TECN | CHG  | COMMENT |                                        |                   |
| <b>0.236<math>\pm</math>0.013 OUR FIT</b>                                     |                          |      |      |         |                                        |                   |
| <b>0.243<math>\pm</math>0.013 OUR AVERAGE</b>                                 |                          |      |      |         |                                        |                   |
| 0.259 $^{+0.018}_{-0.019}$                                                    | BECKER                   | 79   | ASPK | 0       | 17 $\pi^- p$ polarized                 |                   |
| 0.23 $\pm$ 0.02                                                               | CORDEN                   | 79   | OMEG |         | 12-15 $\pi^- p \rightarrow n 2\pi$     |                   |
| 0.22 $\pm$ 0.04                                                               | <sup>28</sup> MATTHEWS   | 71c  | HDBC | 0       | 7 $\pi^+ n \rightarrow \pi^- p$        |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |      |         |                                        |                   |
| 0.245 $\pm$ 0.006                                                             | <sup>29</sup> ESTABROOKS | 75   | RVUE |         | 17 $\pi^- p \rightarrow \pi^+ \pi^- n$ |                   |
| <sup>28</sup> One-pion-exchange model used in this estimation.                |                          |      |      |         |                                        |                   |
| <sup>29</sup> From phase-shift analysis of HYAMS 75 data.                     |                          |      |      |         |                                        |                   |

NODE=M015R1  
NODE=M015R1

NODE=M015R1;LINKAGE=P  
NODE=M015R1;LINKAGE=G

| $\Gamma(\pi\pi)/\Gamma(\pi^\pm \pi^+ \pi^- \pi^0)$                            |             |      |     |         |                  | $\Gamma_4/\Gamma_2$ |
|-------------------------------------------------------------------------------|-------------|------|-----|---------|------------------|---------------------|
| VALUE                                                                         | DOCUMENT ID | TECN | CHG | COMMENT |                  |                     |
| <b>0.35<math>\pm</math>0.11</b>                                               | CASON       | 73   | HBC | -       | 8,18.5 $\pi^- p$ |                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |     |         |                  |                     |
| <0.2                                                                          | HOLMES      | 72   | HBC | +       | 10-12 $K^+ p$    |                     |
| <0.12                                                                         | BALLAM      | 71B  | HBC | -       | 16 $\pi^- p$     |                     |

NODE=M015R2  
NODE=M015R2

| $\Gamma(\pi\pi)/\Gamma(4\pi)$             |                                     |      |     |         |                                 | $\Gamma_4/\Gamma_1$ |
|-------------------------------------------|-------------------------------------|------|-----|---------|---------------------------------|---------------------|
| VALUE                                     | DOCUMENT ID                         | TECN | CHG | COMMENT |                                 |                     |
| <b>0.332<math>\pm</math>0.026 OUR FIT</b> | Error includes scale factor of 1.1. |      |     |         |                                 |                     |
| <b>0.30 <math>\pm</math> 0.10</b>         | BALTAY                              | 78B  | HBC | 0       | 15 $\pi^+ p \rightarrow p 4\pi$ |                     |

NODE=M015R3  
NODE=M015R3

$$\Gamma(K\bar{K})/\Gamma(\pi\pi)$$

$$\Gamma_6/\Gamma_4$$

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

**0.067±0.011 OUR FIT** Error includes scale factor of 1.2.

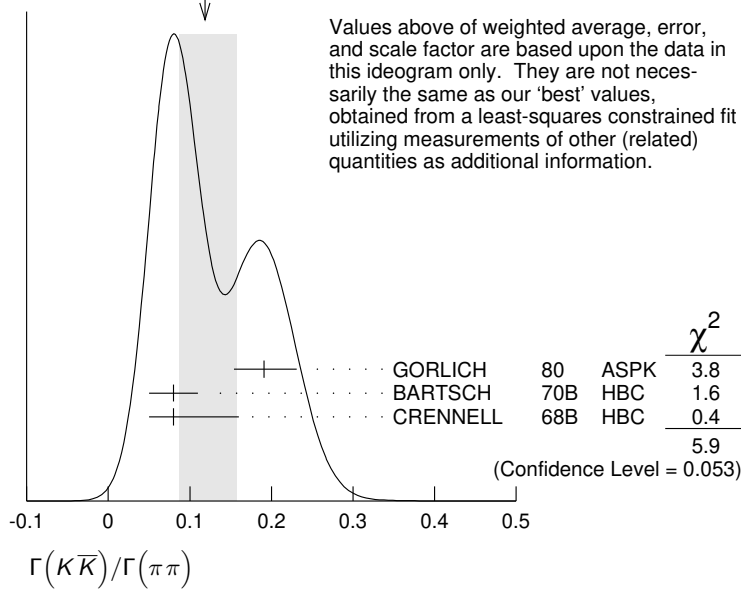
NODE=M015R4  
NODE=M015R4

**0.118<sup>+0.040</sup><sub>-0.032</sub> OUR AVERAGE** Error includes scale factor of 1.7. See the ideogram below.

|                                           |          |     |      |   |                           |
|-------------------------------------------|----------|-----|------|---|---------------------------|
| 0.191 <sup>+0.040</sup> <sub>-0.037</sub> | GORLICH  | 80  | ASPK | 0 | 17,18 $\pi^- p$ polarized |
| 0.08 ± 0.03                               | BARTSCH  | 70B | HBC  | + | 8 $\pi^+ p$               |
| 0.08 <sup>+0.08</sup> <sub>-0.03</sub>    | CRENNELL | 68B | HBC  |   | 6.0 $\pi^- p$             |

WEIGHTED AVERAGE

0.118+0.040-0.032 (Error scaled by 1.7)



$$\Gamma(K\bar{K}\pi)/\Gamma(\pi\pi)$$

$$\Gamma_5/\Gamma_4$$

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

**0.16±0.05 OUR FIT**

**0.16±0.05** <sup>30</sup> BARTSCH 70B HBC + 8  $\pi^+ p$

<sup>30</sup> Increased by us to correspond to  $B(\rho_3(1690) \rightarrow \pi\pi)=0.24$ .

NODE=M015R5  
NODE=M015R5

NODE=M015R5;LINKAGE=A

$$[\Gamma(\pi\pi\rho) + \Gamma(a_2(1320)\pi) + \Gamma(\rho\rho)]/\Gamma(\pi^\pm\pi^+\pi^-\pi^0) \quad (\Gamma_9+\Gamma_{10}+\Gamma_{11})/\Gamma_2$$

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

**0.94±0.09 OUR AVERAGE**

|                   |         |     |     |   |                                |
|-------------------|---------|-----|-----|---|--------------------------------|
| 0.96±0.21         | BALTAY  | 78B | HBC | + | 15 $\pi^+ p \rightarrow p4\pi$ |
| 0.88±0.15         | BALLAM  | 71B | HBC | - | 16 $\pi^- p$                   |
| 1 ± 0.15          | BARTSCH | 70B | HBC | + | 8 $\pi^+ p$                    |
| consistent with 1 | CASO    | 68  | HBC | - | 11 $\pi^- p$                   |

NODE=M015R6  
NODE=M015R6

$$\Gamma(\rho\rho)/\Gamma(\pi^\pm\pi^+\pi^-\pi^0)$$

$$\Gamma_{11}/\Gamma_2$$

| VALUE | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|------|-------------|------|-----|---------|
|-------|------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|            |    |                        |     |     |   |                                 |
|------------|----|------------------------|-----|-----|---|---------------------------------|
| 0.12±0.11  |    | BALTAY                 | 78B | HBC | + | 15 $\pi^+ p \rightarrow p4\pi$  |
| 0.56       | 66 | KLIGER                 | 74  | HBC | - | 4.5 $\pi^- p \rightarrow p4\pi$ |
| 0.13±0.09  |    | <sup>31</sup> THOMPSON | 74  | HBC | + | 13 $\pi^+ p$                    |
| 0.7 ± 0.15 |    | BARTSCH                | 70B | HBC | + | 8 $\pi^+ p$                     |

<sup>31</sup>  $\rho\rho$  and  $a_2(1320)\pi$  modes are indistinguishable.

NODE=M015R7  
NODE=M015R7

NODE=M015R7;LINKAGE=T

$$\Gamma(\rho\rho)/[\Gamma(\pi\pi\rho) + \Gamma(a_2(1320)\pi) + \Gamma(\rho\rho)]$$

$$\Gamma_{11}/(\Gamma_9+\Gamma_{10}+\Gamma_{11})$$

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |      |    |     |   |              |
|-----------|------|----|-----|---|--------------|
| 0.48±0.16 | CASO | 68 | HBC | - | 11 $\pi^- p$ |
|-----------|------|----|-----|---|--------------|

NODE=M015R8  
NODE=M015R8

$\Gamma(a_2(1320)\pi)/\Gamma(\pi^\pm\pi^+\pi^-\pi^0)$  $\Gamma_{10}/\Gamma_2$ 

| VALUE                                                                         | DOCUMENT ID            | TECN | CHG | COMMENT |                            |
|-------------------------------------------------------------------------------|------------------------|------|-----|---------|----------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                        |      |     |         |                            |
| 0.66±0.08                                                                     | BALTAY                 | 78B  | HBC | +       | 15 π <sup>+</sup> p → p 4π |
| 0.36±0.14                                                                     | <sup>32</sup> THOMPSON | 74   | HBC | +       | 13 π <sup>+</sup> p        |
| not seen                                                                      | CASON                  | 73   | HBC | −       | 8,18.5 π <sup>−</sup> p    |
| 0.6 ±0.15                                                                     | BARTSCH                | 70B  | HBC | +       | 8 π <sup>+</sup> p         |
| 0.6                                                                           | BALTAY                 | 68   | HBC | +       | 7,8.5 π <sup>+</sup> p     |

<sup>32</sup>  $\rho\rho$  and  $a_2(1320)\pi$  modes are indistinguishable.NODE=M015R9  
NODE=M015R9

NODE=M015R9;LINKAGE=T

 $\Gamma(\omega\pi)/\Gamma(\pi^\pm\pi^+\pi^-\pi^0)$  $\Gamma_3/\Gamma_2$ 

| <u>VALUE</u>                                                                  | <u>CL%</u> | <u>DOCUMENT ID</u>                  | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> |                                 |
|-------------------------------------------------------------------------------|------------|-------------------------------------|-------------|------------|----------------|---------------------------------|
| <b>0.23±0.05 OUR AVERAGE</b>                                                  |            | Error includes scale factor of 1.2. |             |            |                |                                 |
| 0.33±0.07                                                                     |            | THOMPSON                            | 74          | HBC        | +              | 13 $\pi^+ p$                    |
| 0.12±0.07                                                                     |            | BALLAM                              | 71B         | HBC        | -              | 16 $\pi^- p$                    |
| 0.25±0.10                                                                     |            | BALTAY                              | 68          | HBC        | +              | 7,8.5 $\pi^+ p$                 |
| 0.25±0.10                                                                     |            | JOHNSTON                            | 68          | HBC        | -              | 7.0 $\pi^- p$                   |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |            |                                     |             |            |                |                                 |
| <0.11                                                                         | 95         | BALTAY                              | 78B         | HBC        | +              | 15 $\pi^+ p \rightarrow p4\pi$  |
| <0.09                                                                         |            | KLIGER                              | 74          | HBC        | -              | 4.5 $\pi^- p \rightarrow p4\pi$ |

NODE=M015R10  
NODE=M015R10 $\Gamma(\phi\pi)/\Gamma(\pi^\pm\pi^+\pi^-\pi^0)$  $\Gamma_{12}/\Gamma_2$ 

| VALUE                                                                         | DOCUMENT ID | TECN | CHG | COMMENT           |
|-------------------------------------------------------------------------------|-------------|------|-----|-------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |      |     |                   |
| <0.11                                                                         | BALTAY      | 68   | HBC | + 7,8.5 $\pi^+ p$ |

NODE=M015R11  
NODE=M015R11 $\Gamma(\pi^\pm 2\pi^+ 2\pi^-\pi^0)/\Gamma(\pi^\pm\pi^+\pi^-\pi^0)$  $\Gamma_{14}/\Gamma_2$ 

| VALUE                                                                         | DOCUMENT ID | TECN | CHG | COMMENT           |
|-------------------------------------------------------------------------------|-------------|------|-----|-------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |      |     |                   |
| <0.15                                                                         | BALTAY      | 68   | HBC | + 7,8.5 $\pi^+ p$ |

NODE=M015R12  
NODE=M015R12 $\Gamma(\eta\pi)/\Gamma(\pi^\pm\pi^+\pi^-\pi^0)$  $\Gamma_{13}/\Gamma_2$ 

| <u>VALUE</u>                                                                  | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u> |
|-------------------------------------------------------------------------------|--------------------|-------------|------------|----------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                    |             |            |                |
| <0.02                                                                         | THOMPSON           | 74          | HBC        | + 13 $\pi^+ p$ |

NODE=M015R13  
NODE=M015R13 $\Gamma(K\bar{K})/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE                                             | DOCUMENT ID                         | TECN | CHG | COMMENT |
|---------------------------------------------------|-------------------------------------|------|-----|---------|
| <b><math>0.0158 \pm 0.0026</math> OUR FIT</b>     | Error includes scale factor of 1.2. |      |     |         |
| <b><math>0.0130 \pm 0.0024</math> OUR AVERAGE</b> |                                     |      |     |         |

|                   |                      |     |      |   |                                    |
|-------------------|----------------------|-----|------|---|------------------------------------|
| $0.013 \pm 0.003$ | COSTA                | 80  | OMEG | 0 | $10 \pi^- p \rightarrow K^+ K^- n$ |
| $0.013 \pm 0.004$ | <sup>33</sup> MARTIN | 78B | SPEC | - | $10 \pi p \rightarrow K_S^0 K^- p$ |

<sup>33</sup> From  $(\Gamma_4\Gamma_6)^{1/2} = 0.056 \pm 0.034$  assuming  $B(\rho_3(1690) \rightarrow \pi\pi) = 0.24$ .NODE=M015R14  
NODE=M015R14

NODE=M015R14;LINKAGE=B

 $\Gamma(\omega\pi)/[\Gamma(\omega\pi) + \Gamma(\rho\rho)]$  $\Gamma_3/(\Gamma_3 + \Gamma_{11})$ 

| <u>VALUE</u>                                                                  | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u>            |
|-------------------------------------------------------------------------------|--------------------|-------------|------------|---------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                    |             |            |                           |
| 0.22±0.08                                                                     | CASON              | 73          | HBC        | — 8,18.5 π <sup>−</sup> p |

NODE=M015R16  
NODE=M015R16 $\Gamma(\eta\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |                                               |
|-------|-------------|------|---------|-----------------------------------------------|
| seen  | FUKUI       | 88   | SPEC    | 8.95 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$ |

NODE=M015R17  
NODE=M015R17 $\Gamma(a_2(1320)\pi)/\Gamma(\rho(770)\eta)$  $\Gamma_{10}/\Gamma_8$ 

| <u>VALUE</u>   | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>                                  |
|----------------|--------------------|-------------|-------------------------------------------------|
| <b>5.5±2.0</b> | AMELIN             | 00          | VES 37 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$ |

NODE=M015R18  
NODE=M015R18

**$\rho_3(1690)$  REFERENCES**

|                             |     |              |                               |                            |             |
|-----------------------------|-----|--------------|-------------------------------|----------------------------|-------------|
| AMELIN                      | 00  | NP A668 83   | D. Amelin <i>et al.</i>       | (VES Collab.)              | REFID=47432 |
| ALDE                        | 95  | ZPHY C66 379 | D.M. Alde <i>et al.</i>       | (GAMS Collab.) JP          | REFID=44371 |
| ALDE                        | 92C | ZPHY C54 553 | D.M. Alde <i>et al.</i>       | (BELG, SERP, KEK, LANL+)   | REFID=41859 |
| FUKUI                       | 88  | PL B202 441  | S. Fukui <i>et al.</i>        | (SUGI, NAGO, KEK, KYOT+)   | REFID=40273 |
| DENNEY                      | 83  | PR D28 2726  | D.L. Denney <i>et al.</i>     | (IOWA, MICH)               | REFID=20754 |
| EVANGELIS...                | 81  | NP B178 197  | C. Evangelista <i>et al.</i>  | (BARI, BONN, CERN+)        | REFID=20462 |
| ALPER                       | 80  | PL B4B 422   | B. Alper <i>et al.</i>        | (AMST, CERN, CRAC, MPIM+)  | REFID=21665 |
| COSTA                       | 80  | NP B175 402  | G. Costa <i>et al.</i>        | (BARI, BONN, CERN, GLAS+)  | REFID=20737 |
| GORLICH                     | 80  | NP B174 16   | L. Gorlich <i>et al.</i>      | (CRAC, MPIM, CERN+)        | REFID=20738 |
| BECKER                      | 79  | NP B151 46   | H. Becker <i>et al.</i>       | (MPIM, CERN, ZEEM, CRAC)   | REFID=21084 |
| CORDEN                      | 79  | NP B157 250  | M.J. Corden <i>et al.</i>     | (BIRM, RHEL, TELA+) JP     | REFID=20374 |
| BALTAY                      | 78B | PR D17 62    | C. Baltay <i>et al.</i>       | (COLU, BING)               | REFID=21265 |
| MARTIN                      | 78B | NP B140 158  | A.D. Martin <i>et al.</i>     | (DURH, GEVA)               | REFID=21273 |
| MARTIN                      | 78D | PL 74B 417   | A.D. Martin <i>et al.</i>     | (DURH, GEVA)               | REFID=21272 |
| ANTIPOV                     | 77  | NP B119 45   | Y.M. Antipov <i>et al.</i>    | (SERP, GEVA)               | REFID=20728 |
| GESSAROLI                   | 77  | NP B126 382  | R. Gessaroli <i>et al.</i>    | (BGNA, FIRZ, GENO+)        | REFID=20230 |
| BLUM                        | 75  | PL 57B 403   | W. Blum <i>et al.</i>         | (CERN, MPIM) JP            | REFID=21651 |
| ESTABROOKS                  | 75  | NP B95 322   | P.G. Estabrooks, A.D. Martin  | (DURH)                     | REFID=20642 |
| HYAMS                       | 75  | NP B100 205  | B.D. Hyams <i>et al.</i>      | (CERN, MPIM)               | REFID=20355 |
| ENGLER                      | 74  | PR D10 2070  | A. Engler <i>et al.</i>       | (CMU, CASE)                | REFID=20110 |
| GRAYER                      | 74  | NP B75 189   | G. Grayer <i>et al.</i>       | (CERN, MPIM)               | REFID=20113 |
| KLIGER                      | 74  | SJNP 19 428  | G.K. Kliger <i>et al.</i>     | (ITEP)                     | REFID=21648 |
| Translated from YAF 19 839. |     |              |                               |                            |             |
| OREN                        | 74  | NP B71 189   | Y. Oren <i>et al.</i>         | (ANL, OXF)                 | REFID=20221 |
| THOMPSON                    | 74  | NP B69 220   | G. Thompson <i>et al.</i>     | (PURD)                     | REFID=21650 |
| CASON                       | 73  | PR D7 1971   | N.M. Cason <i>et al.</i>      | (NDAM)                     | REFID=20606 |
| BOWEN                       | 72  | PRL 29 890   | D.R. Bowen <i>et al.</i>      | (NEAS, STON)               | REFID=21711 |
| HOLMES                      | 72  | PR D6 3336   | R. Holmes <i>et al.</i>       | (ROCH)                     | REFID=21639 |
| BALLAM                      | 71B | PR D3 2606   | J. Ballam <i>et al.</i>       | (SLAC)                     | REFID=21630 |
| MATTHEWS                    | 71C | NP B33 1     | J.A.J. Matthews <i>et al.</i> | (TNTO, WISC) JP            | REFID=21633 |
| ARMENISE                    | 70  | LNC 4 199    | N. Armenise <i>et al.</i>     | (BARI, BGNA, FIRZ)         | REFID=20693 |
| BARNHAM                     | 70  | PRL 24 1083  | K.W.J. Barnham <i>et al.</i>  | (BIRM)                     | REFID=21624 |
| BARTSCH                     | 70B | NP B22 109   | J. Bartsch <i>et al.</i>      | (AACH, BERL, CERN)         | REFID=21625 |
| CASO                        | 70  | LNC 3 707    | C. Caso <i>et al.</i>         | (GENO, HAMB, MILA, SACL)   | REFID=20590 |
| STUNTEBECK                  | 70  | PL 32B 391   | P.H. Stuntebeck <i>et al.</i> | (NDAM)                     | REFID=20696 |
| ADERHOLZ                    | 69  | NP B11 259   | M. Aderholz <i>et al.</i>     | (AACH3, BERL, CERN+)       | REFID=20687 |
| ANDERSON                    | 69  | PRL 22 1390  | E.W. Anderson <i>et al.</i>   | (BNL, CMU)                 | REFID=20795 |
| ARMENISE                    | 68  | NC 54A 999   | N. Armenise <i>et al.</i>     | (BARI, BGNA, FIRZ+) I      | REFID=20054 |
| BALTAY                      | 68  | PRL 20 887   | C. Baltay <i>et al.</i>       | (COLU, ROCH, RUTG, YALE) I | REFID=21531 |
| CASO                        | 68  | NC 54A 983   | C. Caso <i>et al.</i>         | (GENO, HAMB, MILA, SACL)   | REFID=20586 |
| CRENNELL                    | 68B | PL 28B 136   | D.J. Crennell <i>et al.</i>   | (BNL)                      | REFID=21616 |
| JOHNSTON                    | 68  | PRL 20 1414  | T.F. Johnston <i>et al.</i>   | (TNTO, WISC) IJP           | REFID=21617 |
| FOCACCI                     | 66  | PRL 17 890   | M.N. Focacci <i>et al.</i>    | (CERN)                     | REFID=20402 |
| GOLDBERG                    | 65  | PL 17 354    | M. Goldberg <i>et al.</i>     | (CERN, EPOL, ORSAY+)       | REFID=21601 |

NODE=M065

 **$\rho(1700)$** 

$$I^G(J^{PC}) = 1^+(1^--)$$

NODE=M065

**THE  $\rho(1450)$  AND THE  $\rho(1700)$** 

Updated September 2019 by S. Eidelman (Novosibirsk), C. Hanhart (Juelich) and G. Venanzoni (Pisa).

In our 1988 edition, we replaced the  $\rho(1600)$  entry with two new ones, the  $\rho(1450)$  and the  $\rho(1700)$ , because there was emerging evidence that the 1600-MeV region actually contains two  $\rho$ -like resonances. Erkal [1] had pointed out this possibility with a theoretical analysis on the consistency of  $2\pi$  and  $4\pi$  electromagnetic form factors and the  $\pi\pi$  scattering length. Donnachie [2], with a full analysis of data on the  $2\pi$  and  $4\pi$  final states in  $e^+e^-$  annihilation and photoproduction reactions, had also argued that in order to obtain a consistent picture, two resonances were necessary. The existence of  $\rho(1450)$  was supported by the analysis of  $\eta\rho^0$  mass spectra obtained in photoproduction and  $e^+e^-$  annihilation [3], as well as that of  $e^+e^- \rightarrow \omega\pi$  [4].

The analysis of [2] was further extended by [5,6] to include new data on  $4\pi$ -systems produced in  $e^+e^-$  annihilation, and in  $\tau$ -decays ( $\tau$  decays to  $4\pi$ , and  $e^+e^-$  annihilation to  $4\pi$  can be

related by the Conserved Vector Current assumption). These systems were successfully analyzed using interfering contributions from two  $\rho$ -like states, and from the tail of the  $\rho(770)$  decaying into two-body states. While specific conclusions on  $\rho(1450) \rightarrow 4\pi$  were obtained, little could be said about the  $\rho(1700)$ .

Independent evidence for two  $1^-$  states is provided by [7] in  $4\pi$  electroproduction at  $\langle Q^2 \rangle = 1$  (GeV/c)<sup>2</sup>, and by [8] in a high-statistics sample of the  $\eta\pi\pi$  system in  $\pi^-p$  charge exchange.

This scenario with two overlapping resonances is supported by other data. Bisello [9] measured the pion form factor in the interval 1.35–2.4 GeV, and observed a deep minimum around 1.6 GeV. The best fit was obtained with the hypothesis of  $\rho$ -like resonances at 1420 and 1770 MeV, with widths of about 250 MeV. Antonelli [10] found that the  $e^+e^- \rightarrow \eta\pi^+\pi^-$  cross section is better fitted with two fully interfering Breit-Wigners, with parameters in fair agreement with those of [2] and [9]. These results can be considered as a confirmation of the  $\rho(1450)$ .

Decisive evidence for the  $\pi\pi$  decay mode of both  $\rho(1450)$  and  $\rho(1700)$  comes from  $\bar{p}p$  annihilation at rest [11]. It has been shown that these resonances also possess a  $K\bar{K}$  decay mode [12–14]. High-statistics studies of the decays  $\tau \rightarrow \pi\pi\nu_\tau$  [15,16], and  $\tau \rightarrow 4\pi\nu_\tau$  [17] also require the  $\rho(1450)$ , but are not sensitive to the  $\rho(1700)$ , because it is too close to the  $\tau$  mass. A recent very-high-statistics study of the  $\tau \rightarrow \pi\pi\nu_\tau$  decay performed at Belle [18] reports the first observation of both  $\rho(1450)$  and  $\rho(1700)$  in  $\tau$  decays. A clear picture of the two  $\pi^+\pi^-$  resonances interfering with the  $\rho(770)$  in  $e^+e^-$  annihilation was also reported by BaBar using the ISR method [19].

The structure of these  $\rho$  states is not yet completely clear. Barnes [20] and Close [21] claim that  $\rho(1450)$  has a mass consistent with radial  $2S$ , but its decays show characteristics of hybrids, and suggest that this state may be a  $2S$ -hybrid mixture. Donnachie [22] argues that hybrid states could have a  $4\pi$  decay mode dominated by the  $a_1\pi$ . Such behavior has been observed by [23] in  $e^+e^- \rightarrow 4\pi$  in the energy range 1.05–1.38 GeV, and by [17] in  $\tau \rightarrow 4\pi$  decays. CLEO [24] and Belle [25] observe the  $\rho(1450) \rightarrow \omega\pi$  decay mode in  $B$ -meson decays, however, do not find  $\rho(1700) \rightarrow \omega\pi^0$ . A similar conclusion is made by [26,27], who studied the process  $e^+e^- \rightarrow \omega\pi^0$  and do not observe a statistically significant signal of the  $\rho(1700)$ . Various

decay modes of the  $\rho(1450)$  and  $\rho(1700)$  are observed in  $\bar{p}n$  and  $\bar{p}p$  annihilation [28,29], but no definite conclusions can be drawn. More data should be collected to clarify the nature of the  $\rho$  states, particularly in the energy range above 1.6 GeV.

We now list under a separate entry the  $\rho(1570)$ , the  $\phi\pi$  state with  $J^{PC} = 1^{--}$  earlier observed by [30] (referred to as  $C(1480)$ ) and recently confirmed by [31]. While [32] shows that it may be a threshold effect, [5] and [33] suggest two independent vector states with this decay mode. The  $C(1480)$  has not been seen in the  $\bar{p}p$  [34] and  $e^+e^-$  [35,36] experiments. However, the sensitivity of the two latter is an order of magnitude lower than that of [31]. Note that [31] can not exclude that their observation is due to an OZI-suppressed decay mode of the  $\rho(1700)$ .

Several observations on the  $\omega\pi$  system in the 1200-MeV region [37–43] may be interpreted in terms of either  $J^P = 1^-$   $\rho(770) \rightarrow \omega\pi$  production [44], or  $J^P = 1^+$   $b_1(1235)$  production [42,43]. We argue that no special entry for a  $\rho(1250)$  is needed. The LASS amplitude analysis [45] showing evidence for  $\rho(1270)$  is preliminary and needs confirmation. For completeness, the relevant observations are listed under the  $\rho(1450)$ .

Recently [46] reported a very broad  $1^{--}$  resonance-like  $K^+K^-$  state in  $J/\psi \rightarrow K^+K^-\pi^0$  decays. Its pole position corresponds to mass of 1576 MeV and width of 818 MeV. [47–49] suggest its exotic structure (molecular or multiquark), while [50] and [51] explain it by the interference between the  $\rho(1450)$  and  $\rho(1700)$ . The latter statement is qualitatively supported by BaBar [52] and SND [53]. We quote [46] as  $X(1575)$  in the section “Further States.”

Evidence for  $\rho$ -like mesons decaying into  $6\pi$  states was first noted by [54] in the analysis of  $6\pi$  mass spectra from  $e^+e^-$  annihilation [55,56] and diffractive photoproduction [57]. Clegg [54] argued that two states at about 2.1 and 1.8 GeV exist: while the former is a candidate for the  $\rho(2150)$ , the latter could be a manifestation of the  $\rho(1700)$  distorted by threshold effects. BaBar reported observations of the new decay modes of the  $\rho(2150)$  in the channels  $\eta'(958)\pi^+\pi^-$  and  $f_1(1285)\pi^+\pi^-$  [58]. The relativistic quark model [59] predicts the  $2^3D_1$  state with  $J^{PC} = 1^{--}$  at 2.15 GeV which can be identified with the  $\rho(2150)$ .

We no longer list under a separate particle  $\rho(1900)$  various observations of irregular behavior of the cross sections



near the  $N\bar{N}$  threshold. Dips of various width around 1.9 GeV were reported by the E687 Collaboration (a narrow one in the  $3\pi^+3\pi^-$  diffractive photoproduction [60,61]) , by the FENICE experiment (a narrow structure in the  $R$  value [62]) , by BaBar in ISR (a narrow structure in  $e^+e^- \rightarrow \phi\pi$  final state [63], but much broader in  $e^+e^- \rightarrow 3\pi^+3\pi^-$  and  $e^+e^- \rightarrow 2(\pi^+\pi^-\pi^0)$  [64]) , by CMD-3 (also a rather broad dip in  $e^+e^- \rightarrow 3\pi^+3\pi^-$  [65]) . A dedicated scan of the  $N\bar{N}$ -threshold region by CMD-3 confirms this effect in the  $e^+e^- \rightarrow 3\pi^+3\pi^-$  and  $e^+e^- \rightarrow K^+K^-\pi^+\pi^-$  final states, but does not see it in the cross section of  $e^+e^- \rightarrow 2\pi^+2\pi^-$  [66]. Most probably, these structures emerge as a threshold effect due to the opening of the  $N\bar{N}$  channel [67,68,69].

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### $\rho(1700)$ MASS

#### $\eta\rho^0$ AND $\pi^+\pi^-$ MODES

VALUE (MeV)

DOCUMENT ID

**1720±20 OUR ESTIMATE**

NODE=M065205

NODE=M065M0

NODE=M065M0

→ UNCHECKED ←

#### $\eta\rho^0$ MODE

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

COMMENT

The data in this block is included in the average printed for a previous datablock.

NODE=M065M6

NODE=M065M6

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |       |                       |    |      |                                               |
|---------|-------|-----------------------|----|------|-----------------------------------------------|
| 1834±12 | 13.4k | <sup>1</sup> GRIBANOV | 20 | CMD3 | 1.1–2.0 $e^+e^- \rightarrow \eta\pi^+\pi^-$   |
| 1840±10 | 7.4k  | <sup>2</sup> ACHASOV  | 18 | SND  | 1.22–2.00 $e^+e^- \rightarrow \eta\pi^+\pi^-$ |
| 1740±20 |       | ANTONELLI             | 88 | DM2  | $e^+e^- \rightarrow \eta\pi^+\pi^-$           |
| 1701±15 |       | <sup>3</sup> FUKUI    | 88 | SPEC | 8.95 $\pi^-p \rightarrow \eta\pi^+\pi^-n$     |

<sup>1</sup> Mass and width of the  $\rho(770)$  fixed at 775 and 149 MeV, respectively; solution 2 of model 2,  $\eta \rightarrow \gamma\gamma$  decays used.

<sup>2</sup> From the combined fit of AULCHENKO 15 and ACHASOV 18 in the model with the interfering  $\rho(1450)$ ,  $\rho(1700)$  and  $\rho(2150)$  with the parameters of the  $\rho(1450)$  and  $\rho(1700)$  floating and the mass and width of the  $\rho(2150)$  fixed at 2155 MeV and 320 MeV, respectively. The phases of the resonances are  $\pi$ , 0 and  $\pi$ , respectively.

<sup>3</sup> Assuming  $\rho^+f_0(1370)$  decay mode interferes with  $a_1(1260)^+\pi$  background. From a two Breit-Wigner fit.

NODE=M065M6;LINKAGE=B

NODE=M065M6;LINKAGE=A

NODE=M065M;LINKAGE=B

#### $\pi\pi$ MODE

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

COMMENT

The data in this block is included in the average printed for a previous datablock.

NODE=M065M1

NODE=M065M1

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                       |                                  |                           |      |      |                                            |
|---------------------------------------|----------------------------------|---------------------------|------|------|--------------------------------------------|
| 1770.54±5.49                          |                                  | <sup>1</sup> BARTOS       | 17   | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$            |
| 1718.50±65.44                         |                                  | <sup>2</sup> BARTOS       | 17A  | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$            |
| 1766.80±52.36                         |                                  | <sup>3</sup> BARTOS       | 17A  | RVUE | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$    |
| 1644 ±36                              | 20k                              | <sup>4</sup> LEES         | 17C  | BABR | $J/\psi \rightarrow \pi^+\pi^-\pi^0$       |
| 1780 ±20                              | <sup>+15</sup><br><sub>-20</sub> | <sup>5</sup> ABRAMOWICZ12 | ZEUS |      | $ep \rightarrow e\pi^+\pi^-p$              |
| 1861 ±17                              |                                  | <sup>6</sup> LEES         | 12G  | BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$      |
| 1728 ±17                              | ±89                              | <sup>7,8</sup> FUJIKAWA   | 08   | BELL | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$    |
| 1780 <sup>+37</sup><br><sub>-29</sub> |                                  | <sup>9</sup> ABELE        | 97   | CBAR | $\bar{p}n \rightarrow \pi^-\pi^0\pi^0$     |
| 1719 ±15                              |                                  | <sup>9</sup> BERTIN       | 97C  | OBLX | 0.0 $\bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |
| 1730 ±30                              |                                  | CLEGG                     | 94   | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$            |
| 1768 ±21                              |                                  | BISELLO                   | 89   | DM2  | $e^+e^- \rightarrow \pi^+\pi^-$            |
| 1745.7 ±91.9                          |                                  | DUBNICKA                  | 89   | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$            |
| 1546 ±26                              |                                  | GESHKEN...                | 89   | RVUE |                                            |
| 1650                                  |                                  | <sup>10</sup> ERKAL       | 85   | RVUE | 20–70 $\gamma p \rightarrow \gamma\pi$     |
| 1550 ±70                              |                                  | ABE                       | 84B  | HYBR | 20 $\gamma p \rightarrow \pi^+\pi^-p$      |
| 1590 ±20                              |                                  | <sup>11</sup> ASTON       | 80   | OMEG | 20–70 $\gamma p \rightarrow p2\pi$         |
| 1600 ±10                              |                                  | <sup>12</sup> ATIYA       | 79B  | SPEC | 50 $\gamma C \rightarrow C2\pi$            |
| 1598 <sup>+24</sup><br><sub>-22</sub> |                                  | BECKER                    | 79   | ASPK | 17 $\pi^-p$ polarized                      |
| 1659 ±25                              |                                  | <sup>10</sup> LANG        | 79   | RVUE |                                            |
| 1575                                  |                                  | <sup>10</sup> MARTIN      | 78C  | RVUE | 17 $\pi^-p \rightarrow \pi^+\pi^-n$        |
| 1610 ±30                              |                                  | <sup>10</sup> FROGGATT    | 77   | RVUE | 17 $\pi^-p \rightarrow \pi^+\pi^-n$        |
| 1590 ±20                              |                                  | <sup>13</sup> HYAMS       | 73   | ASPK | 17 $\pi^-p \rightarrow \pi^+\pi^-n$        |

<sup>1</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of LEES 12G and ABLIKIM 16C.

<sup>2</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, and AMBROSINO 11A.

<sup>3</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUBNICKA 10 to analyze the data of FUJIKAWA 08.

OCCUR=2

NODE=M065M1;LINKAGE=C

NODE=M065M1;LINKAGE=D

NODE=M065M1;LINKAGE=E

- 4 From a Dalitz plot analysis in an isobar model with  $\rho(1450)$  and  $\rho(1700)$  masses and widths floating.
- 5 Using the KUHN 90 parametrization of the pion form factor, neglecting  $\rho-\omega$  interference.
- 6 Using the GOUNARIS 68 parametrization of the pion form factor leaving the masses and widths of the  $\rho(1450)$ ,  $\rho(1700)$ , and  $\rho(2150)$  resonances as free parameters of the fit.
- 7  $|F_\pi(0)|^2$  fixed to 1.
- 8 From the GOUNARIS 68 parametrization of the pion form factor.
- 9 T-matrix pole.
- 10 From phase shift analysis of HYAMS 73 data.
- 11 Simple relativistic Breit-Wigner fit with constant width.
- 12 An additional 40 MeV uncertainty in both the mass and width is present due to the choice of the background shape.
- 13 Included in BECKER 79 analysis.

 **$\pi\omega$  MODE**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID          | TECN | COMMENT                                   |
|-------------------------------------------------------------------------------|------|----------------------|------|-------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                      |      |                                           |
| $1708 \pm 41$                                                                 | 7815 | <sup>1</sup> ACHASOV | 13   | SND $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1550 to 1620                                                                  |      | <sup>2</sup> ACHASOV | 00I  | SND $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 1580 to 1710                                                                  |      | <sup>3</sup> ACHASOV | 00I  | SND $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| $1710 \pm 90$                                                                 |      | ACHASOV              | 97   | RVUE $e^+e^- \rightarrow \omega\pi^0$     |

- <sup>1</sup> From a phenomenological model based on vector meson dominance with the interfering  $\rho(1450)$  and  $\rho(1700)$  and their widths fixed at 400 and 250 MeV, respectively. Systematic uncertainty not estimated.
- <sup>2</sup> Taking into account both  $\rho(1450)$  and  $\rho(1700)$  contributions. Using the data of ACHASOV 00I on  $e^+e^- \rightarrow \omega\pi^0$  and of EDWARDS 00A on  $\tau^- \rightarrow \omega\pi^- \nu_\tau$ .  $\rho(1450)$  mass and width fixed at 1400 MeV and 500 MeV respectively.
- <sup>3</sup> Taking into account the  $\rho(1700)$  contribution only. Using the data of ACHASOV 00I on  $e^+e^- \rightarrow \omega\pi^0$  and of EDWARDS 00A on  $\tau^- \rightarrow \omega\pi^- \nu_\tau$ .

 **$K\bar{K}$  MODE**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN | CHG        | COMMENT                                |
|-------------------------------------------------------------------------------|------|-----------------------|------|------------|----------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                       |      |            |                                        |
| $1688.7 \pm 3.1^{+141.1}_{-1.3}$                                              |      | <sup>1</sup> ALBRECHT | 20   | RVUE       | $0.9 \bar{p}p \rightarrow K^+K^-\pi^0$ |
| $1541 \pm 12 \pm 33$                                                          | 190k | <sup>2</sup> AAIJ     | 16N  | LHCB       | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$  |
| $1740.8 \pm 22.2$                                                             | 27k  | <sup>3</sup> ABELE    | 99D  | CBAR $\pm$ | $0.0 \bar{p}p \rightarrow K^+K^-\pi^0$ |
| $1582 \pm 36$                                                                 | 1600 | CLELAND               | 82B  | SPEC $\pm$ | $50 \pi p \rightarrow K_S^0 K^\pm p$   |

- <sup>1</sup> T-matrix pole, 2 poles, 3 channels, including  $\pi\pi$  scattering data from HYAMS 75.
- <sup>2</sup> Using the GOUNARIS 68 parameterization with a fixed width. Value is average using different  $K\pi$  S-wave parametrizations in fit.
- <sup>3</sup> K-matrix pole. Isospin not determined, could be  $\omega(1650)$  or  $\phi(1680)$ .

 **$2(\pi^+\pi^-)$  MODE**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|------|------------------------|------|------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                        |      |                                          |
| $1851^{+27}_{-24}$                                                            |      | ACHASOV                | 97   | RVUE $e^+e^- \rightarrow 2(\pi^+\pi^-)$  |
| $1570 \pm 20$                                                                 |      | <sup>1</sup> CORDIER   | 82   | DM1 $e^+e^- \rightarrow 2(\pi^+\pi^-)$   |
| $1520 \pm 30$                                                                 |      | <sup>2</sup> ASTON     | 81E  | OMEG $20-70 \gamma p \rightarrow p4\pi$  |
| $1654 \pm 25$                                                                 |      | <sup>3</sup> DIBIANCA  | 81   | DBC $\pi^+d \rightarrow pp2(\pi^+\pi^-)$ |
| $1666 \pm 39$                                                                 |      | <sup>1</sup> BACCI     | 80   | FRAG $e^+e^- \rightarrow 2(\pi^+\pi^-)$  |
| 1780                                                                          | 34   | KILLIAN                | 80   | SPEC $11 e^-p \rightarrow 2(\pi^+\pi^-)$ |
| 1500                                                                          |      | <sup>4</sup> ATIYA     | 79B  | SPEC $50 \gamma C \rightarrow C4\pi^\pm$ |
| $1570 \pm 60$                                                                 | 65   | <sup>5</sup> ALEXANDER | 75   | HBC $7.5 \gamma p \rightarrow p4\pi$     |
| $1550 \pm 60$                                                                 |      | <sup>2</sup> CONVERSI  | 74   | OSPK $e^+e^- \rightarrow 2(\pi^+\pi^-)$  |
| $1550 \pm 50$                                                                 | 160  | SCHACHT                | 74   | STRC $5.5-9 \gamma p \rightarrow p4\pi$  |
| $1450 \pm 100$                                                                | 340  | SCHACHT                | 74   | STRC $9-18 \gamma p \rightarrow p4\pi$   |
| $1430 \pm 50$                                                                 | 400  | BINGHAM                | 72B  | HBC $9.3 \gamma p \rightarrow p4\pi$     |

- <sup>1</sup> Simple relativistic Breit-Wigner fit with model dependent width.
- <sup>2</sup> Simple relativistic Breit-Wigner fit with constant width.
- <sup>3</sup> One peak fit result.
- <sup>4</sup> Parameters roughly estimated, not from a fit.
- <sup>5</sup> Skew mass distribution compensated by Ross-Stodolsky factor.

 **$\pi^+\pi^-\pi^0\pi^0$  MODE**

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN | COMMENT               |
|-------------------------------------------------------------------------------|-------------|------|-----------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |      |                       |
| $1660 \pm 30$                                                                 | ATKINSON    | 85B  | OMEG $20-70 \gamma p$ |

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NODE=M065M1;LINKAGE=FU

NODE=M065M1;LINKAGE=GO

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NODE=M065M;LINKAGE=P

NODE=M065M;LINKAGE=M

NODE=M065M;LINKAGE=R

NODE=M065M;LINKAGE=H

NODE=M065M8

NODE=M065M8

OCCUR=2

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NODE=M065M;LINKAGE=I2

NODE=M065M2

NODE=M065M2

NODE=M065M2;LINKAGE=D

NODE=M065M2;LINKAGE=A

NODE=M065M2;LINKAGE=AN

NODE=M065M4

NODE=M065M4

OCCUR=2

NODE=M065M;LINKAGE=A

NODE=M065M4;LINKAGE=M

NODE=M065M;LINKAGE=O

NODE=M065M;LINKAGE=C

NODE=M065M;LINKAGE=D

NODE=M065M5

NODE=M065M5

**$3(\pi^+\pi^-)$  AND  $2(\pi^+\pi^-\pi^0)$  MODES**

| VALUE (MeV)                                                                   | DOCUMENT ID              | TECN | COMMENT                                              |
|-------------------------------------------------------------------------------|--------------------------|------|------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |                                                      |
| $1730 \pm 34$                                                                 | <sup>1</sup> FRABETTI 04 | E687 | $\gamma p \rightarrow 3\pi^+ 3\pi^- p$               |
| $1783 \pm 15$                                                                 | CLEGG 90                 | RVUE | $e^+e^- \rightarrow 3(\pi^+\pi^-)2(\pi^+\pi^-\pi^0)$ |
| <sup>1</sup> From a fit with two resonances with the JACOB 72 continuum.      |                          |      |                                                      |

NODE=M065M7  
 NODE=M065M7

NODE=M065M;LINKAGE=PI

 **$m_{\rho(1700)^0} - m_{\rho(1700)^\pm}$** 

| VALUE (MeV)                                                                                                                                                                                              | DOCUMENT ID             | TECN | COMMENT                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|------|------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                            |                         |      |                                                                              |
| $-48.30 \pm 83.81$                                                                                                                                                                                       | <sup>1</sup> BARTOS 17A | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$ ,<br>$\tau^- \rightarrow \pi^-\pi^0\nu_\tau$ |
| <sup>1</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUB-NICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, AMBROSINO 11A, and FUJIKAWA 08. |                         |      |                                                                              |

NODE=M065DM

NODE=M065DM

NODE=M065DM;LINKAGE=A

 **$\rho(1700)$  WIDTH** **$\eta\rho^0$  AND  $\pi^+\pi^-$  MODES**

| VALUE (MeV)                   | DOCUMENT ID |
|-------------------------------|-------------|
| <b>250 ± 100 OUR ESTIMATE</b> |             |

NODE=M065210

NODE=M065W0  
 NODE=M065W0  
 → UNCHECKED ←

 **$\eta\rho^0$  MODE**

| VALUE (MeV)                                                                         | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------------------------------------------------|------|-------------|------|---------|
| The data in this block is included in the average printed for a previous datablock. |      |             |      |         |

NODE=M065W6  
 NODE=M065W6

|                                                                               |       |                          |      |                                               |
|-------------------------------------------------------------------------------|-------|--------------------------|------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                          |      |                                               |
| $47 \pm 19$                                                                   | 13.4k | <sup>1</sup> GRIBANOV 20 | CMD3 | $1.1-2.0 e^+e^- \rightarrow \eta\pi^+\pi^-$   |
| $132 \pm 40$                                                                  | 7.4k  | <sup>2</sup> ACHASOV 18  | SND  | $1.22-2.00 e^+e^- \rightarrow \eta\pi^+\pi^-$ |
| $150 \pm 30$                                                                  |       | ANTONELLI 88             | DM2  | $e^+e^- \rightarrow \eta\pi^+\pi^-$           |
| $282 \pm 44$                                                                  |       | <sup>3</sup> FUKUI 88    | SPEC | $8.95 \pi^- p \rightarrow \eta\pi^+\pi^- n$   |

<sup>1</sup> Mass and width of the  $\rho(770)$  fixed at 775 and 149 MeV, respectively; solution 2 of model 2,  $\eta \rightarrow \gamma\gamma$  decays used.

<sup>2</sup> From the combined fit of AULCHENKO 15 and ACHASOV 18 in the model with the interfering  $\rho(1450)$ ,  $\rho(1700)$  and  $\rho(2150)$  with the parameters of the  $\rho(1450)$  and  $\rho(1700)$  floating and the mass and width of the  $\rho(2150)$  fixed at 2155 MeV and 320 MeV, respectively. The phases of the resonances are  $\pi$ , 0 and  $\pi$ , respectively.

<sup>3</sup> Assuming  $\rho^+ f_0(1370)$  decay mode interferes with  $a_1(1260)^+\pi$  background. From a two Breit-Wigner fit.

NODE=M065W6;LINKAGE=B

NODE=M065W6;LINKAGE=A

NODE=M065W;LINKAGE=B

 **$\pi\pi$  MODE**

| VALUE (MeV)                                                                         | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------------------------------------------------|------|-------------|------|---------|
| The data in this block is included in the average printed for a previous datablock. |      |             |      |         |

NODE=M065W1  
 NODE=M065W1

|                                                                               |                |                            |      |                                            |
|-------------------------------------------------------------------------------|----------------|----------------------------|------|--------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                |                            |      |                                            |
| $268.98 \pm 11.40$                                                            |                | <sup>1</sup> BARTOS 17     | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$            |
| $489.58 \pm 16.95$                                                            |                | <sup>2</sup> BARTOS 17A    | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$            |
| $414.71 \pm 119.48$                                                           |                | <sup>3</sup> BARTOS 17A    | RVUE | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$    |
| $109 \pm 19$                                                                  | 20k            | <sup>4</sup> LEES 17C      | BABR | $J/\psi \rightarrow \pi^+\pi^-\pi^0$       |
| $310 \pm 30$                                                                  | $+25$<br>$-35$ | <sup>5</sup> ABRAMOWICZ12  | ZEUS | $ep \rightarrow e\pi^+\pi^-p$              |
| $316 \pm 26$                                                                  |                | <sup>6</sup> LEES 12G      | BABR | $e^+e^- \rightarrow \pi^+\pi^-\gamma$      |
| $164 \pm 21$                                                                  | $+89$<br>$-26$ | <sup>7,8</sup> FUJIKAWA 08 | BELL | $\tau^- \rightarrow \pi^-\pi^0\nu_\tau$    |
| $275 \pm 45$                                                                  |                | <sup>9</sup> ABELE 97      | CBAR | $\bar{p}n \rightarrow \pi^-\pi^0\pi^0$     |
| $310 \pm 40$                                                                  |                | <sup>9</sup> BERTIN 97C    | OBLX | $0.0 \bar{p}p \rightarrow \pi^+\pi^-\pi^0$ |
| $400 \pm 100$                                                                 |                | CLEGG 94                   | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$            |
| $224 \pm 22$                                                                  |                | BISELLO 89                 | DM2  | $e^+e^- \rightarrow \pi^+\pi^-$            |
| $242.5 \pm 163.0$                                                             |                | DUBNICKA 89                | RVUE | $e^+e^- \rightarrow \pi^+\pi^-$            |
| $620 \pm 60$                                                                  |                | GESHKEN... 89              | RVUE |                                            |
| $<315$                                                                        |                | <sup>10</sup> ERKAL 85     | RVUE | $20-70 \gamma p \rightarrow \gamma\pi$     |
| $280 +30$<br>$-80$                                                            |                | ABE 84B                    | HYBR | $20 \gamma p \rightarrow \pi^+\pi^-p$      |
| $230 \pm 80$                                                                  |                | <sup>11</sup> ASTON 80     | OMEG | $20-70 \gamma p \rightarrow p2\pi$         |
| $283 \pm 14$                                                                  |                | <sup>12</sup> ATIYA 79B    | SPEC | $50 \gamma C \rightarrow C2\pi$            |
| $175 +98$<br>$-53$                                                            |                | BECKER 79                  | ASPK | $17 \pi^- p$ polarized                     |
| $232 \pm 34$                                                                  |                | <sup>10</sup> LANG 79      | RVUE |                                            |
| $340$                                                                         |                | <sup>10</sup> MARTIN 78C   | RVUE | $17 \pi^- p \rightarrow \pi^+\pi^-n$       |
| $300 \pm 100$                                                                 |                | <sup>10</sup> FROGGATT 77  | RVUE | $17 \pi^- p \rightarrow \pi^+\pi^-n$       |
| $180 \pm 50$                                                                  |                | <sup>13</sup> HYAMS 73     | ASPK | $17 \pi^- p \rightarrow \pi^+\pi^-n$       |

OCCUR=2

- <sup>1</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUB-NICKA 10 to analyze the data of LEES 12G and ABLIKIM 16C.
- <sup>2</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUB-NICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, and AMBROSINO 11A.
- <sup>3</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUB-NICKA 10 to analyze the data of FUJIKAWA 08.
- <sup>4</sup> From a Dalitz plot analysis in an isobar model with  $\rho(1450)$  and  $\rho(1700)$  masses and widths floating.
- <sup>5</sup> Using the KUHN 90 parametrization of the pion form factor, neglecting  $\rho-\omega$  interference.
- <sup>6</sup> Using the GOUNARIS 68 parametrization of the pion form factor leaving the masses and widths of the  $\rho(1450)$ ,  $\rho(1700)$ , and  $\rho(2150)$  resonances as free parameters of the fit.
- <sup>7</sup>  $|F_\pi(0)|^2$  fixed to 1.
- <sup>8</sup> From the GOUNARIS 68 parametrization of the pion form factor.
- <sup>9</sup> T-matrix pole.
- <sup>10</sup> From phase shift analysis of HYAMS 73 data.
- <sup>11</sup> Simple relativistic Breit-Wigner fit with constant width.
- <sup>12</sup> An additional 40 MeV uncertainty in both the mass and width is present due to the choice of the background shape.
- <sup>13</sup> Included in BECKER 79 analysis.

## **$K\bar{K}$ MODE**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                             |      |                       |     |        |                                          |
|---------------------------------------------|------|-----------------------|-----|--------|------------------------------------------|
| 150.9 ± 2.5 <sup>+60</sup> <sub>-10.6</sub> |      | <sup>1</sup> ALBRECHT | 20  | RVUE   | 0.9 $\bar{p}p \rightarrow K^+ K^- \pi^0$ |
| 187.2 ± 26.7                                | 27k  | <sup>2</sup> ABELE    | 99D | CBAR ± | 0.0 $\bar{p}p \rightarrow K^+ K^- \pi^0$ |
| 265 ± 120                                   | 1600 | CLELAND               | 82B | SPEC ± | 50 $\pi p \rightarrow K_S^0 K^\pm p$     |

<sup>1</sup> T-matrix pole, 2 poles, 3 channels, including  $\pi\pi$  scattering data from HYAMS 75.

<sup>2</sup> K-matrix pole. Isospin not determined, could be  $\omega(1650)$  or  $\phi(1680)$ .

## **$2(\pi^+\pi^-)$ MODE**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |     |                        |     |      |                                         |
|-----------|-----|------------------------|-----|------|-----------------------------------------|
| 510 ± 40  |     | <sup>1</sup> CORDIER   | 82  | DM1  | $e^+e^- \rightarrow 2(\pi^+\pi^-)$      |
| 400 ± 50  |     | <sup>2</sup> ASTON     | 81E | OMEG | 20-70 $\gamma p \rightarrow p4\pi$      |
| 400 ± 146 |     | <sup>3</sup> DIBIANCA  | 81  | DBC  | $\pi^+ d \rightarrow p p 2(\pi^+\pi^-)$ |
| 700 ± 160 |     | <sup>1</sup> BACCI     | 80  | FRAG | $e^+e^- \rightarrow 2(\pi^+\pi^-)$      |
| 100       | 34  | KILLIAN                | 80  | SPEC | 11 $e^- p \rightarrow 2(\pi^+\pi^-)$    |
| 600       |     | <sup>4</sup> ATIYA     | 79B | SPEC | 50 $\gamma C \rightarrow C4\pi^\pm$     |
| 340 ± 160 | 65  | <sup>5</sup> ALEXANDER | 75  | HBC  | 7.5 $\gamma p \rightarrow p4\pi$        |
| 360 ± 100 |     | <sup>2</sup> CONVERSI  | 74  | OSPK | $e^+e^- \rightarrow 2(\pi^+\pi^-)$      |
| 400 ± 120 | 160 | <sup>6</sup> SCHACHT   | 74  | STRC | 5.5-9 $\gamma p \rightarrow p4\pi$      |
| 850 ± 200 | 340 | <sup>6</sup> SCHACHT   | 74  | STRC | 9-18 $\gamma p \rightarrow p4\pi$       |
| 650 ± 100 | 400 | BINGHAM                | 72B | HBC  | 9.3 $\gamma p \rightarrow p4\pi$        |

<sup>1</sup> Simple relativistic Breit-Wigner fit with model-dependent width.

<sup>2</sup> Simple relativistic Breit-Wigner fit with constant width.

<sup>3</sup> One peak fit result.

<sup>4</sup> Parameters roughly estimated, not from a fit.

<sup>5</sup> Skew mass distribution compensated by Ross-Stodolsky factor.

<sup>6</sup> Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

## **$\pi^+\pi^-\pi^0\pi^0$ MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |          |     |                       |
|----------|----------|-----|-----------------------|
| 300 ± 50 | ATKINSON | 85B | OMEG 20-70 $\gamma p$ |
|----------|----------|-----|-----------------------|

## **$\omega\pi^0$ MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |                      |     |                                           |
|-------------|----------------------|-----|-------------------------------------------|
| 350 to 580  | <sup>1</sup> ACHASOV | 00I | SND $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |
| 490 to 1040 | <sup>2</sup> ACHASOV | 00I | SND $e^+e^- \rightarrow \pi^0\pi^0\gamma$ |

<sup>1</sup> Taking into account both  $\rho(1450)$  and  $\rho(1700)$  contributions. Using the data of ACHASOV 00I on  $e^+e^- \rightarrow \omega\pi^0$  and of EDWARDS 00A on  $\tau^- \rightarrow \omega\pi^-\nu_\tau$ .  $\rho(1450)$  mass and width fixed at 1400 MeV and 500 MeV respectively.

<sup>2</sup> Taking into account the  $\rho(1700)$  contribution only. Using the data of ACHASOV 00I on  $e^+e^- \rightarrow \omega\pi^0$  and of EDWARDS 00A on  $\tau^- \rightarrow \omega\pi^-\nu_\tau$ .

NODE=M065W1;LINKAGE=C

NODE=M065W1;LINKAGE=D

NODE=M065W1;LINKAGE=E

NODE=M065W1;LINKAGE=A

NODE=M065W1;LINKAGE=AB

NODE=M065W1;LINKAGE=LE

NODE=M065W1;LINKAGE=FU

NODE=M065W1;LINKAGE=GO

NODE=M065W;LINKAGE=QQ

NODE=M065W;LINKAGE=P

NODE=M065W;LINKAGE=M

NODE=M065W;LINKAGE=R

NODE=M065W;LINKAGE=H

NODE=M065W2

NODE=M065W2

NODE=M065W2;LINKAGE=A

NODE=M065W2;LINKAGE=AN

NODE=M065W4

NODE=M065W4

OCCUR=2

NODE=M065W;LINKAGE=A

NODE=M065W4;LINKAGE=M

NODE=M065W;LINKAGE=O

NODE=M065W;LINKAGE=C

NODE=M065W;LINKAGE=D

NODE=M065W;LINKAGE=E

NODE=M065W5

NODE=M065W5

NODE=M065W9

NODE=M065W9

OCCUR=2

NODE=M065W;LINKAGE=I1

NODE=M065W;LINKAGE=I2

**3( $\pi^+\pi^-$ ) AND 2( $\pi^+\pi^-\pi^0$ ) MODES**

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN | COMMENT                                                   |
|-------------------------------------------------------------------------------|-----------------------|------|-----------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |      |                                                           |
| 315 ± 100                                                                     | <sup>1</sup> FRABETTI | 04   | E687 $\gamma p \rightarrow 3\pi^+ 3\pi^- p$               |
| 285 ± 20                                                                      | CLEGG                 | 90   | RVUE $e^+e^- \rightarrow 3(\pi^+\pi^-)2(\pi^+\pi^-\pi^0)$ |

<sup>1</sup> From a fit with two resonances with the JACOB 72 continuum.

NODE=M065W7  
NODE=M065W7

NODE=M065W;LINKAGE=PI

$$\Gamma_{\rho(1700)^0} - \Gamma_{\rho(1700)^\pm}$$

NODE=M065DW

NODE=M065DW

| VALUE (MeV)                                                                                                                                                                                              | DOCUMENT ID         | TECN | COMMENT                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|-----------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                            |                     |      |                                                                             |
| 74.87 ± 120.67                                                                                                                                                                                           | <sup>1</sup> BARTOS | 17A  | RVUE $e^+e^- \rightarrow \pi^+\pi^-, \tau^- \rightarrow \pi^-\pi^0\nu_\tau$ |
| <sup>1</sup> Applies the Unitary & Analytic Model of the pion electromagnetic form factor of DUB-NICKA 10 to analyze the data of ACHASOV 06, AKHMETSHIN 07, AUBERT 09AS, AMBROSINO 11A, and FUJIKAWA 08. |                     |      |                                                                             |

NODE=M065DW;LINKAGE=A

 **$\rho(1700)$  DECAY MODES**

NODE=M065215;NODE=M065

| Mode                                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------------------------|--------------------------------|
| $\Gamma_1$ $4\pi$                             |                                |
| $\Gamma_2$ $2(\pi^+\pi^-)$                    | seen                           |
| $\Gamma_3$ $\rho\pi\pi$                       | seen                           |
| $\Gamma_4$ $\rho^0\pi^+\pi^-$                 | seen                           |
| $\Gamma_5$ $\rho^0\pi^0\pi^0$                 |                                |
| $\Gamma_6$ $\rho^\pm\pi^\mp\pi^0$             | seen                           |
| $\Gamma_7$ $a_1(1260)\pi$                     | seen                           |
| $\Gamma_8$ $h_1(1170)\pi$                     | seen                           |
| $\Gamma_9$ $\pi(1300)\pi$                     | seen                           |
| $\Gamma_{10}$ $\rho\rho$                      | seen                           |
| $\Gamma_{11}$ $\pi^+\pi^-$                    | seen                           |
| $\Gamma_{12}$ $\pi\pi$                        | seen                           |
| $\Gamma_{13}$ $K\bar{K}^*(892) + \text{c.c.}$ | seen                           |
| $\Gamma_{14}$ $\eta\rho$                      | seen                           |
| $\Gamma_{15}$ $a_2(1320)\pi$                  | not seen                       |
| $\Gamma_{16}$ $K\bar{K}$                      | seen                           |
| $\Gamma_{17}$ $e^+e^-$                        | seen                           |
| $\Gamma_{18}$ $\pi^0\omega$                   | seen                           |
| $\Gamma_{19}$ $\pi^0\gamma$                   | not seen                       |

DESIG=20

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=12;OUR EST;→ UNCHECKED ←

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=7

DESIG=9;OUR EST;→ UNCHECKED ←

DESIG=15;OUR EST;→ UNCHECKED ←

DESIG=16;OUR EST;→ UNCHECKED ←

DESIG=17;OUR EST;→ UNCHECKED ←

DESIG=18;OUR EST;→ UNCHECKED ←

DESIG=4;OUR EST;→ UNCHECKED ←

DESIG=13;OUR EST;→ UNCHECKED ←

DESIG=10;OUR EST;→ UNCHECKED ←

DESIG=11;OUR EST;→ UNCHECKED ←

DESIG=14;OUR EST;→ UNCHECKED ←

DESIG=5;OUR EST;→ UNCHECKED ←

DESIG=8;OUR EST;→ UNCHECKED ←

DESIG=6;OUR EST;→ UNCHECKED ←

DESIG=194

$$\rho(1700) \Gamma(i) \Gamma(e^+e^-) / \Gamma(\text{total})$$

NODE=M065225

This combination of a partial width with the partial width into  $e^+e^-$  and with the total width is obtained from the cross-section into channel<sub>i</sub> in  $e^+e^-$  annihilation.

NODE=M065225

$$\Gamma(2(\pi^+\pi^-)) \times \Gamma(e^+e^-) / \Gamma_{\text{total}} \quad \Gamma_2 \Gamma_{17} / \Gamma$$

| VALUE (keV)                                                                   | DOCUMENT ID | TECN | COMMENT                                 |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                         |
| 2.6 ± 0.2                                                                     | DEL COURT   | 81B  | DM1 $e^+e^- \rightarrow 2(\pi^+\pi^-)$  |
| 2.83 ± 0.42                                                                   | BACCI       | 80   | FRAG $e^+e^- \rightarrow 2(\pi^+\pi^-)$ |

NODE=M065G2  
NODE=M065G2

$$\Gamma(\pi^+\pi^-) \times \Gamma(e^+e^-) / \Gamma_{\text{total}} \quad \Gamma_{11} \Gamma_{17} / \Gamma$$

| VALUE (keV)                                                                   | DOCUMENT ID          | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|----------------------|------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |      |                                               |
| 0.13                                                                          | <sup>1</sup> DIEKMAN | 88   | RVUE $e^+e^- \rightarrow \pi^+\pi^-$          |
| 0.029 <sup>+0.016</sup> <sub>-0.012</sub>                                     | KURDADZE             | 83   | OLYA 0.64–1.4 $e^+e^- \rightarrow \pi^+\pi^-$ |

<sup>1</sup> Using total width = 220 MeV.

NODE=M065G4  
NODE=M065G4

NODE=M065G4;LINKAGE=B

$$\Gamma(K\bar{K}^*(892)+c.c.) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{13}\Gamma_{17}/\Gamma$$

VALUE (keV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.305±0.071 <sup>1</sup> BIZOT 80 DM1 e<sup>+</sup>e<sup>-</sup>

<sup>1</sup> Model dependent.

NODE=M065G10  
NODE=M065G10

NODE=M065G;LINKAGE=M

$$\Gamma(\eta\rho) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{14}\Gamma_{17}/\Gamma$$

VALUE (eV) EVTS DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.35± 0.53±0.08 13.4k <sup>1</sup> GRIBANOV 20 CMD3 1.1–2.0 e<sup>+</sup>e<sup>-</sup> → ηπ<sup>+</sup>π<sup>-</sup>  
84 ±26 ±4 <sup>2</sup> LEES 18 BABR e<sup>+</sup>e<sup>-</sup> → ηπ<sup>+</sup>π<sup>-</sup>  
7 ±3 ANTONELLI 88 DM2 e<sup>+</sup>e<sup>-</sup> → ηπ<sup>+</sup>π<sup>-</sup>

<sup>1</sup> Mass and width of the ρ(770) fixed at 775 and 149 MeV, respectively; solution 2 of model 2, η → γγ decays used.

<sup>2</sup> Includes non-resonant contribution. The selected fit model includes three ρ excited states. Model uncertainty is 80%.

NODE=M065G11  
NODE=M065G11

NODE=M065G11;LINKAGE=B

NODE=M065G11;LINKAGE=A

$$\Gamma(K\bar{K}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{16}\Gamma_{17}/\Gamma$$

VALUE (keV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.035±0.029 <sup>1</sup> BIZOT 80 DM1 e<sup>+</sup>e<sup>-</sup>

<sup>1</sup> Model dependent.

NODE=M065G5  
NODE=M065G5

NODE=M065G5;LINKAGE=M

$$\Gamma(\rho\pi\pi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_3\Gamma_{17}/\Gamma$$

VALUE (keV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

3.510±0.090 <sup>1</sup> BIZOT 80 DM1 e<sup>+</sup>e<sup>-</sup>

<sup>1</sup> Model dependent.

NODE=M065G12  
NODE=M065G12

NODE=M065G12;LINKAGE=M

$$\rho(1700) \Gamma(i)/\Gamma(\text{total}) \times \Gamma(e^+e^-)/\Gamma(\text{total})$$

NODE=M065240

$$\Gamma(\pi^0\omega)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{18}/\Gamma \times \Gamma_{17}/\Gamma$$

VALUE (units 10<sup>-6</sup>) EVTS DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.09±0.05 10.2k <sup>1</sup> ACHASOV 16D SND 1.05–2.00 e<sup>+</sup>e<sup>-</sup> → π<sup>0</sup>π<sup>0</sup>γ  
1.7 ±0.4 7815 <sup>2</sup> ACHASOV 13 SND 1.05–2.00 e<sup>+</sup>e<sup>-</sup> → π<sup>0</sup>π<sup>0</sup>γ

<sup>1</sup> From a phenomenological model based on vector meson dominance with interfering ρ(700), ρ(1450), and ρ(1700). The ρ(1700) mass and width are fixed at 1720 MeV and 250 MeV, respectively. Systematic uncertainty not estimated. Supersedes ACHASOV 13.

<sup>2</sup> From a phenomenological model based on vector meson dominance with the interfering ρ(1450) and ρ(1700) and their widths fixed at 400 and 250 MeV, respectively. Systematic uncertainty not estimated.

OCCUR=4

NODE=M065R01;LINKAGE=B

NODE=M065R01;LINKAGE=AC

$$\Gamma(\eta\rho)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{14}/\Gamma \times \Gamma_{17}/\Gamma$$

VALUE (units 10<sup>-8</sup>) EVTS DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

8.3<sup>+3.8</sup><sub>-3.1</sub> 7.4k <sup>1</sup> ACHASOV 18 SND 1.22–2.00 e<sup>+</sup>e<sup>-</sup> → ηπ<sup>+</sup>π<sup>-</sup>

<sup>1</sup> From the combined fit of AULCHENKO 15 and ACHASOV 18 in the model with the interfering ρ(1450), ρ(1700) and ρ(2150) with the parameters of the ρ(1450) and ρ(1700) floating and the mass and width of the ρ(2150) fixed at 2155 MeV and 320 MeV, respectively. The phases of the resonances are π, 0 and π, respectively.

NODE=M065R00  
NODE=M065R00

NODE=M065R00;LINKAGE=A

## ρ(1700) BRANCHING RATIOS

NODE=M065230

$$\Gamma(\rho\pi\pi)/\Gamma(4\pi) \quad \Gamma_3/\Gamma_1$$

VALUE DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.28±0.06 <sup>1</sup> ABELE 01B CBAR 0.0  $\bar{p}n \rightarrow 5\pi$

<sup>1</sup> ωπ not included.

NODE=M065R19  
NODE=M065R19

NODE=M065R;LINKAGE=BL



$\Gamma(\rho^0\pi^+\pi^-)/\Gamma(2(\pi^+\pi^-))$  $\Gamma_4/\Gamma_2$ 

| VALUE                                                                         | EVTs | DOCUMENT ID          | TECN    | COMMENT                             |
|-------------------------------------------------------------------------------|------|----------------------|---------|-------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |         |                                     |
| $\sim 1.0$                                                                    |      | DELCOURT             | 81B DM1 | $e^+e^- \rightarrow 2(\pi^+\pi^-)$  |
| $0.7 \pm 0.1$                                                                 | 500  | SCHACHT              | 74 STRC | $5.5-18 \gamma p \rightarrow p4\pi$ |
| 0.80                                                                          |      | <sup>1</sup> BINGHAM | 72B HBC | $9.3 \gamma p \rightarrow p4\pi$    |

<sup>1</sup> The  $\pi\pi$  system is in  $S$ -wave.NODE=M065R1  
NODE=M065R1

NODE=M065R1;LINKAGE=S

 $\Gamma(\rho^0\pi^0\pi^0)/\Gamma(\rho^\pm\pi^\mp\pi^0)$  $\Gamma_5/\Gamma_6$ 

| VALUE                                                                         | DOCUMENT ID | TECN     | CHG | COMMENT                            |
|-------------------------------------------------------------------------------|-------------|----------|-----|------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |          |     |                                    |
| $<0.10$                                                                       | ATKINSON    | 85B OMEG |     | $20-70 \gamma p$                   |
| $<0.15$                                                                       | ATKINSON    | 82 OMEG  | 0   | $20-70 \gamma p \rightarrow p4\pi$ |

NODE=M065R6  
NODE=M065R6 $\Gamma(a_1(1260)\pi)/\Gamma(4\pi)$  $\Gamma_7/\Gamma_1$ 

| VALUE                                                                         | DOCUMENT ID        | TECN     | COMMENT                         |
|-------------------------------------------------------------------------------|--------------------|----------|---------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |          |                                 |
| $0.16 \pm 0.05$                                                               | <sup>1</sup> ABELE | 01B CBAR | $0.0 \bar{p}n \rightarrow 5\pi$ |

<sup>1</sup>  $\omega\pi$  not included.NODE=M065R15  
NODE=M065R15

NODE=M065R15;LINKAGE=BL

 $\Gamma(h_1(1170)\pi)/\Gamma(4\pi)$  $\Gamma_8/\Gamma_1$ 

| VALUE                                                                         | DOCUMENT ID        | TECN     | COMMENT                         |
|-------------------------------------------------------------------------------|--------------------|----------|---------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |          |                                 |
| $0.17 \pm 0.06$                                                               | <sup>1</sup> ABELE | 01B CBAR | $0.0 \bar{p}n \rightarrow 5\pi$ |

<sup>1</sup>  $\omega\pi$  not included.NODE=M065R16  
NODE=M065R16

NODE=M065R16;LINKAGE=BL

 $\Gamma(\pi(1300)\pi)/\Gamma(4\pi)$  $\Gamma_9/\Gamma_1$ 

| VALUE                                                                         | DOCUMENT ID        | TECN     | COMMENT                         |
|-------------------------------------------------------------------------------|--------------------|----------|---------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |          |                                 |
| $0.30 \pm 0.10$                                                               | <sup>1</sup> ABELE | 01B CBAR | $0.0 \bar{p}n \rightarrow 5\pi$ |

<sup>1</sup>  $\omega\pi$  not included.NODE=M065R17  
NODE=M065R17

NODE=M065R17;LINKAGE=BL

 $\Gamma(\rho\rho)/\Gamma(4\pi)$  $\Gamma_{10}/\Gamma_1$ 

| VALUE                                                                         | DOCUMENT ID        | TECN     | COMMENT                         |
|-------------------------------------------------------------------------------|--------------------|----------|---------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |          |                                 |
| $0.09 \pm 0.03$                                                               | <sup>1</sup> ABELE | 01B CBAR | $0.0 \bar{p}n \rightarrow 5\pi$ |

<sup>1</sup>  $\omega\pi$  not included.NODE=M065R18  
NODE=M065R18

NODE=M065R18;LINKAGE=BL

 $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID            | TECN     | COMMENT                                 |
|-------------------------------------------------------------------------------|------------------------|----------|-----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |          |                                         |
| $0.108 \pm 0.017^{+0.162}_{-0.004}$                                           | <sup>1</sup> ALBRECHT  | 20 RVUE  | $0.9 \bar{p}p \rightarrow K^+K^-\pi^0$  |
| $0.287^{+0.043}_{-0.042}$                                                     | BECKER                 | 79 ASPK  | $17 \pi^- p$ polarized                  |
| $0.15$ to $0.30$                                                              | <sup>2</sup> MARTIN    | 78C RVUE | $17 \pi^- p \rightarrow \pi^+\pi^-n$    |
| $<0.20$                                                                       | <sup>3</sup> COSTA...  | 77B RVUE | $e^+e^- \rightarrow 2\pi, 4\pi$         |
| $0.30 \pm 0.05$                                                               | <sup>2</sup> FROGGATT  | 77 RVUE  | $17 \pi^- p \rightarrow \pi^+\pi^-n$    |
| $<0.15$                                                                       | <sup>4</sup> EISENBERG | 73 HBC   | $5 \pi^+ p \rightarrow \Delta^{++}2\pi$ |
| $0.25 \pm 0.05$                                                               | <sup>5</sup> HYAMS     | 73 ASPK  | $17 \pi^- p \rightarrow \pi^+\pi^-n$    |

<sup>1</sup> Residue from T-matrix pole, 2 poles, 3 channels, Chew-Mandelstam functions and simplified analytic continuation for the  $4\pi$  channel. Includes scattering data from HYAMS 75 and model-independent calculation of GARCIA-MARTIN 11A.<sup>2</sup> From phase shift analysis of HYAMS 73 data.<sup>3</sup> Estimate using unitarity, time reversal invariance, Breit-Wigner.<sup>4</sup> Estimated using one-pion-exchange model.<sup>5</sup> Included in BECKER 79 analysis.NODE=M065R5  
NODE=M065R5

NODE=M065R5;LINKAGE=A

NODE=M065R5;LINKAGE=P  
NODE=M065R5;LINKAGE=C  
NODE=M065R5;LINKAGE=E  
NODE=M065R5;LINKAGE=H $\Gamma(K\bar{K})/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID           | TECN    | COMMENT                                |
|-------------------------------------------------------------------------------|-----------------------|---------|----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |         |                                        |
| $0.007 \pm 0.006^{+0.041}_{-0.002}$                                           | <sup>1</sup> ALBRECHT | 20 RVUE | $0.9 \bar{p}p \rightarrow K^+K^-\pi^0$ |

<sup>1</sup> Residue from T-matrix pole, 2 poles, 3 channels, Chew-Mandelstam functions and simplified analytic continuation for the  $4\pi$  channel. Includes scattering data from HYAMS 75 and model-independent calculation of GARCIA-MARTIN 11A.NODE=M065R03  
NODE=M065R03

NODE=M065R03;LINKAGE=A

$\Gamma(\pi^+\pi^-)/\Gamma(2(\pi^+\pi^-))$  $\Gamma_{11}/\Gamma_2$ 

| VALUE                                                                         | DOCUMENT ID          | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|----------------------|------|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |      |                                          |
| $0.13 \pm 0.05$                                                               | ASTON                | 80   | OMEG $20-70 \gamma p \rightarrow p 2\pi$ |
| $< 0.14$                                                                      | <sup>1</sup> DAVIER  | 73   | STRC $6-18 \gamma p \rightarrow p 4\pi$  |
| $< 0.2$                                                                       | <sup>2</sup> BINGHAM | 72B  | HBC $9.3 \gamma p \rightarrow p 2\pi$    |
| <sup>1</sup> Upper limit is estimate.                                         |                      |      |                                          |
| <sup>2</sup> $2\sigma$ upper limit.                                           |                      |      |                                          |

NODE=M065R3  
 NODE=M065R3

NODE=M065R3;LINKAGE=E  
 NODE=M065R3;LINKAGE=S

 $\Gamma(\pi\pi)/\Gamma(4\pi)$  $\Gamma_{12}/\Gamma_1$ 

| VALUE                                                                         | DOCUMENT ID          | TECN | COMMENT                               |
|-------------------------------------------------------------------------------|----------------------|------|---------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |      |                                       |
| $0.16 \pm 0.04$                                                               | <sup>1,2</sup> ABELE | 01B  | CBAR $0.0 \bar{p} n \rightarrow 5\pi$ |
| <sup>1</sup> Using ABELE 97.                                                  |                      |      |                                       |
| <sup>2</sup> $\omega\pi$ not included.                                        |                      |      |                                       |

NODE=M065R20  
 NODE=M065R20

NODE=M065R;LINKAGE=LK  
 NODE=M065R20;LINKAGE=BL

 $\Gamma(K\bar{K}^*(892)+c.c.)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                          |
|-------------------------------------------------------------------------------|-------------|------|--------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                                  |
| possibly seen                                                                 | COAN        | 04   | CLEO $\tau^- \rightarrow K^- \pi^- K^+ \nu_\tau$ |

NODE=M065R21  
 NODE=M065R21

 $\Gamma(K\bar{K}^*(892)+c.c.)/\Gamma(2(\pi^+\pi^-))$  $\Gamma_{13}/\Gamma_2$ 

| VALUE                                                                                        | DOCUMENT ID           | TECN | COMMENT                                 |
|----------------------------------------------------------------------------------------------|-----------------------|------|-----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                |                       |      |                                         |
| $0.15 \pm 0.03$                                                                              | <sup>1</sup> DELCOURT | 81B  | DM1 $e^+ e^- \rightarrow \bar{K} K \pi$ |
| <sup>1</sup> Assuming $\rho(1700)$ and $\omega$ radial excitations to be degenerate in mass. |                       |      |                                         |

NODE=M065R9  
 NODE=M065R9

NODE=M065R9;LINKAGE=D

 $\Gamma(\eta\rho)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|-----|-------------|------|---------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                             |
| possibly seen                                                                 |     | AKHMETSHIN  | 00D  | CMD2 $e^+ e^- \rightarrow \eta \pi^+ \pi^-$ |
| $< 0.04$                                                                      |     | DONNACHIE   | 87B  | RVUE                                        |
| $< 0.02$                                                                      | 58  | ATKINSON    | 86B  | OMEG $20-70 \gamma p$                       |

NODE=M065R12  
 NODE=M065R12

 $\Gamma(\eta\rho)/\Gamma(2(\pi^+\pi^-))$  $\Gamma_{14}/\Gamma_2$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|-------------|------|-------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                                 |
| $0.123 \pm 0.027$                                                             | DELCOURT    | 82   | DM1 $e^+ e^- \rightarrow \pi^+ \pi^- \text{MM}$ |
| $\sim 0.1$                                                                    | ASTON       | 80   | OMEG $20-70 \gamma p$                           |

NODE=M065R8  
 NODE=M065R8

 $\Gamma(\pi^+\pi^- \text{ neutrals})/\Gamma(2(\pi^+\pi^-))$  $(\Gamma_5+\Gamma_6+0.714\Gamma_{14})/\Gamma_2$ 

| VALUE                                                                         | DOCUMENT ID         | TECN | COMMENT            |
|-------------------------------------------------------------------------------|---------------------|------|--------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |      |                    |
| $2.6 \pm 0.4$                                                                 | <sup>1</sup> BALLAM | 74   | HBC $9.3 \gamma p$ |
| <sup>1</sup> Upper limit. Background not subtracted.                          |                     |      |                    |

NODE=M065R7  
 NODE=M065R7

NODE=M065R7;LINKAGE=U

 $\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|-------------|------|-------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                                 |
| not seen                                                                      | AMELIN      | 00   | VES $37 \pi^- p \rightarrow \eta \pi^+ \pi^- n$ |

NODE=M065R14  
 NODE=M065R14

 $\Gamma(K\bar{K})/\Gamma(2(\pi^+\pi^-))$  $\Gamma_{16}/\Gamma_2$ 

| VALUE                                                                                        | CL% | DOCUMENT ID           | TECN | CHG | COMMENT                         |
|----------------------------------------------------------------------------------------------|-----|-----------------------|------|-----|---------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                |     |                       |      |     |                                 |
| $0.015 \pm 0.010$                                                                            |     | <sup>1</sup> DELCOURT | 81B  | DM1 | $e^+ e^- \rightarrow \bar{K} K$ |
| $< 0.04$                                                                                     | 95  | BINGHAM               | 72B  | HBC | $0 \quad 9.3 \gamma p$          |
| <sup>1</sup> Assuming $\rho(1700)$ and $\omega$ radial excitations to be degenerate in mass. |     |                       |      |     |                                 |

NODE=M065R4  
 NODE=M065R4

NODE=M065R4;LINKAGE=D

 $\Gamma(K\bar{K})/\Gamma(K\bar{K}^*(892)+c.c.)$  $\Gamma_{16}/\Gamma_{13}$ 

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|-------------|------|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                          |
| $0.052 \pm 0.026$                                                             | BUON        | 82   | DM1 $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M065R10  
 NODE=M065R10

$\Gamma(\pi^0\omega)/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

| VALUE                                                                         | EVTS | DOCUMENT ID | TECN | COMMENT                                          |
|-------------------------------------------------------------------------------|------|-------------|------|--------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |             |      |                                                  |
| not seen                                                                      |      | MATVIENKO   | 15   | BELL $\bar{B}^0 \rightarrow D^{*+} \omega \pi^-$ |
| seen                                                                          | 1.6k | ACHASOV     | 12   | SND $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$     |
| not seen                                                                      | 2382 | AKHMETSHIN  | 03B  | CMD2 $e^+ e^- \rightarrow \pi^0 \pi^0 \gamma$    |
| seen                                                                          |      | ACHASOV     | 97   | RVUE $e^+ e^- \rightarrow \omega \pi^0$          |

 $\Gamma(\pi^0\gamma)/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ 

| VALUE    | DOCUMENT ID          | TECN | COMMENT                                          |
|----------|----------------------|------|--------------------------------------------------|
| not seen | <sup>1</sup> ACHASOV | 10D  | SND $1.075-2.0 e^+ e^- \rightarrow \pi^0 \gamma$ |

<sup>1</sup> From a fit of a VMD model with two effective resonances with masses of 1450 MeV and 1700 MeV to describe the excited vector states  $\omega(1420)$ ,  $\rho(1450)$ ,  $\omega(1650)$ , and  $\rho(1700)$ . The width of the highest mass effective resonance is fixed at 315 MeV.

 $\rho(1700)$  REFERENCES

|               |      |                              |                                              |                                 |
|---------------|------|------------------------------|----------------------------------------------|---------------------------------|
| ALBRECHT      | 20   | EPJ C80 453                  | M. Albrecht <i>et al.</i>                    | (Crystal Barrel Collab.)        |
| GRIBANOV      | 20   | JHEP 2001 112                | S.S. Gribanov <i>et al.</i>                  | (CMD-3 Collab.)                 |
| ACHASOV       | 18   | PR D97 012008                | M.N. Achasov <i>et al.</i>                   | (SND Collab.)                   |
| LEES          | 18   | PR D97 052007                | J.P. Lees <i>et al.</i>                      | (BABAR Collab.)                 |
| BARTOS        | 17   | PR D96 113004                | E. Bartos <i>et al.</i>                      |                                 |
| BARTOS        | 17A  | IJMP A32 1750154             | E. Bartos <i>et al.</i>                      |                                 |
| LEES          | 17C  | PR D95 072007                | J.P. Lees <i>et al.</i>                      | (BABAR Collab.)                 |
| AAIJ          | 16N  | PR D93 052018                | R. Aaij <i>et al.</i>                        | (LHCb Collab.)                  |
| ABLIKIM       | 16C  | PL B753 629                  | M. Ablikim <i>et al.</i>                     | (BESIII Collab.)                |
| ACHASOV       | 16D  | PR D94 112001                | M.N. Achasov <i>et al.</i>                   | (SND Collab.)                   |
| AULCHENKO     | 15   | PR D91 052013                | V.M. Aulchenko <i>et al.</i>                 | (SND Collab.)                   |
| MATVIENKO     | 15   | PR D92 012013                | D. Matvienko <i>et al.</i>                   | (BELLE Collab.)                 |
| ACHASOV       | 13   | PR D88 054013                | M.N. Achasov <i>et al.</i>                   | (SND Collab.)                   |
| ABRAMOWICZ    | 12   | EPJ C72 1869                 | H. Abramowicz <i>et al.</i>                  | (ZEUS Collab.)                  |
| ACHASOV       | 12   | JETPL 94 734                 | M.N. Achasov <i>et al.</i>                   |                                 |
| LEES          | 12G  | Translated from ZETFP 94 796 | J.P. Lees <i>et al.</i>                      | (BABAR Collab.)                 |
| AMBROSINO     | 11A  | PR D86 032013                | F. Ambrosino <i>et al.</i>                   | (KLOE Collab.)                  |
| GARCIA-MAR... | 11A  | PR D83 074004                | R. Garcia-Martin <i>et al.</i>               | (MADR, CRAC)                    |
| ACHASOV       | 10D  | PR D98 112001                | M.N. Achasov <i>et al.</i>                   | (SND Collab.)                   |
| DUBNICKA      | 10   | APS 60 1                     | S. Dubnicka, A.Z. Dubnickova                 |                                 |
| AUBERT        | 09AS | PRL 103 231801               | B. Aubert <i>et al.</i>                      | (BABAR Collab.)                 |
| FUJIKAWA      | 08   | PR D78 027006                | M. Fujikawa <i>et al.</i>                    | (BELLE Collab.)                 |
| AKHMETSHIN    | 07   | PL B648 28                   | R.R. Akhmetshin <i>et al.</i>                | (Novosibirsk CMD-2 Collab.)     |
| ACHASOV       | 06   | JETP 103 380                 | M.N. Achasov <i>et al.</i>                   | (Novosibirsk SND Collab.)       |
| COAN          | 04   | Translated from ZETF 130 437 | T.E. Coan <i>et al.</i>                      | (CLEO Collab.)                  |
| FRABETTI      | 04   | PRL 92 232001                | P.L. Frabetti <i>et al.</i>                  | (FNAL E687 Collab.)             |
| AKHMETSHIN    | 03B  | PL B578 290                  | R.R. Akhmetshin <i>et al.</i>                | (Novosibirsk CMD-2 Collab.)     |
| ABELE         | 01B  | EPJ C21 261                  | A. Abele <i>et al.</i>                       | (Crystal Barrel Collab.)        |
| ACHASOV       | 00I  | PL B486 29                   | M.N. Achasov <i>et al.</i>                   | (Novosibirsk SND Collab.)       |
| AKHMETSHIN    | 00D  | PL B489 125                  | R.R. Akhmetshin <i>et al.</i>                | (Novosibirsk CMD-2 Collab.)     |
| AMELIN        | 00   | NP A668 83                   | D. Amelin <i>et al.</i>                      | (VES Collab.)                   |
| EDWARDS       | 00A  | PR D61 072003                | K.W. Edwards <i>et al.</i>                   | (CLEO Collab.)                  |
| ABELE         | 99D  | PL B468 178                  | A. Abele <i>et al.</i>                       | (Crystal Barrel Collab.)        |
| ABELE         | 97   | PL B391 191                  | A. Abele <i>et al.</i>                       | (Crystal Barrel Collab.)        |
| ACHASOV       | 97   | PR D55 2663                  | N.N. Achasov <i>et al.</i>                   | (NOVM)                          |
| BERTIN        | 97C  | PL B408 476                  | A. Bertin <i>et al.</i>                      | (OBELIX Collab.)                |
| CLEGG         | 94   | ZPHY C62 455                 | A.B. Clegg, A. Donnachie                     | (LANC, MCHS)                    |
| CLEGG         | 90   | ZPHY C45 677                 | A.B. Clegg, A. Donnachie                     | (LANC, MCHS)                    |
| KUHN          | 90   | ZPHY C48 445                 | J.H. Kuhn <i>et al.</i>                      | (MPIM)                          |
| BISELLO       | 89   | PL B220 321                  | D. Bisello <i>et al.</i>                     | (DM2 Collab.)                   |
| DUBNICKA      | 89   | JP G15 1349                  | S. Dubnicka <i>et al.</i>                    | (JINR, SLOV)                    |
| GESHKEN...    | 89   | ZPHY C45 351                 | B.V. Geshkenbein                             | (ITEP)                          |
| ANTONELLI     | 88   | PL B212 133                  | A. Antonelli <i>et al.</i>                   | (DM2 Collab.)                   |
| DIEKMANN      | 88   | PRPL 159 99                  | B. Diekmann                                  | (BONN)                          |
| FUKUI         | 88   | PL B202 441                  | S. Fukui <i>et al.</i>                       | (SUGI, NAGO, KEK, KYOT+)        |
| DONNACHIE     | 87B  | ZPHY C34 257                 | A. Donnachie, A.B. Clegg                     | (MCHS, LANC)                    |
| ATKINSON      | 86B  | ZPHY C30 531                 | M. Atkinson <i>et al.</i>                    | (BONN, CERN, GLAS+)             |
| ATKINSON      | 85B  | ZPHY C26 499                 | M. Atkinson <i>et al.</i>                    | (BONN, CERN, GLAS+)             |
| ERKAL         | 85   | ZPHY C29 485                 | C. Erkal, M.G. Olsson                        | (WISC)                          |
| ABE           | 84B  | PRL 53 751                   | K. Abe <i>et al.</i>                         | (SLAC HFP Collab.)              |
| KURDADZE      | 83   | JETPL 37 733                 | L.M. Kurdadze <i>et al.</i>                  | (NOVO)                          |
| ATKINSON      | 82   | Translated from ZETFP 37 613 | M. Atkinson <i>et al.</i>                    | (BONN, CERN, GLAS+)             |
| BUON          | 82   | PL 118B 221                  | J. Buon <i>et al.</i>                        | (LALO, MONP)                    |
| CLELAND       | 82B  | NP B208 228                  | W.E. Cleland <i>et al.</i>                   | (DURH, GEVA, LAUS+)             |
| CORDIER       | 82   | PL 109B 129                  | A. Cordier <i>et al.</i>                     | (LALO)                          |
| DELCOURT      | 82   | PL 113B 93                   | B. Delcourt <i>et al.</i>                    | (LALO)                          |
| ASTON         | 81E  | NP B189 15                   | D. Aston                                     | (BONN, CERN, EPOL, GLAS, LANC+) |
| DELCOURT      | 81B  | Bonn Conf. 205               | B. Delcourt                                  | (ORSAY)                         |
| DIBIANCA      | 81   | Also PL 109B 129             | A. Cordier <i>et al.</i>                     | (LALO)                          |
| ASTON         | 80   | PR D23 595                   | F.A. di Bianca <i>et al.</i>                 | (CASE, CMU)                     |
| BACCI         | 80   | PL 92B 215                   | D. Aston                                     | (BONN, CERN, EPOL, GLAS, LANC+) |
| BIZOT         | 80   | PL 95B 139                   | C. Bacci <i>et al.</i>                       | (ROMA, FRAS)                    |
| KILLIAN       | 80   | Madison Conf. 546            | J.C. Bizot <i>et al.</i>                     | (LALO, MONP)                    |
| ATIYA         | 79B  | PR D21 3005                  | T.J. Killian <i>et al.</i>                   | (CORN)                          |
| BECKER        | 79   | PRL 43 1691                  | M.S. Atiya <i>et al.</i>                     | (COLU, ILL, FNAL)               |
| LANG          | 79   | NP B151 46                   | H. Becker <i>et al.</i>                      | (MPIM, CERN, ZEEM, CRAC)        |
| MARTIN        | 79   | PR D19 956                   | C.B. Lang, A. Mas-Parada                     | (GRAZ)                          |
| COSTA...      | 78C  | ANP 114 1                    | A.D. Martin, M.R. Pennington                 | (CERN)                          |
| FROGGATT      | 77B  | PL 71B 345                   | B. Costa de Beauregard, B. Pire, T.N. Truong | (EPOL)                          |
| ALEXANDER     | 77   | NP B129 89                   | C.D. Froggatt, J.L. Petersen                 | (GLAS, NORD)                    |
| HYAMS         | 75   | PL 57B 487                   | G. Alexander <i>et al.</i>                   | (TELA)                          |
| BALLAM        | 74   | NP B100 205                  | B.D. Hyams <i>et al.</i>                     | (CERN, MPIM)                    |
| CONVERSI      | 74   | NP B76 375                   | J. Ballam <i>et al.</i>                      | (SLAC, LBL, MPIM)               |
| SCHACHT       | 74   | PL 52B 493                   | M. Conversi <i>et al.</i>                    | (ROMA, FRAS)                    |
| DAVIER        | 73   | NP B81 205                   | P. Schacht <i>et al.</i>                     | (MPIM)                          |
| EISENBERG     | 73   | NP B58 31                    | M. Davier <i>et al.</i>                      | (SLAC)                          |
| HYAMS         | 73   | PL 43B 149                   | Y. Eisenberg <i>et al.</i>                   | (REHO)                          |
| BINGHAM       | 72B  | NP B64 134                   | B.D. Hyams <i>et al.</i>                     | (CERN, MPIM)                    |
| JACOB         | 72   | PL 41B 635                   | H.H. Bingham <i>et al.</i>                   | (LBL, UCB, SLAC) IGJP           |
| GOUNARIS      | 68   | PR D5 1847                   | M. Jacob, R. Slansky                         |                                 |
|               |      | PRL 21 244                   | G.J. Gounaris, J.J. Sakurai                  |                                 |

NODE=M065R13  
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 REFID=49668  
 REFID=48054

$a_2(1700)$ 

$$I^G(J^{PC}) = 1^-(2^{++})$$

NODE=M162

 $a_2(1700)$  MASS

NODE=M162M

| VALUE (MeV)                                                                                                                                                  | EVTS               | DOCUMENT ID                      | TECN     | COMMENT                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------------------|----------|--------------------------------------------------------------------------------------------|
| <b>1698 ±40</b>                                                                                                                                              | <b>OUR AVERAGE</b> | [1705 ± 40 MeV OUR 2020 AVERAGE] |          |                                                                                            |
| <b>1698 ±44</b>                                                                                                                                              |                    | <sup>1</sup> AMSLER              | 02 CBAR  | 0.9 $\bar{p}p \rightarrow \pi^0 \eta \eta$                                                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                |                    |                                  |          |                                                                                            |
| 1638.9 ± 2.3 <sup>+57.4</sup> <sub>-0.1</sub>                                                                                                                |                    | <sup>2</sup> ALBRECHT            | 20 RVUE  | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$ ,<br>$\pi^0 \eta \eta$ , $\pi^0 K^+ K^-$       |
| 1722 ±15 ±67                                                                                                                                                 |                    | <sup>3</sup> RODAS               | 19 JPAC  | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$                                          |
| 1681 <sup>+22</sup> <sub>-35</sub>                                                                                                                           | 46M                | <sup>4,5</sup> AGHASYAN          | 18B COMP | 190 $\pi^- p \rightarrow$<br>$\pi^- \pi^+ \pi^- p$                                         |
| 1720 ±10 ±60                                                                                                                                                 |                    | <sup>6</sup> JACKURA             | 18 JPAC  | $\pi^- p \rightarrow \eta \pi^- p$                                                         |
| 1726 ±12 ±25                                                                                                                                                 |                    | <sup>5</sup> ABLIKIM             | 17K BES3 | $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$                                             |
| 1675 ±25                                                                                                                                                     |                    | ANISOVICH                        | 09 RVUE  | 0.0 $\bar{p}p$ , $\pi N$                                                                   |
| 1722 ± 9 ±15                                                                                                                                                 | 18k                | <sup>7</sup> SCHEGELSKY          | 06 RVUE  | $\gamma \gamma \rightarrow \pi^+ \pi^- \pi^0$                                              |
| 1702 ± 7                                                                                                                                                     | 80k                | <sup>8</sup> UMAN                | 06 E835  | 5.2 $\bar{p}p \rightarrow \eta \eta \pi^0$                                                 |
| 1721 ±13 ±44                                                                                                                                                 | 145k               | LU                               | 05 B852  | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$                                              |
| 1737 ± 5 ± 7                                                                                                                                                 |                    | ABE                              | 04 BELL  | 10.6 $e^+ e^- \rightarrow$<br>$e^+ e^- K^+ K^-$                                            |
| 1767 ±14                                                                                                                                                     | 221                | <sup>9</sup> ACCIARRI            | 01H L3   | $\gamma \gamma \rightarrow K_S^0 K_S^0$ , $E_{\text{cm}}^{\text{ee}} =$<br>91, 183–209 GeV |
| 1660 ±40                                                                                                                                                     |                    | <sup>5</sup> ABELE               | 99B CBAR | 1.94 $\bar{p}p \rightarrow \pi^0 \eta \eta$                                                |
| ~ 1775                                                                                                                                                       |                    | <sup>10</sup> GRYGOREV           | 99 SPEC  | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$                                                     |
| 1752 ±21 ± 4                                                                                                                                                 |                    | ACCIARRI                         | 97T L3   | $\gamma \gamma \rightarrow \pi^+ \pi^- \pi^0$                                              |
| <sup>1</sup> T-matrix pole.                                                                                                                                  |                    |                                  |          |                                                                                            |
| <sup>2</sup> T-matrix pole, 2 poles, 2 channels ( $\pi \eta$ , $K \bar{K}$ ).                                                                                |                    |                                  |          |                                                                                            |
| <sup>3</sup> The coupled-channel analysis of both the $\eta \pi$ and $\eta' \pi$ systems using ADOLPH 15 data. The mass is extracted from the T-matrix pole. |                    |                                  |          |                                                                                            |
| <sup>4</sup> Statistical error negligible.                                                                                                                   |                    |                                  |          |                                                                                            |
| <sup>5</sup> Breit-Wigner mass.                                                                                                                              |                    |                                  |          |                                                                                            |
| <sup>6</sup> Superseded by RODAS 19.                                                                                                                         |                    |                                  |          |                                                                                            |
| <sup>7</sup> From analysis of L3 data at 183–209 GeV.                                                                                                        |                    |                                  |          |                                                                                            |
| <sup>8</sup> Statistical error only.                                                                                                                         |                    |                                  |          |                                                                                            |
| <sup>9</sup> Spin 2 dominant, isospin not determined, could also be $I=1$ .                                                                                  |                    |                                  |          |                                                                                            |
| <sup>10</sup> Possibly two $J^P = 2^+$ resonances with isospins 0 and 1.                                                                                     |                    |                                  |          |                                                                                            |

NODE=M162M

NEW

NODE=M162M;LINKAGE=TT  
 NODE=M162M;LINKAGE=G  
 NODE=M162M;LINKAGE=C

NODE=M162M;LINKAGE=B  
 NODE=M162M;LINKAGE=E  
 NODE=M162M;LINKAGE=D  
 NODE=M162M;LINKAGE=SC  
 NODE=M162M;LINKAGE=ST  
 NODE=M162M;LINKAGE=HA  
 NODE=M162M;LINKAGE=GR

 $a_2(1700)$  WIDTH

NODE=M162W

| VALUE (MeV)                                                                   | EVTS               | DOCUMENT ID                     | TECN     | COMMENT                                                                                    |
|-------------------------------------------------------------------------------|--------------------|---------------------------------|----------|--------------------------------------------------------------------------------------------|
| <b>265 ± 60</b>                                                               | <b>OUR AVERAGE</b> | [258 ± 40 MeV OUR 2020 AVERAGE] |          |                                                                                            |
| <b>265 ± 55</b>                                                               |                    | <sup>1</sup> AMSLER             | 02 CBAR  | 0.9 $\bar{p}p \rightarrow \pi^0 \eta \eta$                                                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |                                 |          |                                                                                            |
| 224.0 ± 2.5 <sup>+1.8</sup> <sub>-48.3</sub>                                  |                    | <sup>2</sup> ALBRECHT           | 20 RVUE  | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta$ ,<br>$\pi^0 \eta \eta$ , $\pi^0 K^+ K^-$       |
| 247 ± 17 ±63                                                                  |                    | <sup>3</sup> RODAS              | 19 JPAC  | 191 $\pi^- p \rightarrow \eta' \pi^- p$                                                    |
| 436 <sup>+20</sup> <sub>-16</sub>                                             | 46M                | <sup>4,5</sup> AGHASYAN         | 18B COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$                                              |
| 280 ± 10 ±70                                                                  |                    | <sup>6</sup> JACKURA            | 18 JPAC  | $\pi^- p \rightarrow \eta \pi^- p$                                                         |
| 190 ± 18 ±30                                                                  |                    | <sup>5</sup> ABLIKIM            | 17K BES3 | $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$                                             |
| 270 <sup>+50</sup> <sub>-20</sub>                                             |                    | ANISOVICH                       | 09 RVUE  | 0.0 $\bar{p}p$ , $\pi N$                                                                   |
| 336 ± 20 ±20                                                                  | 18k                | <sup>7</sup> SCHEGELSKY         | 06 RVUE  | $\gamma \gamma \rightarrow \pi^+ \pi^- \pi^0$                                              |
| 417 ± 19                                                                      | 80k                | <sup>8</sup> UMAN               | 06 E835  | 5.2 $\bar{p}p \rightarrow \eta \eta \pi^0$                                                 |
| 279 ± 49 ±66                                                                  | 145k               | LU                              | 05 B852  | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$                                              |
| 151 ± 22 ±24                                                                  |                    | ABE                             | 04 BELL  | 10.6 $e^+ e^- \rightarrow$<br>$e^+ e^- K^+ K^-$                                            |
| 187 ± 60                                                                      | 221                | <sup>9</sup> ACCIARRI           | 01H L3   | $\gamma \gamma \rightarrow K_S^0 K_S^0$ , $E_{\text{cm}}^{\text{ee}} =$<br>91, 183–209 GeV |
| 280 ± 70                                                                      |                    | <sup>5</sup> ABELE              | 99B CBAR | 1.94 $\bar{p}p \rightarrow \pi^0 \eta \eta$                                                |
| 150 ±110 ±34                                                                  |                    | ACCIARRI                        | 97T L3   | $\gamma \gamma \rightarrow \pi^+ \pi^- \pi^0$                                              |

NODE=M162W

NEW

- <sup>1</sup> T-matrix pole.
- <sup>2</sup> T-matrix pole, 2 poles, 2 channels ( $\pi\eta$ ,  $K\bar{K}$ ).
- <sup>3</sup> The coupled-channel analysis of both the  $\eta\pi$  and  $\eta'\pi$  systems using ADOLPH 15 data. The width is extracted from the T-matrix pole.
- <sup>4</sup> Statistical error negligible.
- <sup>5</sup> Breit-Wigner width.
- <sup>6</sup> Superseded by RODAS 19.
- <sup>7</sup> From analysis of L3 data at 183–209 GeV.
- <sup>8</sup> Statistical error only.
- <sup>9</sup> Spin 2 dominant, isospin not determined, could also be  $I=1$ .

### $a_2(1700)$ DECAY MODES

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ )     |
|-------------------------------|------------------------------------|
| $\Gamma_1$ $\eta\pi$          | (3.6 $\pm$ 1.1 ) %                 |
| $\Gamma_2$ $\gamma\gamma$     | (1.13 $\pm$ 0.30) $\times 10^{-6}$ |
| $\Gamma_3$ $\rho\pi$          | seen                               |
| $\Gamma_4$ $f_2(1270)\pi$     | seen                               |
| $\Gamma_5$ $K\bar{K}$         | (1.9 $\pm$ 1.2 ) %                 |
| $\Gamma_6$ $\omega\pi^-\pi^0$ | seen                               |
| $\Gamma_7$ $\omega\rho$       | seen                               |

### $a_2(1700)$ PARTIAL WIDTHS

| $\Gamma(\eta\pi)$             |      |                             |      | $\Gamma_1$                             |
|-------------------------------|------|-----------------------------|------|----------------------------------------|
| VALUE (MeV)                   | EVTS | DOCUMENT ID                 | TECN | COMMENT                                |
| <b>9.5<math>\pm</math>2.0</b> | 870  | <sup>1</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

<sup>1</sup> From analysis of L3 data at 91 and 183–209 GeV, using  $a_2(1700)$  mass of 1730 MeV and width of 340 MeV, and SU(3) relations.

| $\Gamma(\gamma\gamma)$          |      |                             |      | $\Gamma_2$                             |
|---------------------------------|------|-----------------------------|------|----------------------------------------|
| VALUE (keV)                     | EVTS | DOCUMENT ID                 | TECN | COMMENT                                |
| <b>0.30<math>\pm</math>0.05</b> | 870  | <sup>1</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

<sup>1</sup> From analysis of L3 data at 91 and 183–209 GeV, using  $a_2(1700)$  mass of 1730 MeV and width of 340 MeV, and SU(3) relations.

| $\Gamma(K\bar{K})$            |      |                             |      | $\Gamma_5$                             |
|-------------------------------|------|-----------------------------|------|----------------------------------------|
| VALUE (MeV)                   | EVTS | DOCUMENT ID                 | TECN | COMMENT                                |
| <b>5.0<math>\pm</math>3.0</b> | 870  | <sup>1</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

<sup>1</sup> From analysis of L3 data at 91 and 183–209 GeV, using  $a_2(1700)$  mass of 1730 MeV and width of 340 MeV, and SU(3) relations.

### $a_2(1700)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

| $[\Gamma(\rho\pi) + \Gamma(f_2(1270)\pi)] \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |      |             |        | $(\Gamma_3 + \Gamma_4)\Gamma_2/\Gamma$     |
|----------------------------------------------------------------------------------------------|------|-------------|--------|--------------------------------------------|
| VALUE (keV)                                                                                  | EVTS | DOCUMENT ID | TECN   | COMMENT                                    |
| <b>0.29<math>\pm</math>0.04<math>\pm</math>0.02</b>                                          |      | ACCIARRI    | 97T L3 | $\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.37 $^{+0.12}_{-0.08}$  $\pm$ 0.10      18k      <sup>1</sup> SCHEGELSKY 06      RVUE       $\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$

<sup>1</sup> From analysis of L3 data at 183–209 GeV.

| $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |             |      |         | $\Gamma_5\Gamma_2/\Gamma$ |
|----------------------------------------------------------------------|-------------|------|---------|---------------------------|
| VALUE (eV)                                                           | DOCUMENT ID | TECN | COMMENT |                           |

• • • We do not use the following data for averages, fits, limits, etc. • • •

20.6 $\pm$  4.2 $\pm$  4.6      <sup>1</sup> ABE      04      BELL      10.6  $e^+e^- \rightarrow e^+e^-K^+K^-$   
 49  $\pm$ 11  $\pm$ 13      <sup>2</sup> ACCIARRI      01H L3       $\gamma\gamma \rightarrow K_S^0 K_S^0$ ,  $E_{\text{cm}}^{\text{ee}} = 91$ ,  
 183–209 GeV

<sup>1</sup> Assuming spin 2.

<sup>2</sup> Spin 2 dominant, isospin not determined, could also be  $I=1$ .

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NODE=M162W;LINKAGE=C

NODE=M162W;LINKAGE=B

NODE=M162W;LINKAGE=E

NODE=M162W;LINKAGE=D

NODE=M162W;LINKAGE=SC

NODE=M162W;LINKAGE=ST

NODE=M162W;LINKAGE=HA

NODE=M162215;NODE=M162

DESIG=4

DESIG=1

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DESIG=3;OUR EVAL; $\rightarrow$  UNCHECKED  $\leftarrow$

DESIG=5

DESIG=6;OUR EVAL; $\rightarrow$  UNCHECKED  $\leftarrow$

DESIG=7;OUR EVAL; $\rightarrow$  UNCHECKED  $\leftarrow$

NODE=M162220

NODE=M162W3

NODE=M162W3

NODE=M162W3;LINKAGE=SC

NODE=M162W2

NODE=M162W2

NODE=M162W2;LINKAGE=SC

NODE=M162W1

NODE=M162W1

NODE=M162W1;LINKAGE=SC

NODE=M162225

NODE=M162G1

NODE=M162G1

NODE=M162G1;LINKAGE=SC

NODE=M162G2

NODE=M162G2

NODE=M162G2;LINKAGE=AB

NODE=M162G;LINKAGE=HA

**$a_2(1700)$  BRANCHING RATIOS** **$\Gamma(\rho\pi)/\Gamma(f_2(1270)\pi)$** 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |     |                            |      |                                            |
|-----------------------|-----|----------------------------|------|--------------------------------------------|
| $3.4 \pm 0.4 \pm 0.1$ | 18k | <sup>1</sup> SCHEGELSKY 06 | RVUE | $\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$ |
|-----------------------|-----|----------------------------|------|--------------------------------------------|

<sup>1</sup> From analysis of L3 data at 183–209 GeV. **$\Gamma(K\bar{K})/\Gamma(\eta\pi)$** 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                     |                          |      |                                                                       |
|-------------------------------------|--------------------------|------|-----------------------------------------------------------------------|
| $4.134 \pm 0.106^{+4.909}_{-2.988}$ | <sup>1</sup> ALBRECHT 20 | RVUE | $0.9 \bar{p}p \rightarrow \pi^0\pi^0\eta, \pi^0\eta\eta, \pi^0K^+K^-$ |
|-------------------------------------|--------------------------|------|-----------------------------------------------------------------------|

<sup>1</sup> Residues from T-matrix pole, 2 poles, 2 channels ( $\pi\eta, K\bar{K}$ ). **$a_2(1700)$  REFERENCES**

|            |     |                             |                                |                            |
|------------|-----|-----------------------------|--------------------------------|----------------------------|
| ALBRECHT   | 20  | EPJ C80 453                 | M. Albrecht <i>et al.</i>      | (Crystal Barrel Collab.)   |
| RODAS      | 19  | PRL 122 042002              | A. Rodas <i>et al.</i>         | (JPAC Collab.)             |
| AGHASYAN   | 18B | PR D98 092003               | M. Aghasyan <i>et al.</i>      | (COMPASS Collab.)          |
| JACKURA    | 18  | PL B779 464                 | A. Jackura <i>et al.</i>       | (JPAC and COMPASS Collab.) |
| ABLIKIM    | 17K | PR D95 032002               | M. Ablikim <i>et al.</i>       | (BESIII Collab.)           |
| ADOLPH     | 15  | PL B740 303                 | M. Adolph <i>et al.</i>        | (COMPASS Collab.)          |
| ANISOVICH  | 09  | IJMP A24 2481               | V.V. Anisovich, A.V. Sarantsev |                            |
| SCHEGELSKY | 06  | EPJ A27 199                 | V.A. Schegelsky <i>et al.</i>  |                            |
| SCHEGELSKY | 06A | EPJ A27 207                 | V.A. Schegelsky <i>et al.</i>  |                            |
| UMAN       | 06  | PR D73 052009               | I. Uman <i>et al.</i>          | (FNAL E835)                |
| LU         | 05  | PRL 94 032002               | M. Lu <i>et al.</i>            | (BNL E852 Collab.)         |
| ABE        | 04  | EPJ C32 323                 | K. Abe <i>et al.</i>           | (BELLE Collab.)            |
| AMSLER     | 02  | EPJ C23 29                  | C. Amsler <i>et al.</i>        |                            |
| ACCIARRI   | 01H | PL B501 173                 | M. Acciarri <i>et al.</i>      | (L3 Collab.)               |
| ABELE      | 99B | EPJ C8 67                   | A. Abele <i>et al.</i>         | (Crystal Barrel Collab.)   |
| GRYGOREV   | 99  | PAN 62 470                  | V.K. Grygorev <i>et al.</i>    |                            |
|            |     | Translated from YAF 62 513. |                                |                            |
| ACCIARRI   | 97T | PL B413 147                 | M. Acciarri <i>et al.</i>      | (L3 Collab.)               |

 **$f_0(1710)$** 

$$I^G(J^{PC}) = 0^+(0^{++})$$

See the review on "Non- $q\bar{q}$  Mesons." **$f_0(1710)$  MASS**

OUR EVALUATION below is based on T-matrix poles from BARBERIS 00E and BARBERIS 99D.

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

 **$1704 \pm 12$  OUR EVALUATION** **$1732^{+9}_{-7}$  OUR AVERAGE** Error includes scale factor of 1.6. See the ideogram below.

|                          |          |                       |          |                                                          |
|--------------------------|----------|-----------------------|----------|----------------------------------------------------------|
| $1759 \pm 6^{+14}_{-25}$ | 5.5k     | <sup>1</sup> ABLIKIM  | 13N BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$   |
| $1750^{+6}_{-7}$         |          | <sup>2</sup> UEHARA   | 13 BELL  | $\gamma\gamma \rightarrow K_S^0 K_S^0$                   |
| $1701 \pm 5^{+9}_{-2}$   | 4k       | <sup>3</sup> CHEKANOV | 08 ZEUS  | $e p \rightarrow K_S^0 K_S^0 X$                          |
| $1765^{+4}_{-3}$         | $\pm 13$ | <sup>4</sup> ABLIKIM  | 06V BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$ |
| $1738 \pm 30$            |          | ABLIKIM               | 04E BES2 | $J/\psi \rightarrow \omega K^+ K^-$                      |
| $1740 \pm 4^{+10}_{-25}$ |          | BAI                   | 03G BES  | $J/\psi \rightarrow \gamma K \bar{K}$                    |
| $1740^{+30}_{-25}$       |          | BAI                   | 00A BES  | $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^+\pi^-)$        |
| $1710 \pm 25$            |          | <sup>5</sup> FRENCH   | 99       | $300 pp \rightarrow p_f(K^+ K^-) p_s$                    |

NODE=M162235

NODE=M162R01  
NODE=M162R01

NODE=M162R01;LINKAGE=SC

NODE=M162R00  
NODE=M162R00

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NODE=M162

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REFID=46909

REFID=45761

NODE=M068

NODE=M068

NODE=M068M

NODE=M068M

NODE=M068M  
→ UNCHECKED ←

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                             |       |               |           |      |                                                                                  |         |
|---------------------------------------------|-------|---------------|-----------|------|----------------------------------------------------------------------------------|---------|
| 1803± 3.5 <sup>+45.5</sup> <sub>-10.4</sub> | 6     | ALBRECHT      | 20        | RVUE | 0.9 $\bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta,$<br>$\pi^0 K^+ K^-$ | OCCUR=3 |
| 1744± 7 ± 5                                 | 381   | 7,8           | DOBBS     | 15   | $J/\psi \rightarrow \gamma \pi^+ \pi^-$                                          |         |
| 1705±11 ± 5                                 | 237   | 7,8           | DOBBS     | 15   | $\psi(2S) \rightarrow \gamma \pi^+ \pi^-$                                        | OCCUR=2 |
| 1706± 4 ± 5                                 | 1.0k  | 7,8           | DOBBS     | 15   | $J/\psi \rightarrow \gamma K^+ K^-$                                              | OCCUR=3 |
| 1690± 8 ± 3                                 | 349   | 7,8           | DOBBS     | 15   | $\psi(2S) \rightarrow \gamma K^+ K^-$                                            | OCCUR=4 |
| 1795± 7 <sup>+23</sup> <sub>-20</sub>       |       |               | ABLIKIM   | 13J  | BES3 $J/\psi \rightarrow \gamma \omega \phi$                                     |         |
| 1812 <sup>+19</sup> <sub>-26</sub> ± 18     | 9     | ABLIKIM       | 06J       | BES2 | $J/\psi \rightarrow \gamma \omega \phi$                                          |         |
| 1750±13                                     |       | AMSLER        | 06        | CBAR | 1.64 $\bar{p}p \rightarrow K^+ K^- \pi^0$                                        |         |
| 1747± 5                                     | 80k   | 4,10          | UMAN      | 06   | E835 $5.2 \bar{p}p \rightarrow \eta \eta \pi^0$                                  |         |
| 1776±15                                     |       | VLADIMIRSK... | 06        | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$                                           |         |
| 1790 <sup>+40</sup> <sub>-30</sub>          | 11    | ABLIKIM       | 05        | BES2 | $J/\psi \rightarrow \phi \pi^+ \pi^-$                                            |         |
| 1760±15 <sup>+15</sup> <sub>-10</sub>       | 11    | ABLIKIM       | 05Q       | BES2 | $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$                                |         |
| 1670±20                                     | 4     | BINON         | 05        | GAMS | 33 $\pi^- p \rightarrow \eta \eta n$                                             |         |
| 1732±15                                     | 12    | ANISOVICH     | 03        | RVUE |                                                                                  |         |
| 1682±16                                     |       | TIKHOMIROV    | 03        | SPEC | 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_S^0 X$                                   |         |
| 1670±26                                     | 3.6k  | 13            | NICHITU   | 02   | OBLX $0 \bar{p}p \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$                          |         |
| 1698±18                                     |       | 14            | BARBERIS  | 00E  | 450 $pp \rightarrow p_f \eta \eta p_s$                                           |         |
| 1770±12                                     |       | 15            | ANISOVICH | 99B  | SPEC $0.6-1.2 \bar{p}p \rightarrow \eta \eta \pi^0$                              |         |
| 1730±15                                     |       |               | BARBERIS  | 99   | OMEG $450 pp \rightarrow p_s p_f K^+ K^-$                                        |         |
| 1750±20                                     |       |               | BARBERIS  | 99B  | OMEG $450 pp \rightarrow p_s p_f \pi^+ \pi^-$                                    |         |
| 1710±12 ± 11                                | 16    | BARBERIS      | 99D       | OMEG | 450 $pp \rightarrow K^+ K^-, \pi^+ \pi^-$                                        |         |
| 1750±30                                     | 17    | ANISOVICH     | 98B       | RVUE | Compilation                                                                      |         |
| 1720±39                                     |       | BAI           | 98H       | BES  | $J/\psi \rightarrow \gamma \pi^0 \pi^0$                                          |         |
| 1775± 1.5                                   | 57    | 18            | BARKOV    | 98   | $\pi^- p \rightarrow K_S^0 K_S^0 n$                                              |         |
| 1690±11                                     |       | 19            | ABREU     | 96C  | DLPH $Z^0 \rightarrow K^+ K^- + X$                                               |         |
| 1696± 5 <sup>+9</sup> <sub>-34</sub>        | 20    | BAI           | 96C       | BES  | $J/\psi \rightarrow \gamma K^+ K^-$                                              |         |
| 1781± 8 <sup>+10</sup> <sub>-31</sub>       |       | BAI           | 96C       | BES  | $J/\psi \rightarrow \gamma K^+ K^-$                                              | OCCUR=2 |
| 1768±14                                     |       | BALOSHIN      | 95        | SPEC | 40 $\pi^- C \rightarrow K_S^0 K_S^0 X$                                           |         |
| 1750±15                                     | 21    | BUGG          | 95        | MRK3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$                              |         |
| 1620±16                                     | 20    | BUGG          | 95        | MRK3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$                              | OCCUR=2 |
| 1748±10                                     | 22    | ARMSTRONG     | 93C       | E760 | $\bar{p}p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$                       |         |
| ~ 1750                                      |       | BREAKSTONE    | 93        | SFM  | $pp \rightarrow pp \pi^+ \pi^- \pi^+ \pi^-$                                      |         |
| 1744±15                                     | 23    | ALDE          | 92D       | GAM2 | 38 $\pi^- p \rightarrow \eta \eta n$                                             |         |
| 1713±10                                     | 24    | ARMSTRONG     | 89D       | OMEG | 300 $pp \rightarrow pp K^+ K^-$                                                  |         |
| 1706±10                                     | 24    | ARMSTRONG     | 89D       | OMEG | 300 $pp \rightarrow pp K_S^0 K_S^0$                                              | OCCUR=2 |
| 1707±10                                     | 22    | AUGUSTIN      | 88        | DM2  | $J/\psi \rightarrow \gamma K^+ K^-, K_S^0 K_S^0$                                 |         |
| 1700±15                                     | 20    | BOLONKIN      | 88        | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$                                           |         |
| 1720±60                                     |       | BOLONKIN      | 88        | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$                                           | OCCUR=2 |
| 1638±10                                     | 25    | FALVARD       | 88        | DM2  | $J/\psi \rightarrow \phi K^+ K^-, K_S^0 K_S^0$                                   |         |
| 1690± 4                                     | 26    | FALVARD       | 88        | DM2  | $J/\psi \rightarrow \phi K^+ K^-, K_S^0 K_S^0$                                   | OCCUR=2 |
| 1698±15                                     | 22    | AUGUSTIN      | 87        | DM2  | $J/\psi \rightarrow \gamma \pi^+ \pi^-$                                          |         |
| 1720±10 ± 10                                | 20    | BALTRUSAIT..  | 87        | MRK3 | $J/\psi \rightarrow \gamma K^+ K^-$                                              |         |
| 1755± 8                                     | 27    | ALDE          | 86C       | GAM2 | 38 $\pi^- p \rightarrow n 2\eta$                                                 |         |
| 1730 <sup>+2</sup> <sub>-10</sub>           | 28    | LONGACRE      | 86        | RVUE | 22 $\pi^- p \rightarrow n 2K_S^0$                                                |         |
| 1742±15                                     | 22    | WILLIAMS      | 84        | MPSF | 200 $\pi^- N \rightarrow 2K_S^0 X$                                               |         |
| 1670±50                                     |       | BLOOM         | 83        | CBAL | $J/\psi \rightarrow \gamma 2\eta$                                                |         |
| 1650±50                                     |       | BURKE         | 82        | MRK2 | $J/\psi \rightarrow \gamma 2\rho$                                                |         |
| 1640±50                                     | 29,30 | EDWARDS       | 82D       | CBAL | $J/\psi \rightarrow \gamma 2\eta$                                                |         |
| 1730±10 ± 20                                | 31    | ETKIN         | 82C       | MPS  | 23 $\pi^- p \rightarrow n 2K_S^0$                                                |         |

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

<sup>2</sup> Spin 0 favored over spin 2.

<sup>3</sup> In the SU(3) based model with a specific interference pattern of the  $f_2(1270)$ ,  $a_2^0(1320)$ , and  $f_2'(1525)$  mesons incoherently added to the  $f_0(1710)$  and non-resonant background.

<sup>4</sup> Breit-Wigner mass.

<sup>5</sup>  $J^P = 0^+$ , supersedes by ARMSTRONG 89D.

<sup>6</sup> T-matrix pole, 5 poles, 5 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ), and BINON 84C ( $\eta\eta'$ ).

NODE=M068M;LINKAGE=D

NODE=M068M;LINKAGE=H

NODE=M068M;LINKAGE=HE

NODE=M068M;LINKAGE=BW

NODE=M068M;LINKAGE=C3

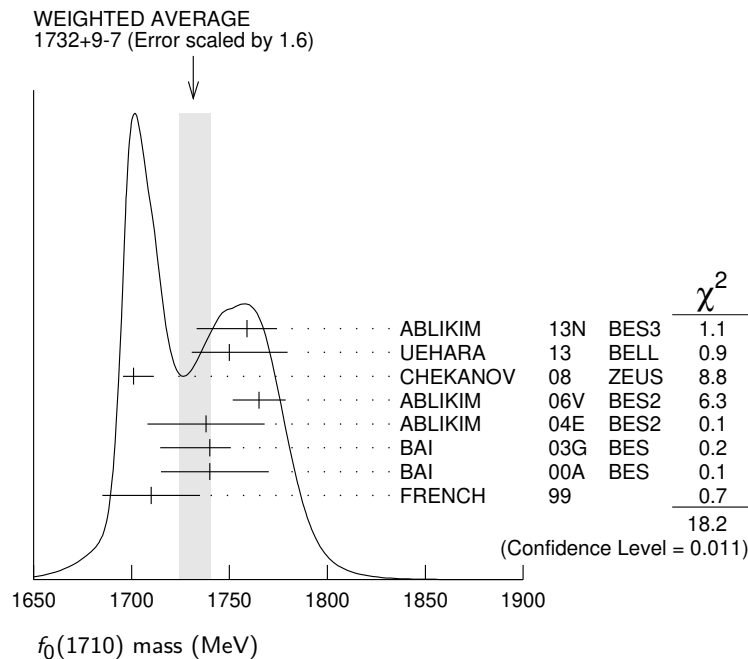
NODE=M068M;LINKAGE=TP

- 7 Using CLEO-c data but not authored by the CLEO Collaboration.  
 8 From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 135$  MeV.  
 9 Not seen by LIU 09 in  $B^\pm \rightarrow K^\pm \omega \phi$ .  
 10 Systematic errors not estimated.  
 11 This state may be different from  $f_0(1710)$ , see CLOSE 05.  
 12 K-matrix pole, assuming  $J^P = 0^+$ , from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K \bar{K} n$ ,  $\pi^+ \pi^- \rightarrow \pi^+ \pi^-$ ,  $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \eta \eta$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^0$ ,  $K^+ K_S^0 \pi^-$  at rest,  $\bar{p} n \rightarrow \pi^- \pi^- \pi^+$ ,  $K_S^0 K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^-$  at rest.  
 13 Decaying to  $f_0(1370) \pi \pi$ .  
 14 T-matrix pole.  
 15 Not seen by AMSLER 02.  
 16 Supersedes BARBERIS 99 and BARBERIS 99B.  
 17 T-matrix pole, assuming  $J^P = 0^+$   
 18 No  $J^{PC}$  determination.  
 19 No  $J^{PC}$  determination, width not determined.  
 20  $J^P = 2^+$ .  
 21 From a fit to the  $0^+$  partial wave.  
 22 No  $J^{PC}$  determination.  
 23 ALDE 92D combines all the GAMS-2000 data.  
 24  $J^P = 2^+$ , superseded by FRENCH 99.  
 25 From an analysis ignoring interference with  $f_2'(1525)$ .  
 26 From an analysis including interference with  $f_2'(1525)$ .  
 27 Superseded by ALDE 92D.  
 28 Uses MRK3 data. From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2. Fit with constrained inelasticity.  
 29  $J^P = 2^+$  preferred.  
 30 From fit neglecting nearby  $f_2'(1525)$ . Replaced by BLOOM 83.  
 31 Superseded by LONGACRE 86.

NODE=M068M;LINKAGE=F  
 NODE=M068M;LINKAGE=G  
 NODE=M068M;LINKAGE=L  
 NODE=M068M;LINKAGE=CH  
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 NODE=M068M;LINKAGE=KM

NODE=M068M;LINKAGE=NC  
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 NODE=M068M;LINKAGE=B1



### $f_0(1710)$ WIDTH

OUR EVALUATION below is based on T-matrix poles from BARBERIS 00E and BARBERIS 99D.

NODE=M068W

NODE=M068W

| VALUE (MeV)     | EVTS                  | DOCUMENT ID                         | TECN               | COMMENT                                                     |
|-----------------|-----------------------|-------------------------------------|--------------------|-------------------------------------------------------------|
| <b>123 ± 18</b> | <b>OUR EVALUATION</b> |                                     |                    |                                                             |
| <b>147 ± 12</b> | <b>OUR AVERAGE</b>    | Error includes scale factor of 1.2. |                    |                                                             |
| 172 ± 10        | +32<br>-16            | 5.5k                                | 1 ABLIKIM 13N BES3 | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \eta \eta$   |
| 139 ± 11        | +96<br>-50            |                                     | 2 UEHARA 13 BELL   | $\gamma \gamma \rightarrow K_S^0 K_S^0$                     |
| 100 ± 24        | +7<br>-22             | 4k                                  | 3 CHEKANOV 08 ZEUS | $e p \rightarrow K_S^0 K_S^0 X$                             |
| 145 ± 8         | ± 69                  |                                     | 4 ABLIKIM 06V BES2 | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$ |

NODE=M068W

→ UNCHECKED ←



|                                                                                                         |      |                            |     |      |                                                                              |         |
|---------------------------------------------------------------------------------------------------------|------|----------------------------|-----|------|------------------------------------------------------------------------------|---------|
| 125 ± 20                                                                                                |      | ABLIKIM                    | 04E | BES2 | $J/\psi \rightarrow \omega K^+ K^-$                                          |         |
| 166 $\begin{smallmatrix} +5 \\ -8 \end{smallmatrix}$ $\begin{smallmatrix} +15 \\ -10 \end{smallmatrix}$ |      | BAI                        | 03G | BES  | $J/\psi \rightarrow \gamma K \bar{K}$                                        |         |
| 120 $\begin{smallmatrix} +50 \\ -40 \end{smallmatrix}$                                                  |      | BAI                        | 00A | BES  | $J/\psi \rightarrow \gamma(\pi^+ \pi^- \pi^+ \pi^-)$                         |         |
| 105 ± 34                                                                                                |      | <sup>5</sup> FRENCH        | 99  |      | $300 p p \rightarrow p_f(K^+ K^-) p_s$                                       |         |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                           |      |                            |     |      |                                                                              |         |
| 289.7 ± 5.0 $\begin{smallmatrix} +32.6 \\ -19.3 \end{smallmatrix}$                                      |      | <sup>6</sup> ALBRECHT      | 20  | RVUE | $0.9 \bar{p} p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta \eta, \pi^0 K^+ K^-$ |         |
| 95 ± 10 $\begin{smallmatrix} +78 \\ -82 \end{smallmatrix}$                                              |      | ABLIKIM                    | 13J | BES3 | $J/\psi \rightarrow \gamma \omega \phi$                                      |         |
| 105 ± 20 ± 28                                                                                           |      | <sup>7</sup> ABLIKIM       | 06J | BES2 | $J/\psi \rightarrow \gamma \omega \phi$                                      |         |
| 148 $\begin{smallmatrix} +40 \\ -30 \end{smallmatrix}$                                                  |      | AMSLER                     | 06  | CBAR | $1.64 \bar{p} p \rightarrow K^+ K^- \pi^0$                                   |         |
| 188 ± 13                                                                                                | 80k  | <sup>4,8</sup> UMAN        | 06  | E835 | $5.2 \bar{p} p \rightarrow \eta \eta \pi^0$                                  |         |
| 250 ± 30                                                                                                |      | VLADIMIRSK...              | 06  | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$                                       |         |
| 270 $\begin{smallmatrix} +60 \\ -30 \end{smallmatrix}$                                                  |      | <sup>9</sup> ABLIKIM       | 05  | BES2 | $J/\psi \rightarrow \phi \pi^+ \pi^-$                                        |         |
| 125 ± 25 $\begin{smallmatrix} +10 \\ -15 \end{smallmatrix}$                                             |      | <sup>4</sup> ABLIKIM       | 05Q | BES2 | $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$                            |         |
| 260 ± 50                                                                                                |      | <sup>4</sup> BINON         | 05  | GAMS | $33 \pi^- p \rightarrow \eta \eta n$                                         |         |
| 144 ± 30                                                                                                |      | <sup>10,11</sup> ANISOVICH | 03  | RVUE |                                                                              |         |
| 320 $\begin{smallmatrix} +50 \\ -20 \end{smallmatrix}$                                                  |      | <sup>11,12</sup> ANISOVICH | 03  | RVUE |                                                                              | OCCUR=2 |
| 102 ± 26                                                                                                |      | TIKHOMIROV                 | 03  | SPEC | $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$                               |         |
| 267 ± 44                                                                                                | 3651 | <sup>13</sup> NICHITIU     | 02  | OBLX | $0 \bar{p} p \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$                          |         |
| 120 ± 26                                                                                                |      | <sup>14</sup> BARBERIS     | 00E |      | $450 p p \rightarrow p_f \eta \eta p_s$                                      |         |
| 220 ± 40                                                                                                |      | <sup>15,16</sup> ANISOVICH | 99B | SPEC | $0.6-1.2 \bar{p} p \rightarrow \eta \eta \pi^0$                              |         |
| 100 ± 25                                                                                                |      | BARBERIS                   | 99  | OMEG | $450 p p \rightarrow p_s p_f K^+ K^-$                                        |         |
| 160 ± 30                                                                                                |      | BARBERIS                   | 99B | OMEG | $450 p p \rightarrow p_s p_f \pi^+ \pi^-$                                    |         |
| 126 ± 16 ± 18                                                                                           |      | <sup>14,17</sup> BARBERIS  | 99D | OMEG | $450 p p \rightarrow K^+ K^-, \pi^+ \pi^-$                                   |         |
| 250 ± 140                                                                                               |      | <sup>18</sup> ANISOVICH    | 98B | RVUE | Compilation                                                                  |         |
| 30 ± 7                                                                                                  | 57   | <sup>19</sup> BARKOV       | 98  |      | $\pi^- p \rightarrow K_S^0 K_S^0 n$                                          |         |
| 103 ± 18 $\begin{smallmatrix} +30 \\ -11 \end{smallmatrix}$                                             |      | <sup>20</sup> BAI          | 96C | BES  | $J/\psi \rightarrow \gamma K^+ K^-$                                          |         |
| 85 ± 24 $\begin{smallmatrix} +22 \\ -19 \end{smallmatrix}$                                              |      | BAI                        | 96C | BES  | $J/\psi \rightarrow \gamma K^+ K^-$                                          | OCCUR=2 |
| 56 ± 19                                                                                                 |      | BALOSHIN                   | 95  | SPEC | $40 \pi^- C \rightarrow K_S^0 K_S^0 X$                                       |         |
| 160 ± 40                                                                                                |      | <sup>21</sup> BUGG         | 95  | MRK3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$                          |         |
| 160 $\begin{smallmatrix} +60 \\ -20 \end{smallmatrix}$                                                  |      | <sup>20</sup> BUGG         | 95  | MRK3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$                          | OCCUR=2 |
| 264 ± 25                                                                                                |      | <sup>22</sup> ARMSTRONG    | 93C | E760 | $\bar{p} p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$                  |         |
| 200 to 300                                                                                              |      | BREAKSTONE                 | 93  | SFM  | $p p \rightarrow p p \pi^+ \pi^- \pi^+ \pi^-$                                |         |
| < 80 90% CL                                                                                             |      | <sup>23</sup> ALDE         | 92D | GAM2 | $38 \pi^- p \rightarrow \eta \eta N^*$                                       |         |
| 181 ± 30                                                                                                |      | <sup>24</sup> ARMSTRONG    | 89D | OMEG | $300 p p \rightarrow p p K^+ K^-$                                            |         |
| 104 ± 30                                                                                                |      | <sup>24</sup> ARMSTRONG    | 89D | OMEG | $300 p p \rightarrow p p K_S^0 K_S^0$                                        | OCCUR=2 |
| 166.4 ± 33.2                                                                                            |      | <sup>22</sup> AUGUSTIN     | 88  | DM2  | $J/\psi \rightarrow \gamma K^+ K^-, K_S^0 K_S^0$                             |         |
| 30 ± 20                                                                                                 |      | <sup>20</sup> BOLONKIN     | 88  | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$                                       |         |
| 350 ± 150                                                                                               |      | BOLONKIN                   | 88  | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$                                       | OCCUR=2 |
| 148 ± 17                                                                                                |      | <sup>25</sup> FALVARD      | 88  | DM2  | $J/\psi \rightarrow \phi K^+ K^-, K_S^0 K_S^0$                               |         |
| 184 ± 6                                                                                                 |      | <sup>26</sup> FALVARD      | 88  | DM2  | $J/\psi \rightarrow \phi K^+ K^-, K_S^0 K_S^0$                               | OCCUR=2 |
| 136 ± 28                                                                                                |      | <sup>22</sup> AUGUSTIN     | 87  | DM2  | $J/\psi \rightarrow \gamma \pi^+ \pi^-$                                      |         |
| 130 ± 20                                                                                                |      | <sup>20</sup> BALTRUSAIT.. | 87  | MRK3 | $J/\psi \rightarrow \gamma K^+ K^-$                                          |         |
| 122 $\begin{smallmatrix} +74 \\ -15 \end{smallmatrix}$                                                  |      | <sup>27</sup> LONGACRE     | 86  | RVUE | $22 \pi^- p \rightarrow n 2 K_S^0$                                           |         |
| 57 ± 38                                                                                                 |      | <sup>28</sup> WILLIAMS     | 84  | MPSF | $200 \pi^- N \rightarrow 2 K_S^0 X$                                          |         |
| 160 ± 80                                                                                                |      | BLOOM                      | 83  | CBAL | $J/\psi \rightarrow \gamma 2 \eta$                                           |         |
| 200 ± 100                                                                                               |      | BURKE                      | 82  | MRK2 | $J/\psi \rightarrow \gamma 2 \rho$                                           |         |
| 220 $\begin{smallmatrix} +100 \\ -70 \end{smallmatrix}$                                                 |      | <sup>29,30</sup> EDWARDS   | 82D | CBAL | $J/\psi \rightarrow \gamma 2 \eta$                                           |         |
| 200 $\begin{smallmatrix} +156 \\ -9 \end{smallmatrix}$                                                  |      | <sup>31</sup> ETKIN        | 82B | MPS  | $23 \pi^- p \rightarrow n 2 K_S^0$                                           |         |

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

<sup>2</sup> Spin 0 favored over spin 2.

<sup>3</sup> In the SU(3) based model with a specific interference pattern of the  $f_2(1270)$ ,  $a_2^0(1320)$ , and  $f_2'(1525)$  mesons incoherently added to the  $f_0(1710)$  and non-resonant background.

NODE=M068W;LINKAGE=F

NODE=M068W;LINKAGE=G

NODE=M068W;LINKAGE=HE

- <sup>4</sup> Breit-Wigner width.
- <sup>5</sup>  $J^P = 0^+$ , supersedes by ARMSTRONG 89D.
- <sup>6</sup> T-matrix pole, 5 poles, 5 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ), and BINON 84C ( $\eta\eta'$ ).
- <sup>7</sup> Not seen by LIU 09 in  $B^\pm \rightarrow K^\pm \omega \phi$ .
- <sup>8</sup> Systematic errors not estimated.
- <sup>9</sup> This state may be different from  $f_0(1710)$ , see CLOSE 05.
- <sup>10</sup> (Solution I)
- <sup>11</sup> K-matrix pole, assuming  $J^P = 0^+$ , from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K\bar{K} n$ ,  $\pi^+ \pi^- \rightarrow \pi^+ \pi^-$ ,  $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \eta \eta$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^0$ ,  $K^+ K_S^0 \pi^-$  at rest,  $\bar{p} n \rightarrow \pi^- \pi^- \pi^+$ ,  $K_S^0 K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^-$  at rest.
- <sup>12</sup> Solution I.
- <sup>13</sup> Decaying to  $f_0(1370) \pi \pi$ .
- <sup>14</sup> T-matrix pole.
- <sup>15</sup>  $J^P = 0^+$ .
- <sup>16</sup> Not seen by AMSLER 02.
- <sup>17</sup> Supersedes BARBERIS 99 and BARBERIS 99B.
- <sup>18</sup> T-matrix pole, assuming  $J^P = 0^+$
- <sup>19</sup> No  $J^{PC}$  determination.
- <sup>20</sup>  $J^P = 2^+$ .
- <sup>21</sup> From a fit to the  $0^+$  partial wave.
- <sup>22</sup> No  $J^{PC}$  determination.
- <sup>23</sup> ALDE 92D combines all the GAMS-2000 data.
- <sup>24</sup>  $J^P = 2^+$ , ( $0^+$  excluded).
- <sup>25</sup> From an analysis ignoring interference with  $f_2'(1525)$ .
- <sup>26</sup> From an analysis including interference with  $f_2'(1525)$ .
- <sup>27</sup> Uses MRK3 data. From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2. Fit with constrained inelasticity.
- <sup>28</sup> No  $J^{PC}$  determination.
- <sup>29</sup>  $J^P = 2^+$  preferred.
- <sup>30</sup> From fit neglecting nearby  $f_2'(1525)$ . Replaced by BLOOM 83.
- <sup>31</sup> From an amplitude analysis of the  $K_S^0 K_S^0$  system, superseded by LONGACRE 86.

NODE=M068W;LINKAGE=BW  
 NODE=M068W;LINKAGE=C3  
 NODE=M068W;LINKAGE=H  
  
 NODE=M068W;LINKAGE=I  
 NODE=M068W;LINKAGE=CH  
 NODE=M068W;LINKAGE=AB  
 NODE=M068W;LINKAGE=K1  
 NODE=M068W;LINKAGE=KM

NODE=M068W;LINKAGE=K2  
 NODE=M068W;LINKAGE=NC  
 NODE=M068W;LINKAGE=TP  
 NODE=M068W;LINKAGE=AV  
 NODE=M068W;LINKAGE=NS  
 NODE=M068W;LINKAGE=BD  
 NODE=M068W;LINKAGE=AN  
 NODE=M068W;LINKAGE=4A  
 NODE=M068W;LINKAGE=A3  
 NODE=M068W;LINKAGE=Q0  
 NODE=M068W;LINKAGE=A1  
 NODE=M068W;LINKAGE=AA  
 NODE=M068W;LINKAGE=B  
 NODE=M068W;LINKAGE=C  
 NODE=M068W;LINKAGE=D  
 NODE=M068W;LINKAGE=A9

NODE=M068M;LINKAGE=WI  
 NODE=M068W;LINKAGE=B2  
 NODE=M068W;LINKAGE=E  
 NODE=M068W;LINKAGE=A

NODE=M068215;NODE=M068

DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=6;OUR EST;→ UNCHECKED ←  
 DESIG=4

NODE=M068220

NODE=M068G2  
 NODE=M068G2

NODE=M068G2;LINKAGE=F

NODE=M068G3  
 NODE=M068G3

NODE=M068G;LINKAGE=Z

### $f_0(1710)$ DECAY MODES

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad K\bar{K}$     | seen                           |
| $\Gamma_2 \quad \eta\eta$     | seen                           |
| $\Gamma_3 \quad \pi\pi$       | seen                           |
| $\Gamma_4 \quad \gamma\gamma$ | seen                           |
| $\Gamma_5 \quad \omega\omega$ | seen                           |

### $f_0(1710) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$

| $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |     |             |      |         | $\Gamma_1 \Gamma_4 / \Gamma$           |
|------------------------------------------------------------------------|-----|-------------|------|---------|----------------------------------------|
| VALUE (eV)                                                             | CL% | DOCUMENT ID | TECN | COMMENT |                                        |
| $12^{+3}_{-2} + 227_8$                                                 |     | UEHARA      | 13   | BELL    | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                      |     |      |                                        |
|------|----|----------------------|-----|------|----------------------------------------|
| <480 | 95 | ALBRECHT             | 90G | ARG  | $\gamma\gamma \rightarrow K^+ K^-$     |
| <110 | 95 | <sup>1</sup> BEHREND | 89C | CELL | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |
| <280 | 95 | <sup>1</sup> ALTHOFF | 85B | TASS | $\gamma\gamma \rightarrow K\bar{K}\pi$ |

<sup>1</sup> Assuming helicity 2.

| $\Gamma(\pi\pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |     |                     |      |         | $\Gamma_3 \Gamma_4 / \Gamma$           |
|----------------------------------------------------------------------|-----|---------------------|------|---------|----------------------------------------|
| VALUE (keV)                                                          | CL% | DOCUMENT ID         | TECN | COMMENT |                                        |
| <0.82                                                                | 95  | <sup>1</sup> BARATE | 00E  | ALEP    | $\gamma\gamma \rightarrow \pi^+ \pi^-$ |

<sup>1</sup> Assuming spin 0.

**$f_0(1710)$  BRANCHING RATIOS**

NODE=M068225

 **$\Gamma(K\bar{K})/\Gamma_{\text{total}}$**  **$\Gamma_1/\Gamma$** 

| VALUE                                                                         | EVTS | DOCUMENT ID           | TECN | COMMENT                               |
|-------------------------------------------------------------------------------|------|-----------------------|------|---------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |      |                                       |
| seen                                                                          | 1004 | <sup>1</sup> DOBBS    | 15   | $J/\psi \rightarrow \gamma K^+ K^-$   |
| seen                                                                          | 349  | <sup>1</sup> DOBBS    | 15   | $\psi(2S) \rightarrow \gamma K^+ K^-$ |
| $0.36 \pm 0.12$                                                               |      | ALBALADEJO            | 08   | RVUE                                  |
| $0.38^{+0.09}_{-0.19}$                                                        |      | <sup>2</sup> LONGACRE | 86   | MPS $22 \pi^- p \rightarrow n 2K_S^0$ |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2. Fit with constrained inelasticity.NODE=M068R2  
NODE=M068R2

OCCUR=2

NODE=M068R2;LINKAGE=A  
NODE=M068R;LINKAGE=L **$\Gamma(\eta\eta)/\Gamma_{\text{total}}$**  **$\Gamma_2/\Gamma$** 

| VALUE                                                                         | DOCUMENT ID           | TECN    |
|-------------------------------------------------------------------------------|-----------------------|---------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |         |
| $0.22 \pm 0.12$                                                               | ALBALADEJO            | 08 RVUE |
| $0.18^{+0.03}_{-0.13}$                                                        | <sup>1</sup> LONGACRE | 86 RVUE |

<sup>1</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2. Fit with constrained inelasticity.NODE=M068R1  
NODE=M068R1

NODE=M068R1;LINKAGE=L

 **$\Gamma(\pi\pi)/\Gamma_{\text{total}}$**  **$\Gamma_3/\Gamma$** 

| VALUE                                                                         | EVTS | DOCUMENT ID           | TECN | COMMENT                                                             |
|-------------------------------------------------------------------------------|------|-----------------------|------|---------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |      |                                                                     |
| seen                                                                          | 381  | <sup>1</sup> DOBBS    | 15   | $J/\psi \rightarrow \gamma \pi^+ \pi^-$                             |
| seen                                                                          | 237  | <sup>1</sup> DOBBS    | 15   | $\psi(2S) \rightarrow \gamma \pi^+ \pi^-$                           |
| not seen                                                                      |      | AMSLER                | 02   | CBAR $0.9 \bar{p} p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$ |
| $0.039^{+0.002}_{-0.024}$                                                     |      | <sup>2</sup> LONGACRE | 86   | RVUE                                                                |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles, but assuming spin 2. Fit with constrained inelasticity.NODE=M068R5  
NODE=M068R5

OCCUR=2

NODE=M068R5;LINKAGE=A  
NODE=M068R5;LINKAGE=L **$\Gamma(\pi\pi)/\Gamma(K\bar{K})$**  **$\Gamma_3/\Gamma_1$** 

| VALUE                                                                         | CL%                | DOCUMENT ID            | TECN | COMMENT                                                            |
|-------------------------------------------------------------------------------|--------------------|------------------------|------|--------------------------------------------------------------------|
| <b><math>0.23 \pm 0.05</math></b>                                             | <b>OUR AVERAGE</b> |                        |      |                                                                    |
| $0.64 \pm 0.27 \pm 0.18$                                                      |                    | LEES                   | 18A  | BABR $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-, \gamma K^+ K^-$ |
| $0.41^{+0.11}_{-0.17}$                                                        |                    | ABLIKIM                | 06V  | BES2 $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$   |
| $0.2 \pm 0.024 \pm 0.036$                                                     |                    | BARBERIS               | 99D  | OMEG 450 $pp \rightarrow K^+ K^-, \pi^+ \pi^-$                     |
| $0.39 \pm 0.14$                                                               |                    | ARMSTRONG              | 91   | OMEG 300 $pp \rightarrow pp\pi\pi, ppK\bar{K}$                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |                        |      |                                                                    |
| $0.32 \pm 0.14$                                                               |                    | ALBALADEJO             | 08   | RVUE                                                               |
| $< 0.11$                                                                      | 95                 | <sup>1</sup> ABLIKIM   | 04E  | BES2 $J/\psi \rightarrow \omega K^+ K^-$                           |
| $5.8^{+9.1}_{-5.5}$                                                           |                    | <sup>2</sup> ANISOVICH | 02D  | SPEC Combined fit                                                  |

<sup>1</sup> Using data from ABLIKIM 04A.<sup>2</sup> From a combined K-matrix analysis of Crystal Barrel ( $0. p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ ), GAMS ( $\pi p \rightarrow \pi^0 \pi^0 n, \eta \eta n, \eta \eta' n$ ), and BNL ( $\pi p \rightarrow K\bar{K} n$ ) data.NODE=M068R6  
NODE=M068R6NODE=M068R;LINKAGE=AB  
NODE=M068R;LINKAGE=CH **$\Gamma(\eta\eta)/\Gamma(K\bar{K})$**  **$\Gamma_2/\Gamma_1$** 

| VALUE                                                                         | CL% | DOCUMENT ID             | TECN | COMMENT                                          |
|-------------------------------------------------------------------------------|-----|-------------------------|------|--------------------------------------------------|
| <b><math>0.48 \pm 0.15</math></b>                                             |     | BARBERIS                | 00E  | 450 $pp \rightarrow p_f \eta \eta p_s$           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                         |      |                                                  |
| $0.46^{+0.70}_{-0.38}$                                                        |     | <sup>1</sup> ANISOVICH  | 02D  | SPEC Combined fit                                |
| $< 0.02$                                                                      | 90  | <sup>2</sup> PROKOSHKIN | 91   | GA24 $300 \pi^- p \rightarrow \pi^- p \eta \eta$ |

<sup>1</sup> From a combined K-matrix analysis of Crystal Barrel ( $0. p\bar{p} \rightarrow \pi^0 \pi^0 \pi^0, \pi^0 \eta \eta, \pi^0 \pi^0 \eta$ ), GAMS ( $\pi p \rightarrow \pi^0 \pi^0 n, \eta \eta n, \eta \eta' n$ ), and BNL ( $\pi p \rightarrow K\bar{K} n$ ) data.<sup>2</sup> Combining results of GAM4 with those of ARMSTRONG 89D.NODE=M068R7  
NODE=M068R7

NODE=M068R7;LINKAGE=CH

NODE=M068R;LINKAGE=A

 **$\Gamma(\omega\omega)/\Gamma_{\text{total}}$**  **$\Gamma_5/\Gamma$** 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT                                       |
|-------|------|-------------|------|-----------------------------------------------|
| seen  | 180  | ABLIKIM     | 06H  | BES $J/\psi \rightarrow \gamma \omega \omega$ |

NODE=M068R3  
NODE=M068R3

**$\phi_0(1710)$  REFERENCES**

NODE=M068

|               |     |                               |                                 |                          |             |
|---------------|-----|-------------------------------|---------------------------------|--------------------------|-------------|
| ALBRECHT      | 20  | EPJ C80 453                   | M. Albrecht <i>et al.</i>       | (Crystal Barrel Collab.) | REFID=60439 |
| LEES          | 18A | PR D97 112006                 | J.P. Lees <i>et al.</i>         | (BABAR Collab.)          | REFID=58950 |
| DOBBS         | 15  | PR D91 052006                 | S. Dobbs <i>et al.</i>          | (NWES)                   | REFID=56805 |
| ABLIKIM       | 13J | PR D87 032008                 | M. Ablikim <i>et al.</i>        | (BESIII Collab.)         | REFID=54955 |
| ABLIKIM       | 13N | PR D87 092009                 | Ablikim M. <i>et al.</i>        | (BESIII Collab.)         | REFID=55387 |
| UEHARA        | 13  | PTEP 2013 123C01              | S. Uehara <i>et al.</i>         | (BELLE Collab.)          | REFID=55592 |
| LIU           | 09  | PR D79 071102                 | C. Liu <i>et al.</i>            | (BELLE Collab.)          | REFID=52752 |
| ALBALADEJO    | 08  | PRL 101 252002                | M. Albaladejo, J.A. Oller       |                          | REFID=52656 |
| CHEKANOV      | 08  | PRL 101 112003                | S. Chekanov <i>et al.</i>       | (ZEUS Collab.)           | REFID=52275 |
| ABLIKIM       | 06H | PR D73 112007                 | M. Ablikim <i>et al.</i>        | (BES Collab.)            | REFID=51125 |
| ABLIKIM       | 06J | PRL 96 162002                 | M. Ablikim <i>et al.</i>        | (BES Collab.)            | REFID=51127 |
| ABLIKIM       | 06V | PL B642 441                   | M. Ablikim <i>et al.</i>        | (BES Collab.)            | REFID=51507 |
| AMSLER        | 06  | PL B639 165                   | C. Amsler <i>et al.</i>         | (Crystal Barrel Collab.) | REFID=51136 |
| UMAN          | 06  | PR D73 052009                 | I. Uman <i>et al.</i>           | (FNAL E835)              | REFID=51063 |
| VLADIMIRSK... | 06  | PAN 69 493                    | V.V. Vladimirov <i>et al.</i>   | (ITEP, Moscow)           | REFID=51191 |
|               |     | Translated from YAF 69 515.   |                                 |                          |             |
| ABLIKIM       | 05  | PL B607 243                   | M. Ablikim <i>et al.</i>        | (BES Collab.)            | REFID=50450 |
| ABLIKIM       | 05Q | PR D72 092002                 | M. Ablikim <i>et al.</i>        | (BES Collab.)            | REFID=50958 |
| BINON         | 05  | PAN 68 960                    | F. Binon <i>et al.</i>          |                          | REFID=50780 |
|               |     | Translated from YAF 68 998.   |                                 |                          |             |
| CLOSE         | 05  | PR D71 094022                 | F.E. Close, Q. Zhao             |                          | REFID=50788 |
| ABLIKIM       | 04A | PL B598 149                   | M. Ablikim <i>et al.</i>        | (BES Collab.)            | REFID=49740 |
| ABLIKIM       | 04E | PL B603 138                   | M. Ablikim <i>et al.</i>        | (BES Collab.)            | REFID=50174 |
| ANISOVICH     | 03  | EPJ A16 229                   | V.V. Anisovich <i>et al.</i>    |                          | REFID=49401 |
| BAI           | 03G | PR D68 052003                 | J.Z. Bai <i>et al.</i>          | (BES Collab.)            | REFID=49580 |
| TIKHOMIROV    | 03  | PAN 66 828                    | G.D. Tikhomirov <i>et al.</i>   |                          | REFID=49423 |
|               |     | Translated from YAF 66 860.   |                                 |                          |             |
| AMSLER        | 02  | EPJ C23 29                    | C. Amsler <i>et al.</i>         |                          | REFID=48580 |
| ANISOVICH     | 02D | PAN 65 1545                   | V.V. Anisovich <i>et al.</i>    |                          | REFID=48831 |
|               |     | Translated from YAF 65 1583.  |                                 |                          |             |
| NICHITIU      | 02  | PL B545 261                   | F. Nichitiu <i>et al.</i>       | (OBELIX Collab.)         | REFID=48848 |
| BAI           | 00A | PL B472 207                   | J.Z. Bai <i>et al.</i>          | (BES Collab.)            | REFID=47426 |
| BARATE        | 00E | PL B472 189                   | R. Barate <i>et al.</i>         | (ALEPH Collab.)          | REFID=47428 |
| BARBERIS      | 00E | PL B479 59                    | D. Barberis <i>et al.</i>       | (WA 102 Collab.)         | REFID=47961 |
| ANISOVICH     | 99B | PL B449 154                   | A.V. Anisovich <i>et al.</i>    |                          | REFID=46886 |
| BARBERIS      | 99  | PL B453 305                   | D. Barberis <i>et al.</i>       | (Omega Expt.)            | REFID=46921 |
| BARBERIS      | 99B | PL B453 316                   | D. Barberis <i>et al.</i>       | (Omega Expt.)            | REFID=46922 |
| BARBERIS      | 99D | PL B462 462                   | D. Barberis <i>et al.</i>       | (Omega Expt.)            | REFID=47395 |
| FRENCH        | 99  | PL B460 213                   | B. French <i>et al.</i>         | (WA76 Collab.)           | REFID=47491 |
| ANISOVICH     | 98B | SPU 41 419                    | V.V. Anisovich <i>et al.</i>    |                          | REFID=46331 |
|               |     | Translated from UFN 168 481.  |                                 |                          |             |
| BAI           | 98H | PRL 81 1179                   | J.Z. Bai <i>et al.</i>          | (BES Collab.)            | REFID=46342 |
| BARKOV        | 98  | JETPL 68 764                  | B.P. Barkov <i>et al.</i>       |                          | REFID=46616 |
| ABREU         | 96C | PL B379 309                   | P. Abreu <i>et al.</i>          | (DELPHI Collab.)         | REFID=44671 |
| BAI           | 96C | PRL 77 3959                   | J.Z. Bai <i>et al.</i>          | (BES Collab.)            | REFID=45169 |
| BALOSHIN      | 95  | PAN 58 46                     | O.N. Baloshin <i>et al.</i>     | (ITEP)                   | REFID=44621 |
|               |     | Translated from YAF 58 50.    |                                 |                          |             |
| BUGG          | 95  | PL B353 378                   | D.V. Bugg <i>et al.</i>         | (LOQM, PNPI, WASH)       | REFID=44438 |
| ARMSTRONG     | 93C | PL B307 394                   | T.A. Armstrong <i>et al.</i>    | (FNAL, FERR, GENO+)      | REFID=43587 |
| BREAKSTONE    | 93  | ZPHY C58 251                  | A.M. Breakstone <i>et al.</i>   | (IOWA, CERN, DORT+)      | REFID=43312 |
| ALDE          | 92D | PL B284 457                   | D.M. Alde <i>et al.</i>         | (GAM2 Collab.)           | REFID=41591 |
| Also          |     | SJNP 54 451                   | D.M. Alde <i>et al.</i>         | (GAM2 Collab.)           | REFID=44696 |
|               |     | Translated from YAF 54 745.   |                                 |                          |             |
| ARMSTRONG     | 91  | ZPHY C51 351                  | T.A. Armstrong <i>et al.</i>    | (ATHU, BARI, BIRM+)      | REFID=41744 |
| PROKOSHKIN    | 91  | SPD 36 155                    | Y.D. Prokoshkin                 | (GAM2 and GAM4 Collab.)  | REFID=41719 |
|               |     | Translated from DANS 316 900. |                                 |                          |             |
| ALBRECHT      | 90G | ZPHY C48 183                  | H. Albrecht <i>et al.</i>       | (ARGUS Collab.)          | REFID=41374 |
| ARMSTRONG     | 89D | PL B227 186                   | T.A. Armstrong, M. Benayoun     | (ATHU, BARI, BIRM+)      | REFID=41010 |
| BEHREND       | 89C | ZPHY C43 91                   | H.J. Behrend <i>et al.</i>      | (CELLO Collab.)          | REFID=40915 |
| AUGUSTIN      | 88  | PRL 60 2238                   | J.E. Augustin <i>et al.</i>     | (DM2 Collab.)            | REFID=40574 |
| BOLONKIN      | 88  | NP B309 426                   | B.V. Bolonkin <i>et al.</i>     | (ITEP, SERP)             | REFID=40580 |
| FALVARD       | 88  | PR D38 2706                   | A. Falvard <i>et al.</i>        | (CLER, FRAS, LALO+)      | REFID=40576 |
| AUGUSTIN      | 87  | ZPHY C36 369                  | J.E. Augustin <i>et al.</i>     | (LALO, CLER, FRAS+)      | REFID=40268 |
| BALTRUSAIT... | 87  | PR D35 2077                   | R.M. Baltrusaitis <i>et al.</i> | (Mark III Collab.)       | REFID=40010 |
| ALDE          | 86C | PL B182 105                   | D.M. Alde <i>et al.</i>         | (SERP, BELG, LANL, LAPP) | REFID=21694 |
| LONGACRE      | 86  | PL B177 223                   | R.S. Longacre <i>et al.</i>     | (BNL, BRAN, CUNY+)       | REFID=20768 |
| ALTHOFF       | 85B | ZPHY C29 189                  | M. Althoff <i>et al.</i>        | (TASSO Collab.)          | REFID=21349 |
| BINON         | 84C | NC 80A 363                    | F.G. Binon <i>et al.</i>        | (BELG, LAPP, SERP+)      | REFID=21418 |
| WILLIAMS      | 84  | PR D30 877                    | E.G.H. Williams <i>et al.</i>   | (VAND, NDAM, TUFTS+)     | REFID=21693 |
| BINON         | 83  | NC 78A 313                    | F.G. Binon <i>et al.</i>        | (BELG, LAPP, SERP+)      | REFID=20750 |
| BLOOM         | 83  | ARNS 33 143                   | E.D. Bloom, C. Peck             | (SLAC, CIT)              | REFID=21682 |
| BURKE         | 82  | PRL 49 632                    | D.L. Burke <i>et al.</i>        | (LBL, SLAC)              | REFID=21676 |
| EDWARDS       | 82D | PRL 48 458                    | C. Edwards <i>et al.</i>        | (CIT, HARV, PRIN+)       | REFID=21677 |
| ETKIN         | 82B | PR D25 1786                   | A. Etkin <i>et al.</i>          | (BNL, CUNY, TUFTS, VAND) | REFID=20390 |
| ETKIN         | 82C | PR D25 2446                   | A. Etkin <i>et al.</i>          | (BNL, CUNY, TUFTS, VAND) | REFID=20391 |
| HYAMS         | 75  | NP B100 205                   | B.D. Hyams <i>et al.</i>        | (CERN, MPIIM)            | REFID=20355 |

**$\eta(1760)$** 

$$I^G(J^{PC}) = 0^+(0^-+)$$

NODE=M114

## OMITTED FROM SUMMARY TABLE

Seen by DM2 in the  $\rho\rho$  system (BISELLO 89B). Structure in this region has been reported before in the same system (BALTRUSAITIS 86B) and in the  $\omega\omega$  system (BALTRUSAITIS 85C, BISELLO 87).

NODE=M114

 **$\eta(1760)$  MASS**

NODE=M114M

NODE=M114M

| VALUE (MeV)                                                                                                      | EVTS | DOCUMENT ID          | TECN     | COMMENT                                    |
|------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------|
| <b>1751±15 OUR AVERAGE</b>                                                                                       |      |                      |          |                                            |
| $1768^{+24}_{-25} \pm 10$                                                                                        | 465  | <sup>1</sup> ZHANG   | 12A BELL | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |
| $1744 \pm 10 \pm 15$                                                                                             | 1045 | <sup>2</sup> ABLIKIM | 06H BES  | $J/\psi \rightarrow \gamma\omega\omega$    |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                    |      |                      |          |                                            |
| $1703^{+12}_{-11} \pm 2$                                                                                         |      | <sup>3</sup> ZHANG   | 12A BELL | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |
| $1760 \pm 11$                                                                                                    | 320  | <sup>4</sup> BISELLO | 89B DM2  | $J/\psi \rightarrow 4\pi\gamma$            |
| <sup>1</sup> From a single-resonance fit.                                                                        |      |                      |          |                                            |
| <sup>2</sup> From a partial wave analysis including $\eta(1760)$ , $f_0(1710)$ , $f_2(1640)$ , and $f_2(1910)$ . |      |                      |          |                                            |
| <sup>3</sup> From a two-resonance fit.                                                                           |      |                      |          |                                            |
| <sup>4</sup> Estimated by us from various fits. Systematic uncertainties not estimated.                          |      |                      |          |                                            |

OCCUR=2

NODE=M114M;LINKAGE=ZA  
 NODE=M114M;LINKAGE=MA  
 NODE=M114M;LINKAGE=ZH  
 NODE=M114M;LINKAGE=A

 **$\eta(1760)$  WIDTH**

NODE=M114W

NODE=M114W

| VALUE (MeV)                                                                                                      | EVTS | DOCUMENT ID          | TECN     | COMMENT                                    |
|------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------|
| <b>240±30 OUR AVERAGE</b>                                                                                        |      |                      |          |                                            |
| $224^{+62}_{-56} \pm 25$                                                                                         | 465  | <sup>5</sup> ZHANG   | 12A BELL | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |
| $244^{+24}_{-21} \pm 25$                                                                                         | 1045 | <sup>6</sup> ABLIKIM | 06H BES  | $J/\psi \rightarrow \gamma\omega\omega$    |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                    |      |                      |          |                                            |
| $42^{+36}_{-22} \pm 15$                                                                                          |      | <sup>7</sup> ZHANG   | 12A BELL | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |
| $60 \pm 16$                                                                                                      | 320  | <sup>8</sup> BISELLO | 89B DM2  | $J/\psi \rightarrow 4\pi\gamma$            |
| <sup>5</sup> From a single-resonance fit.                                                                        |      |                      |          |                                            |
| <sup>6</sup> From a partial wave analysis including $\eta(1760)$ , $f_0(1710)$ , $f_2(1640)$ , and $f_2(1910)$ . |      |                      |          |                                            |
| <sup>7</sup> From a two-resonance fit.                                                                           |      |                      |          |                                            |
| <sup>8</sup> Estimated by us from various fits. Systematic uncertainties not estimated.                          |      |                      |          |                                            |

OCCUR=2

NODE=M114W;LINKAGE=ZA  
 NODE=M114W;LINKAGE=MA  
 NODE=M114W;LINKAGE=ZH  
 NODE=M114W;LINKAGE=B

 **$\eta(1760)$  DECAY MODES**

NODE=M114215;NODE=M114

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1$ $4\pi$             |                                |
| $\Gamma_2$ $2\pi^+2\pi^-$     | seen                           |
| $\Gamma_3$ $\pi^+\pi^-2\pi^0$ | seen                           |
| $\Gamma_4$ $\rho^0\rho^0$     | seen                           |
| $\Gamma_5$ $\rho^+\rho^-$     | seen                           |
| $\Gamma_6$ $\omega\omega$     | seen                           |
| $\Gamma_7$ $\eta'\pi^+\pi^-$  | seen                           |
| $\Gamma_8$ $\gamma\gamma$     | seen                           |

DESIG=1

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=7

DESIG=8;OUR EVAL;→ UNCHECKED ←

DESIG=9;OUR EVAL;→ UNCHECKED ←

 **$\eta(1760)$   $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

NODE=M114225

| $\Gamma(\eta'\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$             |      |                     |          |                                            |  | $\Gamma_7\Gamma_8/\Gamma$ |
|-----------------------------------------------------------------------------------------|------|---------------------|----------|--------------------------------------------|--|---------------------------|
| VALUE (eV)                                                                              | EVTS | DOCUMENT ID         | TECN     | COMMENT                                    |  |                           |
| <b><math>28.2^{+7.9}_{-7.5} \pm 3.7</math></b>                                          | 465  | <sup>9</sup> ZHANG  | 12A BELL | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |  |                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • •           |      |                     |          |                                            |  |                           |
| $3.0^{+2.0}_{-1.2} \pm 0.8$                                                             | 52   | <sup>10</sup> ZHANG | 12A BELL | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |  |                           |
| $18^{+13}_{-10} \pm 5$                                                                  | 315  | <sup>11</sup> ZHANG | 12A BELL | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |  |                           |
| <sup>9</sup> From a single-resonance fit.                                               |      |                     |          |                                            |  |                           |
| <sup>10</sup> From a two-resonance fit. For constructive interference with the X(1835). |      |                     |          |                                            |  |                           |
| <sup>11</sup> From a two-resonance fit. For destructive interference with the X(1835).  |      |                     |          |                                            |  |                           |

NODE=M114G01  
 NODE=M114G01

OCCUR=2

OCCUR=3

NODE=M114G01;LINKAGE=ZH  
 NODE=M114G01;LINKAGE=ZA  
 NODE=M114G01;LINKAGE=ZN

$\eta(1760)$  BRANCHING RATIOS

NODE=M114210

 $\Gamma(2\pi^+ 2\pi^-)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE | DOCUMENT ID | TECN    | COMMENT                                   |
|-------|-------------|---------|-------------------------------------------|
| seen  | BISELLO     | 89B DM2 | $J/\psi \rightarrow \gamma 2\pi^+ 2\pi^-$ |

NODE=M114R01  
NODE=M114R01 $\Gamma(\pi^+ \pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE | DOCUMENT ID | TECN    | COMMENT                                        |
|-------|-------------|---------|------------------------------------------------|
| seen  | BISELLO     | 89B DM2 | $J/\psi \rightarrow \gamma \pi^+ \pi^- 2\pi^0$ |

NODE=M114R02  
NODE=M114R02 $\Gamma(\rho^0 \rho^0)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE | DOCUMENT ID     | TECN    | COMMENT                                   |
|-------|-----------------|---------|-------------------------------------------|
| seen  | BISELLO         | 89B DM2 | $J/\psi \rightarrow \gamma \rho^0 \rho^0$ |
| seen  | BALTRUSAIT...86 | MRK3    | $J/\psi \rightarrow \gamma \rho^0 \rho^0$ |

NODE=M114R03  
NODE=M114R03 $\Gamma(\rho^+ \rho^-)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE | DOCUMENT ID     | TECN    | COMMENT                                   |
|-------|-----------------|---------|-------------------------------------------|
| seen  | BISELLO         | 89B DM2 | $J/\psi \rightarrow \gamma \rho^+ \rho^-$ |
| seen  | BALTRUSAIT...86 | MRK3    | $J/\psi \rightarrow \gamma \rho^+ \rho^-$ |

NODE=M114R04  
NODE=M114R04 $\Gamma(\omega\omega)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE | DOCUMENT ID      | TECN   | COMMENT                                 |
|-------|------------------|--------|-----------------------------------------|
| seen  | BISELLO          | 87 DM2 | $J/\psi \rightarrow \omega\omega$       |
| seen  | BALTRUSAIT...85C | MRK3   | $J/\psi \rightarrow \gamma\omega\omega$ |

NODE=M114R06  
NODE=M114R06 $\Gamma(\gamma\gamma)/\Gamma(\omega\omega)$  $\Gamma_8/\Gamma_6$ 

| VALUE                  | CL% | DOCUMENT ID           | TECN     | COMMENT                                               |
|------------------------|-----|-----------------------|----------|-------------------------------------------------------|
| $<2.48 \times 10^{-3}$ | 90  | <sup>12</sup> ABLIKIM | 180 BES3 | $\psi(2S) \rightarrow \pi^+ \pi^- \gamma\gamma\gamma$ |

<sup>12</sup> Using results from ABLIKIM 06H.

NODE=M114R08  
NODE=M114R08

NODE=M114R08;LINKAGE=A

 $\eta(1760)$  REFERENCES

NODE=M114

|                   |             |               |                                 |                     |
|-------------------|-------------|---------------|---------------------------------|---------------------|
| ABLIKIM           | 180         | PR D97 072014 | M. Ablikim <i>et al.</i>        | (BESIII Collab.)    |
| ZHANG             | 12A         | PR D86 052002 | C.C. Zhang <i>et al.</i>        | (BELLE Collab.)     |
| ABLIKIM           | 06H         | PR D73 112007 | M. Ablikim <i>et al.</i>        | (BES Collab.)       |
| BISELLO           | 89B         | PR D39 701    | G. Busetto <i>et al.</i>        | (DM2 Collab.)       |
| BISELLO           | 87          | PL B192 239   | D. Bisello <i>et al.</i>        | (PADO, CLER, FRAS+) |
| BALTRUSAIT... 86  | PR D33 629  |               | R.M. Baltrusaitis <i>et al.</i> | (Mark III Collab.)  |
| BALTRUSAIT... 86B | PR D33 1222 |               | R.M. Baltrusaitis <i>et al.</i> | (Mark III Collab.)  |
| BALTRUSAIT... 85C | PRL 55 1723 |               | R.M. Baltrusaitis <i>et al.</i> | (CIT, UCSC+)        |

REFID=58925  
REFID=54763  
REFID=51125  
REFID=40575  
REFID=40012  
REFID=22009  
REFID=22100  
REFID=22095

NODE=M075

 $\pi(1800)$ 

$$I^G(J^{PC}) = 1^-(0^-+)$$

See the review on "Non- $q\bar{q}$  Mesons."

NODE=M075

 $\pi(1800)$  MASS

NODE=M075M

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

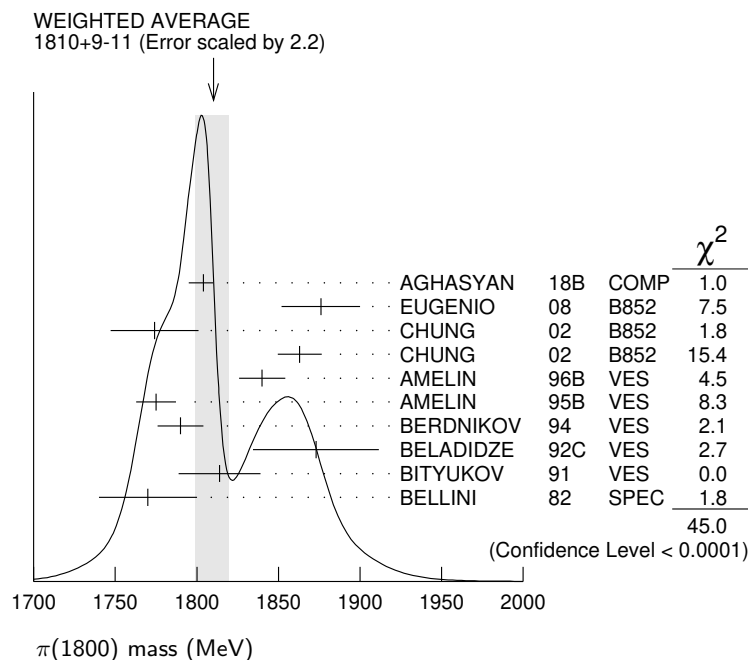
NODE=M075M

 **$1810^{+9}_{-11}$  OUR AVERAGE** Error includes scale factor of 2.2. See the ideogram below.

|                                                                               |      |                        |     |      |                                                             |
|-------------------------------------------------------------------------------|------|------------------------|-----|------|-------------------------------------------------------------|
| $1804^{+6}_{-9}$                                                              | 46M  | <sup>1</sup> AGHASYAN  | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$               |
| $1876 \pm 18 \pm 16$                                                          | 4k   | <sup>2</sup> EUGENIO   | 08  | B852 | 18 $\pi^- p \rightarrow \eta \eta \pi^- p$                  |
| $1774 \pm 18 \pm 20$                                                          |      | <sup>3</sup> CHUNG     | 02  | B852 | 18.3 $\pi^- p \rightarrow$<br>$\pi^+ \pi^- \pi^- p$         |
| $1863 \pm 9 \pm 10$                                                           |      | <sup>4</sup> CHUNG     | 02  | B852 | 18.3 $\pi^- p \rightarrow$<br>$\pi^+ \pi^- \pi^- p$         |
| $1840 \pm 10 \pm 10$                                                          | 1.2k | AMELIN                 | 96B | VES  | 37 $\pi^- A \rightarrow \eta \eta \pi^- A$                  |
| $1775 \pm 7 \pm 10$                                                           |      | <sup>5</sup> AMELIN    | 95B | VES  | 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$                |
| $1790 \pm 14$                                                                 |      | <sup>6</sup> BERDNIKOV | 94  | VES  | 37 $\pi^- A \rightarrow K^+ K^- \pi^- A$                    |
| $1873 \pm 33 \pm 20$                                                          |      | BELADIDZE              | 92C | VES  | 36 $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$ |
| $1814 \pm 10 \pm 23$                                                          | 426  | BITYUKOV               | 91  | VES  | 36 $\pi^- C \rightarrow \pi^- \eta \eta C$                  |
| $1770 \pm 30$                                                                 | 1.1k | BELLINI                | 82  | SPEC | 40 $\pi^- A \rightarrow 3\pi A$                             |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                        |     |      |                                                             |
| $1785 \pm 9^{+12}_{-6}$                                                       | 420k | <sup>7</sup> ALEKSEEV  | 10  | COMP | 190 $\pi^- Pb \rightarrow$<br>$\pi^- \pi^- \pi^+ Pb'$       |
| $1737 \pm 5 \pm 15$                                                           |      | AMELIN                 | 99  | VES  | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$             |

OCCUR=2

- 1 Statistical error negligible.  
 2 From a single-pole fit.  
 3 In the  $f_0(980)\pi$  wave.  
 4 In the  $f_0(500)\pi$  wave.  
 5 From a fit to  $J^{PC} = 0^{-+} f_0(980)\pi, f_0(1370)\pi$  waves.  
 6 From a fit to  $J^{PC} = 0^{-+} K_0^*(1430)K^-$  and  $f_0(980)\pi^-$  waves.  
 7 Superseded by AGHASYAN 2018B.



### $\pi(1800)$ WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

**215<sup>+7</sup><sub>-8</sub> OUR AVERAGE**

|                                  |      |              |     |      |                                                |
|----------------------------------|------|--------------|-----|------|------------------------------------------------|
| 220 <sup>+8</sup> <sub>-11</sub> | 46M  | 8 AGHASYAN   | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$  |
| 221 ± 26 ± 38                    | 4k   | 9 EUGENIO    | 08  | B852 | 18 $\pi^- p \rightarrow \eta \eta \pi^- p$     |
| 223 ± 48 ± 50                    |      | 10 CHUNG     | 02  | B852 | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |
| 191 ± 21 ± 20                    |      | 11 CHUNG     | 02  | B852 | 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |
| 210 ± 30 ± 30                    | 1.2k | AMELIN       | 96B | VES  | 37 $\pi^- A \rightarrow \eta \eta \pi^- A$     |
| 190 ± 15 ± 15                    |      | 12 AMELIN    | 95B | VES  | 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$   |
| 210 ± 70                         |      | 13 BERDNIKOV | 94  | VES  | 37 $\pi^- A \rightarrow K^+ K^- \pi^- A$       |
| 225 ± 35 ± 20                    |      | BELADIDZE    | 92C | VES  | 36 $\pi^- Be \rightarrow \pi^- \eta' \eta Be$  |
| 205 ± 18 ± 32                    | 426  | BITYUKOV     | 91  | VES  | 36 $\pi^- C \rightarrow \pi^- \eta \eta C$     |
| 310 ± 50                         | 1.1k | BELLINI      | 82  | SPEC | 40 $\pi^- A \rightarrow 3\pi A$                |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                        |      |             |    |      |                                                  |
|----------------------------------------|------|-------------|----|------|--------------------------------------------------|
| 208 ± 22 <sup>+21</sup> <sub>-37</sub> | 420k | 14 ALEKSEEV | 10 | COMP | 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$ |
| 259 ± 19 ± 6                           |      | AMELIN      | 99 | VES  | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$  |

- 8 Statistical error negligible.  
 9 From a single-pole fit.  
 10 In the  $f_0(980)\pi$  wave.  
 11 In the  $f_0(500)\pi$  wave.  
 12 From a fit to  $J^{PC} = 0^{-+} f_0(980)\pi, f_0(1370)\pi$  waves.  
 13 From a fit to  $J^{PC} = 0^{-+} K_0^*(1430)K^-$  and  $f_0(980)\pi^-$  waves.  
 14 Superseded by AGHASYAN 2018B.

NODE=M075M;LINKAGE=B  
 NODE=M075M;LINKAGE=SP  
 NODE=M075M;LINKAGE=C1  
 NODE=M075M;LINKAGE=C2  
 NODE=M075M;LINKAGE=AX  
 NODE=M075M;LINKAGE=A  
 NODE=M075M;LINKAGE=C

NODE=M075W

NODE=M075W

OCCUR=2

NODE=M075W;LINKAGE=B  
 NODE=M075W;LINKAGE=SP  
 NODE=M075W;LINKAGE=C1  
 NODE=M075W;LINKAGE=C2  
 NODE=M075W;LINKAGE=AX  
 NODE=M075W;LINKAGE=A  
 NODE=M075W;LINKAGE=C

**$\pi(1800)$  DECAY MODES**

NODE=M075215;NODE=M075

| Mode                                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi^+ \pi^- \pi^-$        | seen                           |
| $\Gamma_2 \quad f_0(500) \pi^-$           | seen                           |
| $\Gamma_3 \quad f_0(980) \pi^-$           | seen                           |
| $\Gamma_4 \quad f_0(1370) \pi^-$          | seen                           |
| $\Gamma_5 \quad f_0(1500) \pi^-$          | not seen                       |
| $\Gamma_6 \quad \rho \pi^-$               | not seen                       |
| $\Gamma_7 \quad \eta \eta \pi^-$          | seen                           |
| $\Gamma_8 \quad a_0(980) \eta$            | seen                           |
| $\Gamma_9 \quad a_2(1320) \eta$           | not seen                       |
| $\Gamma_{10} \quad f_2(1270) \pi$         | not seen                       |
| $\Gamma_{11} \quad f_0(1370) \pi^-$       | not seen                       |
| $\Gamma_{12} \quad f_0(1500) \pi^-$       | seen                           |
| $\Gamma_{13} \quad \eta \eta'(958) \pi^-$ | seen                           |
| $\Gamma_{14} \quad K_0^*(1430) K^-$       | seen                           |
| $\Gamma_{15} \quad K^*(892) K^-$          | not seen                       |

DESIG=10;OUR EST;→ UNCHECKED ←  
DESIG=11;OUR EST;→ UNCHECKED ←  
DESIG=3;OUR EST;→ UNCHECKED ←  
DESIG=1  
DESIG=12  
DESIG=2  
DESIG=7;OUR EST;→ UNCHECKED ←  
DESIG=5;OUR EST;→ UNCHECKED ←  
DESIG=13  
DESIG=14  
DESIG=15  
DESIG=6;OUR EST;→ UNCHECKED ←  
DESIG=8;OUR EST;→ UNCHECKED ←  
DESIG=4  
DESIG=9

 **$\pi(1800)$  BRANCHING RATIOS**

NODE=M075220

| $\Gamma(f_0(980)\pi^-)/\Gamma(f_0(500)\pi^-)$ | $\Gamma_3/\Gamma_2$                                                        |
|-----------------------------------------------|----------------------------------------------------------------------------|
| <u>VALUE</u>                                  | <u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>                              |
| <b>0.44±0.08±0.38</b>                         | <sup>15</sup> CHUNG 02 B852 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |

NODE=M075R11  
NODE=M075R11

| $\Gamma(f_0(980)\pi^-)/\Gamma(f_0(1370)\pi^-)$                                | $\Gamma_3/\Gamma_4$                                                         |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| <u>VALUE</u>                                                                  | <u>DOCUMENT ID</u> <u>TECN</u> <u>CHG</u> <u>COMMENT</u>                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                                             |
| 1.7±1.3                                                                       | <sup>16</sup> AMELIN 95B VES — 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$ |

NODE=M075R5  
NODE=M075R5

| $\Gamma(f_0(1370)\pi^-)/\Gamma_{\text{total}}$ | $\Gamma_4/\Gamma$                                        |
|------------------------------------------------|----------------------------------------------------------|
| <u>VALUE</u>                                   | <u>DOCUMENT ID</u> <u>TECN</u> <u>CHG</u> <u>COMMENT</u> |
| <b>seen</b>                                    | BELLINI 82 SPEC — 40 $\pi^- A \rightarrow 3\pi A$        |

NODE=M075R1  
NODE=M075R1

| $\Gamma(f_0(1500)\pi^-)/\Gamma_{\text{total}}$ | $\Gamma_5/\Gamma$                                            |
|------------------------------------------------|--------------------------------------------------------------|
| <u>VALUE</u>                                   | <u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>                |
| <b>not seen</b>                                | CHUNG 02 B852 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$ |

NODE=M075R12  
NODE=M075R12

| $\Gamma(\rho\pi^-)/\Gamma_{\text{total}}$ | $\Gamma_6/\Gamma$                                        |
|-------------------------------------------|----------------------------------------------------------|
| <u>VALUE</u>                              | <u>DOCUMENT ID</u> <u>TECN</u> <u>CHG</u> <u>COMMENT</u> |
| <b>not seen</b>                           | BELLINI 82 SPEC — 40 $\pi^- A \rightarrow 3\pi A$        |

NODE=M075R2  
NODE=M075R2

| $\Gamma(\rho\pi^-)/\Gamma(f_0(980)\pi^-)$                                        | $\Gamma_6/\Gamma_3$                                           |
|----------------------------------------------------------------------------------|---------------------------------------------------------------|
| <u>VALUE</u> <u>CL%</u> <u>DOCUMENT ID</u> <u>TECN</u> <u>CHG</u> <u>COMMENT</u> |                                                               |
| • • • We do not use the following data for averages, fits, limits, etc. • • •    |                                                               |
| <0.25                                                                            | CHUNG 02 B852 18.3 $\pi^- p \rightarrow \pi^+ \pi^- \pi^- p$  |
| <0.14 90                                                                         | AMELIN 95B VES — 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$ |

NODE=M075R6  
NODE=M075R6

| $\Gamma(\eta\eta\pi^-)/\Gamma(\pi^+\pi^-\pi^-)$                                   | $\Gamma_7/\Gamma_1$                                                     |
|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <u>VALUE</u> <u>EVTs</u> <u>DOCUMENT ID</u> <u>TECN</u> <u>CHG</u> <u>COMMENT</u> |                                                                         |
| • • • We do not use the following data for averages, fits, limits, etc. • • •     |                                                                         |
| 0.5±0.1 1200                                                                      | <sup>16</sup> AMELIN 96B VES — 37 $\pi^- A \rightarrow \eta\eta\pi^- A$ |

NODE=M075R8  
NODE=M075R8

| $\Gamma(a_2(1320)\eta)/\Gamma_{\text{total}}$ | $\Gamma_9/\Gamma$                                        |
|-----------------------------------------------|----------------------------------------------------------|
| <u>VALUE</u>                                  | <u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>            |
| <b>not seen</b>                               | EUGENIO 08 B852 18 $\pi^- p \rightarrow \eta\eta\pi^- p$ |

NODE=M075R13  
NODE=M075R13

| $\Gamma(f_2(1270)\pi)/\Gamma_{\text{total}}$ | $\Gamma_{10}/\Gamma$                                     |
|----------------------------------------------|----------------------------------------------------------|
| <u>VALUE</u>                                 | <u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>            |
| <b>not seen</b>                              | EUGENIO 08 B852 18 $\pi^- p \rightarrow \eta\eta\pi^- p$ |

NODE=M075R14  
NODE=M075R14

| $\Gamma(f_0(1370)\pi^-)/\Gamma_{\text{total}}$ | $\Gamma_{11}/\Gamma$                                     |
|------------------------------------------------|----------------------------------------------------------|
| <u>VALUE</u>                                   | <u>DOCUMENT ID</u> <u>TECN</u> <u>COMMENT</u>            |
| <b>not seen</b>                                | EUGENIO 08 B852 18 $\pi^- p \rightarrow \eta\eta\pi^- p$ |

NODE=M075R15  
NODE=M075R15



$\Gamma(f_0(1500)\pi^-)/\Gamma(a_0(980)\eta)$  $\Gamma_{12}/\Gamma_8$ 

| VALUE                                                                         | EVTS | DOCUMENT ID              | TECN | CHG  | COMMENT                                              |
|-------------------------------------------------------------------------------|------|--------------------------|------|------|------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                          |      |      |                                                      |
| 0.48 $\pm$ 0.17                                                               | 4k   | <sup>16,17</sup> EUGENIO | 08   | B852 | — 18 $\pi^- p \rightarrow \eta\eta\pi^- p$           |
| 0.030 $^{+0.014}_{-0.011}$                                                    |      | <sup>16</sup> ANISOVICH  | 01B  | SPEC | 0 0.6–1.94 $p\bar{p} \rightarrow \eta\eta\pi^0\pi^0$ |
| 0.08 $\pm$ 0.03                                                               | 1200 | <sup>16,18</sup> AMELIN  | 96B  | VES  | — 37 $\pi^- A \rightarrow \eta\eta\pi^- A$           |

NODE=M075R7  
 NODE=M075R7

 $\Gamma(\eta\eta'(958)\pi^-)/\Gamma(\eta\eta\pi^-)$  $\Gamma_{13}/\Gamma_7$ 

| VALUE                                                                         | EVTS         | DOCUMENT ID             | TECN | CHG | COMMENT                                                       |
|-------------------------------------------------------------------------------|--------------|-------------------------|------|-----|---------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                         |      |     |                                                               |
| 0.29 $\pm$ 0.07                                                               |              | <sup>16</sup> BELADIDZE | 92C  | VES | — 36 $\pi^- \text{Be} \rightarrow \pi^- \eta' \eta \text{Be}$ |
| 0.3 $\pm$ 0.1                                                                 | 426 $\pm$ 57 | <sup>16</sup> BITYUKOV  | 91   | VES | — 36 $\pi^- \text{C} \rightarrow \pi^- \eta \eta \text{C}$    |

NODE=M075R10  
 NODE=M075R10

 $\Gamma(K_0^*(1430)K^-)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE       | DOCUMENT ID  | TECN | CHG | COMMENT                                  |
|-------------|--------------|------|-----|------------------------------------------|
| <b>seen</b> | BERDNIKOV 94 | VES  | —   | 37 $\pi^- A \rightarrow K^+ K^- \pi^- A$ |

NODE=M075R4  
 NODE=M075R4

 $\Gamma(K^*(892)K^-)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE           | DOCUMENT ID  | TECN | CHG | COMMENT                                  |
|-----------------|--------------|------|-----|------------------------------------------|
| <b>not seen</b> | BERDNIKOV 94 | VES  | —   | 37 $\pi^- A \rightarrow K^+ K^- \pi^- A$ |

NODE=M075R9  
 NODE=M075R9

<sup>15</sup> Assuming that  $f_0(980)$  decays only to  $\pi\pi$ .

<sup>16</sup> Systematic errors not estimated.

<sup>17</sup> From a single-pole fit.

<sup>18</sup> Assuming that  $f_0(1500)$  decays only to  $\eta\eta$  and  $a_0(980)$  decays only to  $\eta\pi$ .

NODE=M075R;LINKAGE=CK  
 NODE=M075R5;LINKAGE=NS  
 NODE=M075R7;LINKAGE=SP  
 NODE=M075R7;LINKAGE=A

 $\pi(1800)$  REFERENCES

NODE=M075

|           |     |                              |                                            |                    |
|-----------|-----|------------------------------|--------------------------------------------|--------------------|
| AGHASYAN  | 18B | PR D98 092003                | M. Aghasyan <i>et al.</i>                  | (COMPASS Collab.)  |
| ALEKSEEV  | 10  | PRL 104 241803               | M.G. Alekseev <i>et al.</i>                | (COMPASS Collab.)  |
| EUGENIO   | 08  | PL B660 466                  | P. Eugenio <i>et al.</i>                   | (BNL E852 Collab.) |
| CHUNG     | 02  | PR D65 072001                | S.U. Chung <i>et al.</i>                   | (BNL E852 Collab.) |
| ANISOVICH | 01B | PL B500 222                  | A.V. Anisovich <i>et al.</i>               |                    |
| AMELIN    | 99  | PAN 62 445                   | D.V. Amelin <i>et al.</i>                  | (VES Collab.)      |
|           |     | Translated from YAF 62 487.  |                                            |                    |
| AMELIN    | 96B | PAN 59 976                   | D.V. Amelin <i>et al.</i>                  | (SERP, TBIL) IGJPC |
|           |     | Translated from YAF 59 1021. |                                            |                    |
| AMELIN    | 95B | PL B356 595                  | D.V. Amelin <i>et al.</i>                  | (SERP, TBIL)       |
| BERDNIKOV | 94  | PL B337 219                  | E.B. Berdnikov <i>et al.</i>               | (SERP, TBIL)       |
| BELADIDZE | 92C | SJNP 55 1535                 | G.M. Beladidze, S.I. Bitukov, G.V. Borisov | (SERP+)            |
|           |     | Translated from YAF 55 2748. |                                            |                    |
| BITYUKOV  | 91  | PL B268 137                  | S.I. Bitukov <i>et al.</i>                 | (SERP, TBIL)       |
| BELLINI   | 82  | PRL 48 1697                  | G. Bellini <i>et al.</i>                   | (MILA, BGNA, JINR) |

REFID=44725

REFID=44433  
 REFID=44073  
 REFID=43175

REFID=41749  
 REFID=21134

**$f_2(1810)$** 

$$J^{PC} = 0^{+}(2^{++})$$

OMITTED FROM SUMMARY TABLE

Needs confirmation.

NODE=M038

NODE=M038

NODE=M038M

NODE=M038M

 **$f_2(1810)$  MASS**

| VALUE (MeV)         | EVTs               | DOCUMENT ID                                                 | TECN      | COMMENT                                                         |
|---------------------|--------------------|-------------------------------------------------------------|-----------|-----------------------------------------------------------------|
| <b>1815 ±12</b>     | <b>OUR AVERAGE</b> | Error includes scale factor of 1.4. See the ideogram below. |           |                                                                 |
| 1822 $^{+29}_{-24}$ | $^{+66}_{-57}$     | 5.5k                                                        | 1 ABLIKIM | 13N BES3 $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$ |
| 1737 ± 9            | $^{+198}_{-65}$    |                                                             | 2 UEHARA  | 10A BELL $10.6 e^+e^- \rightarrow e^+e^- \eta\eta$              |
| 1800 ±30            | 40                 |                                                             | ALDE      | 88D GAM4 $300 \pi^- p \rightarrow \pi^- p 4\pi^0$               |
| 1806 ±10            | 1600               |                                                             | ALDE      | 87 GAM4 $100 \pi^- p \rightarrow 4\pi^0 n$                      |
| 1870 ±40            |                    |                                                             | 3 ALDE    | 86D GAM4 $100 \pi^- p \rightarrow \eta\eta n$                   |
| 1857 $^{+35}_{-24}$ |                    |                                                             | 4 COSTA   | 80 OMEG $10 \pi^- p \rightarrow K^+ K^- n$                      |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                               |  |  |            |                                                                                    |
|-------------------------------|--|--|------------|------------------------------------------------------------------------------------|
| 1845.0 ± 2.2 $^{+1.6}_{-7.2}$ |  |  | 5 ALBRECHT | 20 RVUE $0.9 \bar{p}p \rightarrow \pi^0 \pi^0 \eta, \pi^0 \eta\eta, \pi^0 K^+ K^-$ |
| 1858 $^{+18}_{-71}$           |  |  | 6 LONGACRE | 86 RVUE Compilation                                                                |
| 1799 ±15                      |  |  | 7 CASON    | 82 STRC $8 \pi^+ p \rightarrow \Delta^{++} \pi^0 \pi^0$                            |

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

<sup>2</sup> Breit-Wigner mass. Could also be the  $f_2(1910)$ .

<sup>3</sup> Seen in only one solution.

<sup>4</sup> Error increased by spread of two solutions. Included in LONGACRE 86 global analysis.

<sup>5</sup> T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).

<sup>6</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.

<sup>7</sup> From an amplitude analysis of the reaction  $\pi^+\pi^- \rightarrow 2\pi^0$ . The resonance in the  $2\pi^0$  final state is not confirmed by PROKOSHKIN 97.

NODE=M038M;LINKAGE=B

NODE=M038M;LINKAGE=UE

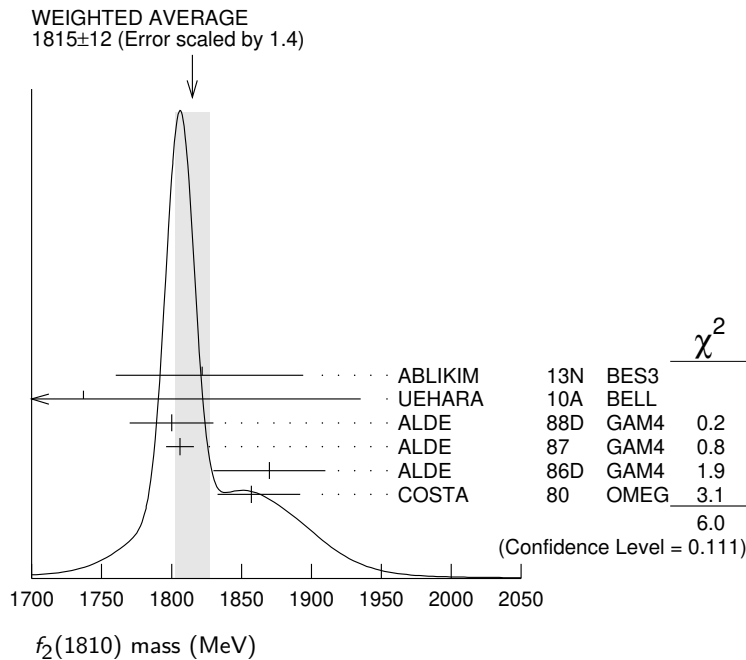
NODE=M038M;LINKAGE=F

NODE=M038M;LINKAGE=A

NODE=M038M;LINKAGE=C

NODE=M038M;LINKAGE=L

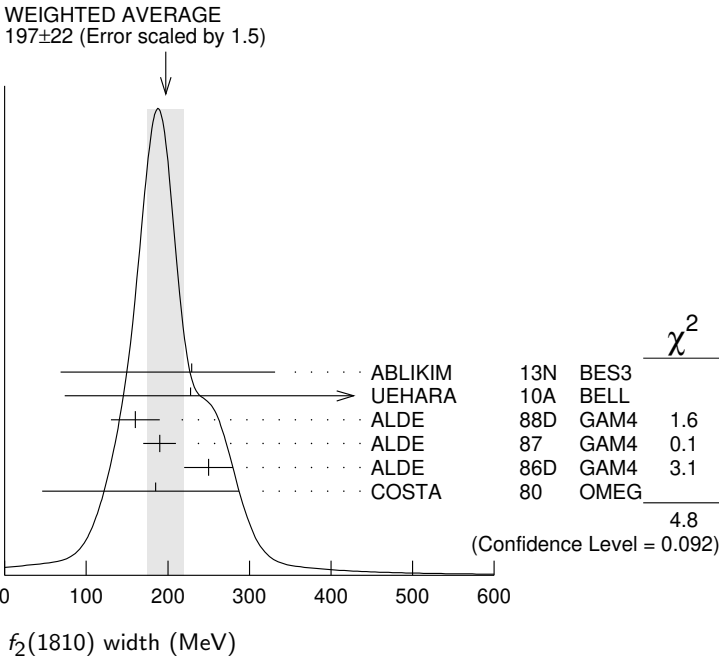
NODE=M038M;LINKAGE=P1

 **$f_2(1810)$  WIDTH**

NODE=M038W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                                               |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|----------|-----------------------------------------------------------------------|
| 197 ± 22 OUR AVERAGE                                                          |      | Error includes scale factor of 1.5. See the ideogram below. |          |                                                                       |
| 229 + 52 - 42 + 88 - 155                                                      | 5.5k | <sup>1</sup> ABLIKIM                                        | 13N BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$                |
| 228 + 21 - 20 + 234 - 153                                                     |      | <sup>2</sup> UEHARA                                         | 10A BELL | $10.6 e^+e^- \rightarrow e^+e^-\eta\eta$                              |
| 160 ± 30                                                                      | 40   | ALDE                                                        | 88D GAM4 | $300 \pi^-p \rightarrow \pi^-p4\pi^0$                                 |
| 190 ± 20                                                                      | 1600 | ALDE                                                        | 87 GAM4  | $100 \pi^-p \rightarrow 4\pi^0n$                                      |
| 250 ± 30                                                                      |      | <sup>3</sup> ALDE                                           | 86D GAM4 | $100 \pi^-p \rightarrow \eta\eta n$                                   |
| 185 + 102 - 139                                                               |      | <sup>4</sup> COSTA                                          | 80 OMEG  | $10 \pi^-p \rightarrow K^+K^-n$                                       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                             |          |                                                                       |
| 260.9 ± 3.9 + 199.9 - 38.2                                                    |      | <sup>5</sup> ALBRECHT                                       | 20 RVUE  | $0.9 \bar{p}p \rightarrow \pi^0\pi^0\eta, \pi^0\eta\eta, \pi^0K^+K^-$ |
| 388 + 15 - 21                                                                 |      | <sup>6</sup> LONGACRE                                       | 86 RVUE  | Compilation                                                           |
| 280 + 42 - 35                                                                 |      | <sup>7</sup> CASON                                          | 82 STRC  | $8 \pi^+p \rightarrow \Delta^{++}\pi^0\pi^0$                          |

- <sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.
- <sup>2</sup> Breit-Wigner width. Could also be the  $f_2(1910)$ .
- <sup>3</sup> Seen in only one solution.
- <sup>4</sup> Error increased by spread of two solutions. Included in LONGACRE 86 global analysis.
- <sup>5</sup> T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).
- <sup>6</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.
- <sup>7</sup> From an amplitude analysis of the reaction  $\pi^+\pi^- \rightarrow 2\pi^0$ . The resonance in the  $2\pi^0$  final state is not confirmed by PROKOSHKIN 97.



**$f_2(1810)$  DECAY MODES**

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi\pi$       |                                |
| $\Gamma_2 \quad \eta\eta$     | seen                           |
| $\Gamma_3 \quad 4\pi^0$       | seen                           |
| $\Gamma_4 \quad K^+K^-$       |                                |
| $\Gamma_5 \quad \gamma\gamma$ | seen                           |

NODE=M038W

NODE=M038W;LINKAGE=B

NODE=M038W;LINKAGE=UE  
NODE=M038W;LINKAGE=F  
NODE=M038W;LINKAGE=A  
NODE=M038W;LINKAGE=C

NODE=M038W;LINKAGE=L

NODE=M038W;LINKAGE=P1

NODE=M038215;NODE=M038

DESIG=2  
DESIG=3  
DESIG=4;OUR EST;→ UNCHECKED ←  
DESIG=1  
DESIG=5;OUR EST;→ UNCHECKED ←

$f_2(1810) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$ 

NODE=M038225

 $\Gamma(\eta\eta) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$  $\Gamma_2 \Gamma_5 / \Gamma$ 

VALUE (eV)

DOCUMENT ID

TECN

COMMENT

 $5.2^{+0.9+37.3}_{-0.8-4.5}$ <sup>1</sup> UEHARA 10A BELL 10.6  $e^+ e^- \rightarrow e^+ e^- \eta\eta$ NODE=M038G01  
NODE=M038G01<sup>1</sup> Including interference with the  $f'_2(1525)$  (parameters fixed to the values from the 2008 edition of this review, PDG 08) and  $f_2(1270)$ . May also be the  $f_0(1500)$ .

NODE=M038G01;LINKAGE=UE

 $f_2(1810)$  BRANCHING RATIOS

NODE=M038220

 $\Gamma(\pi\pi) / \Gamma_{\text{total}}$  $\Gamma_1 / \Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen

AMSLER 02 CBAR 0.9  $\bar{p}p \rightarrow \pi^0 \eta\eta, \pi^0 \pi^0 \pi^0$ 

not seen

PROKOSHKIN 97 GAM2 38  $\pi^- p \rightarrow \pi^0 \pi^0 n$  $0.21^{+0.02}_{-0.03}$ <sup>1</sup> LONGACRE 86 RVUE Compilation $0.44 \pm 0.03$ <sup>2</sup> CASON 82 STRC 8  $\pi^+ p \rightarrow \Delta^{++} \pi^0 \pi^0$ NODE=M038R2  
NODE=M038R2<sup>1</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.

NODE=M038R2;LINKAGE=L

<sup>2</sup> Included in LONGACRE 86 global analysis.

NODE=M038R;LINKAGE=C

 $\Gamma(\eta\eta) / \Gamma_{\text{total}}$  $\Gamma_2 / \Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

seen

ABLIKIM 13N BES3 PWA of  $J/\psi \rightarrow \gamma\eta\eta$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $0.008^{+0.028}_{-0.003}$ <sup>1</sup> LONGACRE 86 RVUE CompilationNODE=M038R3  
NODE=M038R3<sup>1</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.

NODE=M038R3;LINKAGE=L

 $\Gamma(\pi\pi) / \Gamma(4\pi^0)$  $\Gamma_1 / \Gamma_3$ 

VALUE

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt;0.75

ALDE 87 GAM4 100  $\pi^- p \rightarrow 4\pi^0 n$ NODE=M038R4  
NODE=M038R4 $\Gamma(4\pi^0) / \Gamma(\eta\eta)$  $\Gamma_3 / \Gamma_2$ 

VALUE

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $0.8 \pm 0.3$ ALDE 87 GAM4 100  $\pi^- p \rightarrow 4\pi^0 n$ NODE=M038R5  
NODE=M038R5 $\Gamma(K^+ K^-) / \Gamma_{\text{total}}$  $\Gamma_4 / \Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $0.003^{+0.019}_{-0.002}$ <sup>1</sup> LONGACRE 86 RVUE Compilation

seen

COSTA 80 OMEG 10  $\pi^- p \rightarrow K^+ K^- n$ NODE=M038R1  
NODE=M038R1<sup>1</sup> From a partial-wave analysis of data using a K-matrix formalism with 5 poles. Includes compilation of several other experiments.

NODE=M038R1;LINKAGE=L

 $f_2(1810)$  REFERENCES

NODE=M038

|            |     |                               |                               |                           |
|------------|-----|-------------------------------|-------------------------------|---------------------------|
| ALBRECHT   | 20  | EPJ C80 453                   | M. Albrecht <i>et al.</i>     | (Crystal Barrel Collab.)  |
| ABLIKIM    | 13N | PR D87 092009                 | Ablikim M. <i>et al.</i>      | (BESIII Collab.)          |
| UEHARA     | 10A | PR D82 114031                 | S. Uehara <i>et al.</i>       | (BELLE Collab.)           |
| PDG        | 08  | PL B667 1                     | C. Amsler <i>et al.</i>       | (PDG Collab.)             |
| AMSLER     | 02  | EPJ C23 29                    | C. Amsler <i>et al.</i>       |                           |
| PROKOSHKIN | 97  | PD 42 117                     | Y.D. Prokoshkin <i>et al.</i> | (SERP)                    |
| ALDE       | 88D | Translated from DANS 353 323. |                               |                           |
|            |     | SJNP 47 810                   | D.M. Alde <i>et al.</i>       | (SERP, BELG, LANL, LAPP+) |
| ALDE       | 87  | Translated from YAF 47 1273.  |                               |                           |
|            |     | PL B198 286                   | D.M. Alde <i>et al.</i>       | (LANL, BRUX, SERP, LAPP)  |
| ALDE       | 86D | NP B269 485                   | D.M. Alde <i>et al.</i>       | (BELG, LAPP, SERP, CERN+) |
| LONGACRE   | 86  | PL B177 223                   | R.S. Longacre <i>et al.</i>   | (BNL, BRAN, CUNY+)        |
| BINON      | 83  | NC 78A 313                    | F.G. Binon <i>et al.</i>      | (BELG, LAPP, SERP+)       |
| CASON      | 82  | PRL 48 1316                   | N.M. Cason <i>et al.</i>      | (NDAM, ANL)               |
| COSTA      | 80  | NP B175 402                   | G. Costa <i>et al.</i>        | (BARI, BONN, CERN, GLAS+) |
| HYAMS      | 75  | NP B100 205                   | B.D. Hyams <i>et al.</i>      | (CERN, MPIM)              |

REFID=60439  
REFID=55387  
REFID=53641  
REFID=52166  
REFID=48580  
REFID=45386  
REFID=44652  
REFID=40221  
REFID=20765  
REFID=20768  
REFID=20750  
REFID=20746  
REFID=20737  
REFID=20355

**X(1835)**

$$J^{PC} = ?(0^{-+})$$

NODE=M085

## OMITTED FROM SUMMARY TABLE

Could be a superposition of two states, one with small width appearing as threshold enhancement in  $p\bar{p}$ , the other one with a larger width. For the former ABLIKIM 12D determine  $J^{PC} = 0^{-+}$ .

NODE=M085

**X(1835) MASS**

NODE=M085M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID              | TECN     | COMMENT                                       |
|-------------------------------------------------------------------------------|------|--------------------------|----------|-----------------------------------------------|
| <b>1826.5<sup>+13.0</sup><sub>-3.4</sub> OUR AVERAGE</b>                      |      |                          |          |                                               |
| 1825.3 $\pm$ 2.4 <sup>+17.3</sup> <sub>-2.4</sub>                             |      | <sup>1</sup> ABLIKIM     | 16J BES3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |
| 1844 $\pm$ 9 <sup>+16</sup> <sub>-25</sub>                                    |      | ABLIKIM                  | 15T BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                          |          |                                               |
| 1839 $\pm$ 26 $\pm$ 26                                                        |      | <sup>2</sup> ABLIKIM     | 18I BES3 | $J/\psi \rightarrow \gamma \gamma \phi(1020)$ |
| 1909.5 $\pm$ 15.9 <sup>+9.4</sup> <sub>-27.5</sub>                            |      | <sup>3</sup> ABLIKIM     | 16J BES3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |
| 1842.2 $\pm$ 4.2 <sup>+7.1</sup> <sub>-2.6</sub>                              | 0.6k | ABLIKIM                  | 13U BES3 | $J/\psi \rightarrow \gamma 3(\pi^+ \pi^-)$    |
| 1832 <sup>+19</sup> <sub>-5</sub> $\pm$ 26                                    |      | <sup>4</sup> ABLIKIM     | 12D BES3 | $J/\psi \rightarrow \gamma p\bar{p}$          |
| 1836.5 $\pm$ 3.0 <sup>+5.6</sup> <sub>-2.1</sub>                              | 4265 | <sup>5</sup> ABLIKIM     | 11C BES3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |
| 1877.3 $\pm$ 6.3 <sup>+3.4</sup> <sub>-7.4</sub>                              |      | <sup>6</sup> ABLIKIM     | 11J BES3 | $J/\psi \rightarrow \omega(\eta \pi^+ \pi^-)$ |
| 1837 <sup>+10</sup> <sub>-12</sub> $\pm$ 9 <sup>+9</sup> <sub>-7</sub>        | 231  | <sup>7,8</sup> ALEXANDER | 10 CLEO  | $J/\psi \rightarrow \gamma p\bar{p}$          |
| 1833.7 $\pm$ 6.1 $\pm$ 2.7                                                    | 264  | ABLIKIM                  | 05R BES2 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |
| 1831 $\pm$ 7                                                                  |      | <sup>8,9</sup> ABLIKIM   | 05R BES2 | $J/\psi \rightarrow \gamma p\bar{p}$          |
| 1859 <sup>+3</sup> <sub>-10</sub> $\pm$ 5 <sup>+5</sup> <sub>-25</sub>        |      | <sup>8</sup> BAI         | 03F BES2 | $J/\psi \rightarrow \gamma p\bar{p}$          |

OCCUR=2

OCCUR=2

<sup>1</sup> From a fit of the measured  $\pi^+ \pi^- \eta'$  lineshape that accounts for the abrupt distortion observed at the  $p\bar{p}$  threshold through interference with a second previously unseen narrow resonance near 1870 MeV. The fit uses Breit-Wigner functions for the signal shapes and includes known backgrounds and contributors.

NODE=M085M;LINKAGE=B

<sup>2</sup> From a fit to  $\gamma \phi$  invariant mass. Angular analysis consistent with  $J^{PC} = 0^{-+}$ . Other  $J^{PC}$  not excluded.

NODE=M085M;LINKAGE=C

<sup>3</sup> Pole mass from a fit of the measured  $\pi^+ \pi^- \eta'$  lineshape to a Flatte formula that accounts for the abrupt distortion observed at the  $p\bar{p}$  threshold; the fit also includes known backgrounds and contributors, as well as an *ad hoc* Breit-Wigner function ( $M \approx 1919$  MeV;  $\Gamma \approx 51$  MeV) that is required for a good fit.

NODE=M085M;LINKAGE=A

<sup>4</sup> From the fit including final state interaction effects in isospin 0  $S$ -wave according to SIBIRTSEV 05A. Supersedes ABLIKIM 10G.

NODE=M085M;LINKAGE=AK

<sup>5</sup> From a fit of the  $\pi^+ \pi^- \eta'$  mass distribution to a combination of  $\gamma f_1(1510)$ ,  $\gamma X(1835)$ , and two states  $\gamma X(2120)$  and  $\gamma X(2370)$ , for  $M(\pi^+ \pi^- \eta') < 2.8$  GeV, and accounting for backgrounds from non- $\eta'$  events and  $J/\psi \rightarrow \pi^0 \pi^+ \pi^- \eta'$ .

NODE=M085M;LINKAGE=AI

<sup>6</sup> The selected process is  $J/\psi \rightarrow \omega a_0(980) \pi$ . This state may be due also to  $\eta_2(1870)$  or to a combination of  $X(1835)$  and  $\eta_2(1870)$ .

NODE=M085M;LINKAGE=BL

<sup>7</sup> From a fit of the  $p\bar{p}$  mass distribution to a combination of  $\gamma X(1835)$ ,  $\gamma R$  with  $M(R) = 2100$  MeV and  $\Gamma(R) = 160$  MeV, and  $\gamma p\bar{p}$  phase space, for  $M(p\bar{p}) < 2.85$  GeV.

NODE=M085M;LINKAGE=AE

<sup>8</sup> Evidence for a threshold enhancement in the  $p\bar{p}$  mass spectrum was also reported by ABE 02K, AUBERT, B 05L, and WANG 05A in  $B^+ \rightarrow p\bar{p} K^+$ , WANG 05A in  $B^0 \rightarrow p\bar{p} K_S^0$ , ABE 02W in  $\bar{B}^0 \rightarrow p\bar{p} D^0$ , DEL-AMO-SANCHEZ 12 in  $B \rightarrow D(D^*) p\bar{p}(\pi)$ , and WEI 08 in  $B^+ \rightarrow p\bar{p} \pi^+$  decays. Not seen by ATHAR 06 in  $\Upsilon(1S) \rightarrow p\bar{p} \gamma$ .

NODE=M085M;LINKAGE=HF

<sup>9</sup> From the fit including final state interaction effects in isospin 0  $S$ -wave according to SIBIRTSEV 05A. Systematic errors not estimated.

NODE=M085M;LINKAGE=AB

**X(1835) WIDTH**

NODE=M085W

| <u>VALUE (MeV)</u>                                              | <u>CL%</u> | <u>EVTS</u>          | <u>DOCUMENT ID</u> | <u>TECN</u>                                   | <u>COMMENT</u> |
|-----------------------------------------------------------------|------------|----------------------|--------------------|-----------------------------------------------|----------------|
| <b>242<sup>+14</sup><sub>-15</sub> OUR AVERAGE</b>              |            |                      |                    |                                               |                |
| 245.2±13.1 <sup>+ 4.6</sup> <sub>- 9.6</sub>                    |            | <sup>1</sup> ABLIKIM | 16J BES3           | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |                |
| 192 <sup>+20</sup> <sub>-17</sub> <sup>+62</sup> <sub>-43</sub> |            | ABLIKIM              | 15T BES3           | $J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$  |                |

NODE=M085W

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                             |      |                          |          |                                             |
|---------------------------------------------|------|--------------------------|----------|---------------------------------------------|
| 175 ±57 ±25                                 |      | <sup>2</sup> ABLIKIM     | 18I BES3 | $J/\psi \rightarrow \gamma\gamma\phi(1020)$ |
| 273.5±21.4 <sup>+6.1</sup> <sub>-64.0</sub> |      | <sup>3</sup> ABLIKIM     | 16J BES3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$  |
| 83 ±14 ±11                                  | 0.6k | ABLIKIM                  | 13U BES3 | $J/\psi \rightarrow \gamma 3(\pi^+\pi^-)$   |
| < 76                                        | 90   | <sup>4</sup> ABLIKIM     | 12D BES3 | $J/\psi \rightarrow \gamma p\bar{p}$        |
| 190 ± 9 <sup>+38</sup> <sub>-36</sub>       | 4265 | <sup>5</sup> ABLIKIM     | 11C BES3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$  |
| 57 ±12 <sup>+19</sup> <sub>-4</sub>         |      | <sup>6</sup> ABLIKIM     | 11J BES3 | $J/\psi \rightarrow \omega(\eta\pi^+\pi^-)$ |
| 0 <sup>+44</sup> <sub>-0</sub>              | 231  | <sup>7,8</sup> ALEXANDER | 10 CLEO  | $J/\psi \rightarrow \gamma p\bar{p}$        |
| 67.7±20.3± 7.7                              | 264  | ABLIKIM                  | 05R BES2 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$  |
| < 153                                       | 90   | <sup>8,9</sup> ABLIKIM   | 05R BES2 | $J/\psi \rightarrow \gamma p\bar{p}$        |
| < 30                                        |      | <sup>8</sup> BAI         | 03F BES2 | $J/\psi \rightarrow \gamma p\bar{p}$        |

<sup>1</sup> From a fit of the measured  $\pi^+\pi^-\eta'$  lineshape that accounts for the abrupt distortion observed at the  $p\bar{p}$  threshold through interference with a second previously unseen narrow resonance near 1870 MeV. The fit uses Breit-Wigner functions for the signal shapes and includes known backgrounds and contributors.

<sup>2</sup> From a fit to  $\gamma\phi$  invariant mass. Angular analysis consistent with  $J^{PC} = 0^{-+}$ . Other  $J^{PC}$  not excluded.

<sup>3</sup> Pole width from a fit of the measured  $\pi^+\pi^-\eta'$  lineshape to a Flatte formula that accounts for the abrupt distortion observed at the  $p\bar{p}$  threshold; the fit also includes known backgrounds and contributors, as well as an *ad hoc* Breit-Wigner function ( $M \approx 1919$  MeV;  $\Gamma \approx 51$  MeV) that is required for a good fit.

<sup>4</sup> From the fit including final state interaction effects in isospin 0  $S$ -wave according to SIBIRTSEV 05A. Supersedes ABLIKIM 10G.

<sup>5</sup> From a fit of the  $\pi^+\pi^-\eta'$  mass distribution to a combination of  $\gamma f_1(1510)$ ,  $\gamma X(1835)$ , and two states  $\gamma X(2120)$  and  $\gamma X(2370)$ , for  $M(\pi^+\pi^-\eta') < 2.8$  GeV, and accounting for backgrounds from non- $\eta'$  events and  $J/\psi \rightarrow \pi^0\pi^+\pi^-\eta'$ .

<sup>6</sup> The selected process is  $J/\psi \rightarrow \omega a_0(980)\pi$ . This state may be due also to  $\eta_2(1870)$  or to a combination of  $X(1835)$  and  $\eta_2(1870)$ .

<sup>7</sup> From a fit of the  $p\bar{p}$  mass distribution to a combination of  $\gamma X(1835)$ ,  $\gamma R$  with  $M(R) = 2100$  MeV and  $\Gamma(R) = 160$  MeV, and  $\gamma p\bar{p}$  phase space, for  $M(p\bar{p}) < 2.85$  GeV.

<sup>8</sup> Evidence for a threshold enhancement in the  $p\bar{p}$  mass spectrum was also reported by ABE 02K, AUBERT, B 05L, and WANG 05A in  $B^+ \rightarrow p\bar{p}K^+$ , WANG 05A in  $B^0 \rightarrow p\bar{p}K_S^0$ , ABE 02W in  $\bar{B}^0 \rightarrow p\bar{p}D^0$ , DEL-AMO-SANCHEZ 12 in  $B \rightarrow D(D^*)p\bar{p}(\pi)$ , and WEI 08 in  $B^+ \rightarrow p\bar{p}\pi^+$  decays. Not seen by ATHAR 06 in  $\Upsilon(1S) \rightarrow p\bar{p}\gamma$ .

<sup>9</sup> From the fit including final state interaction effects in isospin 0  $S$ -wave according to SIBIRTSEV 05A. Systematic errors not estimated.

OCCUR=2

NODE=M085W;LINKAGE=B

NODE=M085W;LINKAGE=C

NODE=M085W;LINKAGE=A

NODE=M085W;LINKAGE=AK

NODE=M085W;LINKAGE=AI

NODE=M085W;LINKAGE=BL

NODE=M085W;LINKAGE=AE

NODE=M085W;LINKAGE=HF

NODE=M085W;LINKAGE=AB

### X(1835) DECAY MODES

NODE=M085215;NODE=M085

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1$ $p\bar{p}$         | seen                           |
| $\Gamma_2$ $\eta'\pi^+\pi^-$  | seen                           |
| $\Gamma_3$ $\gamma\gamma$     |                                |
| $\Gamma_4$ $K_S^0 K_S^0 \eta$ | seen                           |
| $\Gamma_5$ $\gamma\phi(1020)$ | possibly seen                  |
| $\Gamma_6$ $3(\pi^+\pi^-)$    | seen                           |

DESIG=1;OUR EVAL;→ UNCHECKED ←

DESIG=2

DESIG=4

DESIG=5;OUR EVAL;→ UNCHECKED ←

DESIG=6

DESIG=7

### X(1835) $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

NODE=M085225

| $\Gamma(\eta'\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | $\Gamma_2\Gamma_3/\Gamma$ |
|-----------------------------------------------------------------------------|---------------------------|
| VALUE (eV)                                                                  | CL%                       |
| DOCUMENT ID                                                                 | TECN                      |
| COMMENT                                                                     |                           |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                    |          |                                            |
|-------|----|--------------------|----------|--------------------------------------------|
| <35.6 | 90 | <sup>1</sup> ZHANG | 12A BELL | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |
| <83   | 90 | <sup>2</sup> ZHANG | 12A BELL | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |

OCCUR=2

<sup>1</sup> From a two-resonance fit and constructive interference of the  $\eta(1760)$  and  $X(1835)$ , a significance of  $2.8\sigma$ .

NODE=M085G01;LINKAGE=ZH

<sup>2</sup> From a two-resonance fit and destructive interference of the  $\eta(1760)$  and  $X(1835)$ , a significance of  $2.8\sigma$ .

NODE=M085G01;LINKAGE=ZA

**X(1835) BRANCHING RATIOS**

NODE=M085220

$$\Gamma(p\bar{p})/\Gamma(\eta'\pi^+\pi^-)$$

$$\Gamma_1/\Gamma_2$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |         |     |      |                                            |
|-------|---------|-----|------|--------------------------------------------|
| 0.333 | ABLIKIM | 05R | BES2 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$ |
|-------|---------|-----|------|--------------------------------------------|

NODE=M085R01  
NODE=M085R01

$$\Gamma(\eta'\pi^+\pi^-)/\Gamma(K_S^0 K_S^0 \eta)$$

$$\Gamma_2/\Gamma_4$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |                      |     |      |                                              |
|---------------|----------------------|-----|------|----------------------------------------------|
| $6.7 \pm 1.8$ | <sup>1</sup> ABLIKIM | 15T | BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$ |
|---------------|----------------------|-----|------|----------------------------------------------|

NODE=M085R00  
NODE=M085R00<sup>1</sup> Using results from ABLIKIM 05R.

NODE=M085R00;LINKAGE=A

$$\Gamma(\eta'\pi^+\pi^-)/\Gamma_{\text{total}}$$

$$\Gamma_2/\Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|             |                      |     |      |                                            |
|-------------|----------------------|-----|------|--------------------------------------------|
| <b>seen</b> | <sup>1</sup> ABLIKIM | 16J | BES3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$ |
|-------------|----------------------|-----|------|--------------------------------------------|

<sup>1</sup> ABLIKIM 16J quotes  $B(J/\psi \rightarrow \gamma X(1835)) \times B(X(1835) \rightarrow \pi^+\pi^-\eta') = (3.93 \pm 0.38^{+0.31}_{-0.84}) \times 10^{-4}$  from a fit of the measured  $\pi^+\pi^-\eta'$  lineshape that accounts for the abrupt distortion observed at the  $p\bar{p}$  threshold with a Flatte formula in addition to known backgrounds and contributors, as well as an *ad hoc* Breit-Wigner ( $M \approx 1919$  MeV;  $\Gamma \approx 51$  MeV) that is required for a good fit. Another explanation for the distortion provided by ABLIKIM 16J is that a second resonance near 1870 MeV interferes with the  $X(1835)$ ; fits to this possibility yield product branching fraction values compatible with that shown within the respective systematic uncertainties.

NODE=M085R03  
NODE=M085R03

NODE=M085R03;LINKAGE=A

$$\Gamma(\gamma\phi(1020))/\Gamma_{\text{total}}$$

$$\Gamma_5/\Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|                      |                      |     |      |                                             |
|----------------------|----------------------|-----|------|---------------------------------------------|
| <b>possibly seen</b> | <sup>1</sup> ABLIKIM | 18I | BES3 | $J/\psi \rightarrow \gamma\gamma\phi(1020)$ |
|----------------------|----------------------|-----|------|---------------------------------------------|

<sup>1</sup> Seen as a peak in  $\gamma\phi$  invariant mass. Angular analysis consistent with  $J^{PC} = 0^{-+}$ . Other  $J^{PC}$  not excluded.

NODE=M085R04  
NODE=M085R04

NODE=M085R04;LINKAGE=A

$$\Gamma(\gamma\gamma)/\Gamma(\eta'\pi^+\pi^-)$$

$$\Gamma_3/\Gamma_2$$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                        |    |                      |     |      |                                                     |
|------------------------|----|----------------------|-----|------|-----------------------------------------------------|
| $<9.80 \times 10^{-3}$ | 90 | <sup>1</sup> ABLIKIM | 18O | BES3 | $\psi(2S) \rightarrow \pi^+\pi^-\gamma\gamma\gamma$ |
|------------------------|----|----------------------|-----|------|-----------------------------------------------------|

<sup>1</sup> Using results from ABLIKIM 16J.NODE=M085R05  
NODE=M085R05

NODE=M085R05;LINKAGE=A

$$\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$$

$$\Gamma_6/\Gamma$$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

|             |      |         |     |      |                                           |
|-------------|------|---------|-----|------|-------------------------------------------|
| <b>seen</b> | 0.6k | ABLIKIM | 13U | BES3 | $J/\psi \rightarrow \gamma 3(\pi^+\pi^-)$ |
|-------------|------|---------|-----|------|-------------------------------------------|

NODE=M085R06  
NODE=M085R06**X(1835) REFERENCES**

NODE=M085

|               |     |                |                                  |                      |
|---------------|-----|----------------|----------------------------------|----------------------|
| ABLIKIM       | 18I | PR D97 051101  | M. Ablikim <i>et al.</i>         | (BESIII Collab.)     |
| ABLIKIM       | 18O | PR D97 072014  | M. Ablikim <i>et al.</i>         | (BESIII Collab.)     |
| ABLIKIM       | 16J | PRL 117 042002 | M. Ablikim <i>et al.</i>         | (BESIII Collab.)     |
| ABLIKIM       | 15T | PRL 115 091803 | M. Ablikim <i>et al.</i>         | (BESIII Collab.)     |
| ABLIKIM       | 13U | PR D88 091502  | M. Ablikim <i>et al.</i>         | (BESIII Collab.)     |
| ABLIKIM       | 12D | PRL 108 112003 | M. Ablikim <i>et al.</i>         | (BESIII Collab.) JPC |
| DEL-AMO-SA... | 12  | PR D85 092017  | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)      |
| ZHANG         | 12A | PR D86 052002  | C.C. Zhang <i>et al.</i>         | (BELLE Collab.)      |
| ABLIKIM       | 11C | PRL 106 072002 | M. Ablikim <i>et al.</i>         | (BESIII Collab.)     |
| ABLIKIM       | 11J | PRL 107 182001 | M. Ablikim <i>et al.</i>         | (BESIII Collab.)     |
| ABLIKIM       | 10G | CP C34 421     | M. Ablikim <i>et al.</i>         | (BESIII Collab.)     |
| ALEXANDER     | 10  | PR D82 092002  | J.P. Alexander <i>et al.</i>     | (CLEO Collab.)       |
| WEI           | 08  | PL B659 80     | J.-T. Wei <i>et al.</i>          | (BELLE Collab.)      |
| ATHAR         | 06  | PR D73 032001  | S.B. Athar <i>et al.</i>         | (CLEO Collab.)       |
| ABLIKIM       | 05R | PRL 95 262001  | M. Ablikim <i>et al.</i>         | (BES Collab.)        |
| AUBERT,B      | 05L | PR D72 051101  | B. Aubert <i>et al.</i>          | (BABAR Collab.)      |
| SIBIRTSEV     | 05A | PR D71 054010  | A. Sibirtsev, J. Haidenbauer     |                      |
| WANG          | 05A | PL B617 141    | M.-Z. Wang <i>et al.</i>         | (BELLE Collab.)      |
| BAI           | 03F | PRL 91 022001  | J.Z. Bai <i>et al.</i>           | (BES II Collab.)     |
| ABE           | 02K | PRL 88 181803  | K. Abe <i>et al.</i>             | (BELLE Collab.)      |
| ABE           | 02W | PRL 89 151802  | K. Abe <i>et al.</i>             | (BELLE Collab.)      |

REFID=58893  
REFID=58925  
REFID=57454  
REFID=56785  
REFID=55582  
REFID=54269  
REFID=54286  
REFID=54763  
REFID=53684  
REFID=53931  
REFID=55685  
REFID=53525  
REFID=52086  
REFID=50993  
REFID=50985  
REFID=50827  
REFID=51038  
REFID=50651  
REFID=49473  
REFID=48690  
REFID=48980

$\phi_3(1850)$ 

$$I^G(J^{PC}) = 0^-(3^{--})$$

NODE=M054

 $\phi_3(1850)$  MASS

NODE=M054M

| VALUE (MeV)                        | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                   |
|------------------------------------|------|-------------|----------|---------------------------------------------------------------------------|
| <b>1854 ± 7 OUR AVERAGE</b>        |      |             |          |                                                                           |
| 1855 ± 10                          |      | ASTON       | 88E LASS | 11 $K^- p \rightarrow K^- K^+ \Lambda$ ,<br>$K_S^0 K^\pm \pi^\mp \Lambda$ |
| 1870 <sup>+30</sup> <sub>-20</sub> | 430  | ARMSTRONG   | 82 OMEG  | 18.5 $K^- p \rightarrow$<br>$K^- K^+ \Lambda$                             |
| 1850 ± 10                          | 123  | ALHARRAN    | 81B HBC  | 8.25 $K^- p \rightarrow K \bar{K} \Lambda$                                |

NODE=M054M

 $\phi_3(1850)$  WIDTH

NODE=M054W

| VALUE (MeV)                                                                           | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                   |
|---------------------------------------------------------------------------------------|------|-------------|----------|---------------------------------------------------------------------------|
| <b>87<sup>+28</sup><sub>-23</sub> OUR AVERAGE</b> Error includes scale factor of 1.2. |      |             |          |                                                                           |
| 64 ± 31                                                                               |      | ASTON       | 88E LASS | 11 $K^- p \rightarrow K^- K^+ \Lambda$ ,<br>$K_S^0 K^\pm \pi^\mp \Lambda$ |
| 160 <sup>+90</sup> <sub>-50</sub>                                                     | 430  | ARMSTRONG   | 82 OMEG  | 18.5 $K^- p \rightarrow$<br>$K^- K^+ \Lambda$                             |
| 80 <sup>+40</sup> <sub>-30</sub>                                                      | 123  | ALHARRAN    | 81B HBC  | 8.25 $K^- p \rightarrow K \bar{K} \Lambda$                                |

NODE=M054W

 $\phi_3(1850)$  DECAY MODES

NODE=M054215;NODE=M054

| Mode                                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------------------|--------------------------------|
| $\Gamma_1$ $K \bar{K}$                      | seen                           |
| $\Gamma_2$ $K \bar{K}^*(892) + \text{c.c.}$ | seen                           |

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=2;OUR EST;→ UNCHECKED ←

 $\phi_3(1850)$  BRANCHING RATIOS

NODE=M054220

| $\Gamma(K \bar{K}^*(892) + \text{c.c.})/\Gamma(K \bar{K})$                    |             |          |                                                                           | $\Gamma_2/\Gamma_1$ |
|-------------------------------------------------------------------------------|-------------|----------|---------------------------------------------------------------------------|---------------------|
| VALUE                                                                         | DOCUMENT ID | TECN     | COMMENT                                                                   |                     |
| <b>0.55<sup>+0.85</sup><sub>-0.45</sub></b>                                   | ASTON       | 88E LASS | 11 $K^- p \rightarrow K^- K^+ \Lambda$ ,<br>$K_S^0 K^\pm \pi^\mp \Lambda$ |                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |          |                                                                           |                     |
| 0.8 ± 0.4                                                                     | ALHARRAN    | 81B HBC  | 8.25 $K^- p \rightarrow K \bar{K} \pi \Lambda$                            |                     |

NODE=M054R1  
NODE=M054R1 $\phi_3(1850)$  REFERENCES

NODE=M054

|           |     |             |                              |                                |
|-----------|-----|-------------|------------------------------|--------------------------------|
| ASTON     | 88E | PL B208 324 | D. Aston <i>et al.</i>       | (SLAC, NAGO, CINC, INUS) IGJPC |
| ARMSTRONG | 82  | PL 110B 77  | T.A. Armstrong <i>et al.</i> | (BARI, BIRM, CERN+) JP         |
| ALHARRAN  | 81B | PL 101B 357 | S. Al-Harran <i>et al.</i>   | (BIRM, CERN, GLAS+)            |

REFID=40577  
REFID=21405  
REFID=21702



$\eta_2(1870)$ 

$$I^G(J^{PC}) = 0^+(2^-+)$$

NODE=M101

 $\eta_2(1870)$  MASS

NODE=M101M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID | TECN     | COMMENT                                       |
|-------------------------------------------------------------------------------|------|-------------|----------|-----------------------------------------------|
| <b>1842± 8 OUR AVERAGE</b>                                                    |      |             |          |                                               |
| 1835±12                                                                       |      | BARBERIS    | 00B      | 450 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$ |
| 1844±13                                                                       |      | BARBERIS    | 00C      | 450 $pp \rightarrow p_f 4\pi p_s$             |
| 1840±25                                                                       |      | BARBERIS    | 97B OMEG | 450 $pp \rightarrow pp2(\pi^+ \pi^-)$         |
| 1875±20±35                                                                    |      | ADOMEIT     | 96 CBAR  | 1.94 $\bar{p}p \rightarrow \eta 3\pi^0$       |
| 1881±32±40                                                                    | 26   | KARCH       | 92 CBAL  | $e^+e^- \rightarrow e^+e^- \eta \pi^0 \pi^0$  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |                                               |
| 1860± 5±15                                                                    |      | ANISOVICH   | 00E SPEC | 0.9–1.94 $\bar{p}p \rightarrow \eta 3\pi^0$   |
| 1840±15                                                                       |      | BAI         | 99 BES   | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$  |

NODE=M101M

 $\eta_2(1870)$  WIDTH

NODE=M101W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID | TECN     | COMMENT                                       |
|-------------------------------------------------------------------------------|------|-------------|----------|-----------------------------------------------|
| <b>225±14 OUR AVERAGE</b>                                                     |      |             |          |                                               |
| 235±22                                                                        |      | BARBERIS    | 00B      | 450 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$ |
| 228±23                                                                        |      | BARBERIS    | 00C      | 450 $pp \rightarrow p_f 4\pi p_s$             |
| 200±40                                                                        |      | BARBERIS    | 97B OMEG | 450 $pp \rightarrow pp2(\pi^+ \pi^-)$         |
| 200±25±45                                                                     |      | ADOMEIT     | 96 CBAR  | 1.94 $\bar{p}p \rightarrow \eta 3\pi^0$       |
| 221±92±44                                                                     | 26   | KARCH       | 92 CBAL  | $e^+e^- \rightarrow e^+e^- \eta \pi^0 \pi^0$  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |                                               |
| 250±25 <sup>+50</sup> <sub>-35</sub>                                          |      | ANISOVICH   | 00E SPEC | 0.9–1.94 $\bar{p}p \rightarrow \eta 3\pi^0$   |
| 170±40                                                                        |      | BAI         | 99 BES   | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$  |

NODE=M101W

 $\eta_2(1870)$  DECAY MODES

NODE=M101225;NODE=M101

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $\eta \pi \pi$   |                                |
| $\Gamma_2$ $a_2(1320) \pi$  |                                |
| $\Gamma_3$ $f_2(1270) \eta$ |                                |
| $\Gamma_4$ $a_0(980) \pi$   |                                |
| $\Gamma_5$ $\gamma \gamma$  | seen                           |

DESIG=1

DESIG=4

DESIG=8

DESIG=2

DESIG=9

 $\eta_2(1870)$  BRANCHING RATIOS

NODE=M101230

 $\Gamma(a_2(1320)\pi)/\Gamma(f_2(1270)\eta)$  $\Gamma_2/\Gamma_3$ 

| VALUE                       | DOCUMENT ID            | TECN    | COMMENT                                       |
|-----------------------------|------------------------|---------|-----------------------------------------------|
| <b>1.7 ±0.4 OUR AVERAGE</b> |                        |         |                                               |
| 1.60±0.40                   | <sup>1</sup> ANISOVICH | 11 SPEC | 0.9–1.94 $p\bar{p}$                           |
| 20.4 ±6.6                   | BARBERIS               | 00B     | 450 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$ |
| 4.1 ±2.3                    | ADOMEIT                | 96 CBAR | 1.94 $\bar{p}p \rightarrow \eta 3\pi^0$       |

<sup>1</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M101R2

NODE=M101R2

NODE=M101R2;LINKAGE=AN

 $\Gamma(a_2(1320)\pi)/\Gamma(a_0(980)\pi)$  $\Gamma_2/\Gamma_4$ 

| VALUE            | DOCUMENT ID | COMMENT                                           |
|------------------|-------------|---------------------------------------------------|
| <b>32.6±12.6</b> | BARBERIS    | 00B 450 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$ |

NODE=M101R4

NODE=M101R4

 $\Gamma(a_0(980)\pi)/\Gamma(f_2(1270)\eta)$  $\Gamma_4/\Gamma_3$ 

| VALUE            | DOCUMENT ID            | TECN    | COMMENT             |
|------------------|------------------------|---------|---------------------|
| <b>0.48±0.45</b> | <sup>1</sup> ANISOVICH | 11 SPEC | 0.9–1.94 $p\bar{p}$ |

<sup>1</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M101R01

NODE=M101R01

NODE=M101R01;LINKAGE=AN

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE       | DOCUMENT ID | TECN    | COMMENT                                      |
|-------------|-------------|---------|----------------------------------------------|
| <b>seen</b> | KARCH       | 92 CBAL | $e^+e^- \rightarrow e^+e^- \eta \pi^0 \pi^0$ |

NODE=M101R02

NODE=M101R02

$\eta_2(1870)$  REFERENCES

|           |     |              |                              |                          |
|-----------|-----|--------------|------------------------------|--------------------------|
| ANISOVICH | 11  | EPJ C71 1511 | A.V. Anisovich <i>et al.</i> | (LOQM, RAL, PNPI)        |
| ANISOVICH | 00E | PL B477 19   | A.V. Anisovich <i>et al.</i> |                          |
| BARBERIS  | 00B | PL B471 435  | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| BARBERIS  | 00C | PL B471 440  | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| BAI       | 99  | PL B446 356  | J.Z. Bai <i>et al.</i>       | (BES Collab.)            |
| BARBERIS  | 97B | PL B413 217  | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| ADOMEIT   | 96  | ZPHY C71 227 | J. Adomeit <i>et al.</i>     | (Crystal Barrel Collab.) |
| KARCH     | 92  | ZPHY C54 33  | K. Karch <i>et al.</i>       | (Crystal Ball Collab.)   |

NODE=M101

REFID=53631  
REFID=47945  
REFID=47958  
REFID=47959  
REFID=46606  
REFID=45758  
REFID=45202  
REFID=42170

 $\pi_2(1880)$ 

$$I^G(J^{PC}) = 1^-(2^-+)$$

NODE=M185

 $\pi_2(1880)$  MASS

NODE=M185M

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

NODE=M185M

**1874<sup>+26</sup><sub>-5</sub> OUR AVERAGE** Error includes scale factor of 1.6. See the ideogram below.

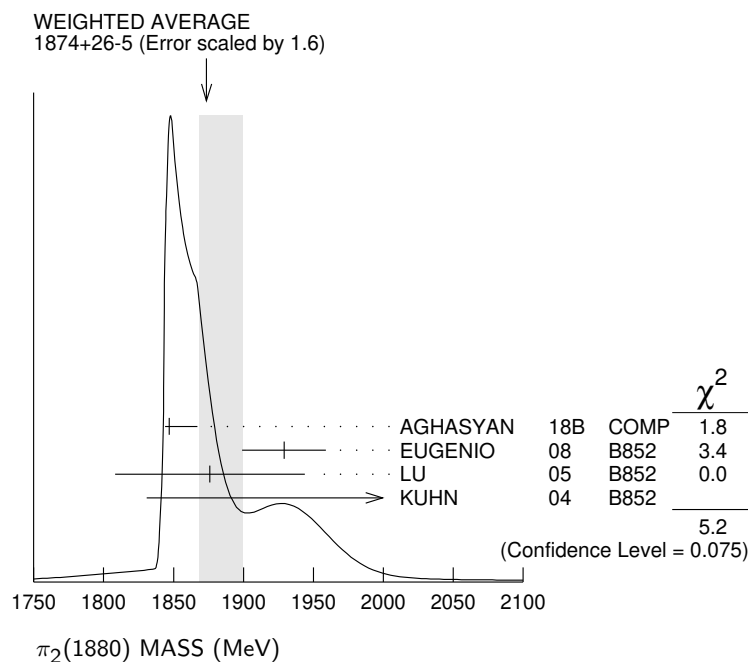
|                                   |      |                       |     |      |                                                   |
|-----------------------------------|------|-----------------------|-----|------|---------------------------------------------------|
| 1847 <sup>+20</sup> <sub>-3</sub> | 46M  | <sup>1</sup> AGHASYAN | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$     |
| 1929 $\pm$ 24 $\pm$ 18            | 4k   | EUGENIO               | 08  | B852 | 18 $\pi^- p \rightarrow \eta \eta \pi^- p$        |
| 1876 $\pm$ 11 $\pm$ 67            | 145k | LU                    | 05  | B852 | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| 2003 $\pm$ 88 $\pm$ 148           | 69k  | KUHN                  | 04  | B852 | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

1880 $\pm$ 20 ANISOVICH 01B SPEC 0 0.6–1.94  $\bar{p} p \rightarrow \eta \eta \pi^0 \pi^0$

<sup>1</sup> Statistical error negligible.

NODE=M185M;LINKAGE=A

 $\pi_2(1880)$  WIDTH

NODE=M185W

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

NODE=M185W

**237<sup>+33</sup><sub>-30</sub> OUR AVERAGE** Error includes scale factor of 1.2.

|                                   |      |                       |     |      |                                                   |
|-----------------------------------|------|-----------------------|-----|------|---------------------------------------------------|
| 246 <sup>+33</sup> <sub>-28</sub> | 46M  | <sup>2</sup> AGHASYAN | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$     |
| 323 $\pm$ 87 $\pm$ 43             | 4k   | EUGENIO               | 08  | B852 | 18 $\pi^- p \rightarrow \eta \eta \pi^- p$        |
| 146 $\pm$ 17 $\pm$ 62             | 145k | LU                    | 05  | B852 | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| 306 $\pm$ 132 $\pm$ 121           | 69k  | KUHN                  | 04  | B852 | 18 $\pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

255 $\pm$ 45 ANISOVICH 01B SPEC 0 0.6–1.94  $\bar{p} p \rightarrow \eta \eta \pi^0 \pi^0$

<sup>2</sup> Statistical error negligible.

NODE=M185W;LINKAGE=A

**$\pi_2(1880)$  DECAY MODES**

NODE=M185215;NODE=M185

| Mode       |                    |
|------------|--------------------|
| $\Gamma_1$ | $\eta\eta\pi^-$    |
| $\Gamma_2$ | $a_0(980)\eta$     |
| $\Gamma_3$ | $a_2(1320)\eta$    |
| $\Gamma_4$ | $f_0(1500)\pi$     |
| $\Gamma_5$ | $f_1(1285)\pi$     |
| $\Gamma_6$ | $\omega\pi^-\pi^0$ |

DESIG=1

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=6

 **$\Gamma(a_2(1320)\eta)/\Gamma(f_1(1285)\pi)$**  **$\Gamma_3/\Gamma_5$** 

| VALUE | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|------|-------------|------|-----|---------|
|-------|------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |     |      |    |      |   |                                                |
|----------|-----|------|----|------|---|------------------------------------------------|
| 22.7±7.3 | 69k | KUHN | 04 | B852 | — | 18 $\pi^- p \rightarrow \eta\pi^+\pi^-\pi^- p$ |
|----------|-----|------|----|------|---|------------------------------------------------|

NODE=M185R01

NODE=M185R01

 **$\Gamma(f_0(1500)\pi)/\Gamma(a_0(980)\eta)$**  **$\Gamma_4/\Gamma_2$** 

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                        |                        |     |      |   |                                                    |
|----------------------------------------|------------------------|-----|------|---|----------------------------------------------------|
| 0.28 <sup>+0.20</sup> <sub>-0.15</sub> | <sup>3</sup> ANISOVICH | 01B | SPEC | 0 | 0.6–1.94 $\bar{p}p \rightarrow \eta\eta\pi^0\pi^0$ |
|----------------------------------------|------------------------|-----|------|---|----------------------------------------------------|

<sup>3</sup> Systematic errors not estimated.

NODE=M185R02

NODE=M185R02

NODE=M185R02;LINKAGE=NS

 **$\pi_2(1880)$  REFERENCES**

|           |     |               |                              |                    |
|-----------|-----|---------------|------------------------------|--------------------|
| AGHASYAN  | 18B | PR D98 092003 | M. Aghasyan <i>et al.</i>    | (COMPASS Collab.)  |
| EUGENIO   | 08  | PL B660 466   | P. Eugenio <i>et al.</i>     | (BNL E852 Collab.) |
| LU        | 05  | PRL 94 032002 | M. Lu <i>et al.</i>          | (BNL E852 Collab.) |
| KUHN      | 04  | PL B595 109   | J. Kuhn <i>et al.</i>        | (BNL E852 Collab.) |
| ANISOVICH | 01B | PL B500 222   | A.V. Anisovich <i>et al.</i> |                    |

NODE=M185

REFID=59471

REFID=52160

REFID=50459

REFID=49773

REFID=48318

 **$\rho(1900)$** 

$$I^G(J^{PC}) = 1^+(1^{--})$$

NODE=M170

OMITTED FROM SUMMARY TABLE

See our mini-review under the  $\rho(1700)$ .

NODE=M170

 **$\rho(1900)$  MASS**

NODE=M170M

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|            |    |                         |     |      |                                                    |
|------------|----|-------------------------|-----|------|----------------------------------------------------|
| 1909±17±25 | 54 | <sup>1</sup> AUBERT     | 08S | BABR | 10.6 $e^+e^- \rightarrow \phi\pi^0\gamma$          |
| 1880±30    |    | AUBERT                  | 06D | BABR | 10.6 $e^+e^- \rightarrow 3\pi^+3\pi^-\gamma$       |
| 1860±20    |    | AUBERT                  | 06D | BABR | 10.6 $e^+e^- \rightarrow 2(\pi^+\pi^-\pi^0)\gamma$ |
| 1910±10    |    | <sup>2,3</sup> FRABETTI | 04  | E687 | $\gamma p \rightarrow 3\pi^+3\pi^-p$               |
| 1870±10    |    | ANTONELLI               | 96  | SPEC | $e^+e^- \rightarrow \text{hadrons}$                |

OCCUR=2

<sup>1</sup> From the fit with two resonances.<sup>2</sup> From a fit with two resonances with the JACOB 72 continuum.<sup>3</sup> Supersedes FRABETTI 01.

NODE=M170M;LINKAGE=AU

NODE=M170M;LINKAGE=PI

NODE=M170M;LINKAGE=RS

 **$\rho(1900)$  WIDTH**

NODE=M170W

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |    |                         |     |      |                                                    |
|---------|----|-------------------------|-----|------|----------------------------------------------------|
| 48±17±2 | 54 | <sup>4</sup> AUBERT     | 08S | BABR | 10.6 $e^+e^- \rightarrow \phi\pi^0\gamma$          |
| 130±30  |    | AUBERT                  | 06D | BABR | 10.6 $e^+e^- \rightarrow 3\pi^+3\pi^-\gamma$       |
| 160±20  |    | AUBERT                  | 06D | BABR | 10.6 $e^+e^- \rightarrow 2(\pi^+\pi^-\pi^0)\gamma$ |
| 37±13   |    | <sup>5,6</sup> FRABETTI | 04  | E687 | $\gamma p \rightarrow 3\pi^+3\pi^-p$               |
| 10±5    |    | ANTONELLI               | 96  | SPEC | $e^+e^- \rightarrow \text{hadrons}$                |

OCCUR=2

<sup>4</sup> From the fit with two resonances.<sup>5</sup> From a fit with two resonances with the JACOB 72 continuum.<sup>6</sup> Supersedes FRABETTI 01.

NODE=M170W;LINKAGE=AU

NODE=M170W;LINKAGE=PI

NODE=M170W;LINKAGE=RS

$\rho(1900) \Gamma(i) \Gamma(e^+ e^-) / \Gamma^2(\text{total})$  $\Gamma(\phi\pi) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_4 / \Gamma \times \Gamma_6 / \Gamma$ 

| VALUE (units $10^{-8}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |    |                     |          |                                              |
|-----------------------|----|---------------------|----------|----------------------------------------------|
| $4.2 \pm 1.2 \pm 0.8$ | 54 | <sup>7</sup> AUBERT | 08S BABR | $10.6 e^+ e^- \rightarrow \phi \pi^0 \gamma$ |
|-----------------------|----|---------------------|----------|----------------------------------------------|

<sup>7</sup> From the fit with two resonances. $\rho(1900)$  DECAY MODES

| Mode                              | Fraction ( $\Gamma_i / \Gamma$ ) |
|-----------------------------------|----------------------------------|
| $\Gamma_1$ $6\pi$                 | seen                             |
| $\Gamma_2$ $3\pi^+ 3\pi^-$        | seen                             |
| $\Gamma_3$ $2\pi^+ 2\pi^- 2\pi^0$ |                                  |
| $\Gamma_4$ $\phi\pi$              |                                  |
| $\Gamma_5$ hadrons                | seen                             |
| $\Gamma_6$ $e^+ e^-$              | seen                             |
| $\Gamma_7$ $\overline{N} N$       | not seen                         |

 $\rho(1900)$  BRANCHING RATIOS

| $\Gamma(6\pi) / \Gamma_{\text{total}}$ |      |               |      | $\Gamma_1 / \Gamma$                         |
|----------------------------------------|------|---------------|------|---------------------------------------------|
| VALUE                                  | EVTs | DOCUMENT ID   | TECN | COMMENT                                     |
| seen                                   | 8k   | AKHMETSHIN 13 | CMD3 | $e^+ e^- \rightarrow 3\pi^+ 3\pi^-$         |
| not seen                               |      | AGNELLO 02    | OBLX | $\bar{n} p \rightarrow 3\pi^+ 2\pi^- \pi^0$ |
| seen                                   |      | FRABETTI 01   | E687 | $\gamma p \rightarrow 3\pi^+ 3\pi^- p$      |
| seen                                   |      | ANTONELLI 96  | SPEC | $e^+ e^- \rightarrow \text{hadrons}$        |

 $\rho(1900)$  REFERENCES

|               |               |                               |                     |
|---------------|---------------|-------------------------------|---------------------|
| AKHMETSHIN 13 | PL B723 82    | R.R. Akhmetshin <i>et al.</i> | (CMD-3 Collab.)     |
| AUBERT 08S    | PR D77 092002 | B. Aubert <i>et al.</i>       | (BABAR Collab.)     |
| AUBERT 06D    | PR D73 052003 | B. Aubert <i>et al.</i>       | (BABAR Collab.)     |
| FRABETTI 04   | PL B578 290   | P.L. Frabetti <i>et al.</i>   | (FNAL E687 Collab.) |
| AGNELLO 02    | PL B527 39    | M. Agnello <i>et al.</i>      | (OBELIX Collab.)    |
| FRABETTI 01   | PL B514 240   | P.L. Frabetti <i>et al.</i>   | (FNAL E687 Collab.) |
| ANTONELLI 96  | PL B365 427   | A. Antonelli <i>et al.</i>    | (FENICE Collab.)    |
| JACOB 72      | PR D5 1847    | M. Jacob, R. Slansky          |                     |

 $f_2(1910)$ 

$$I^G(J^{PC}) = 0^+(2^{++})$$

## OMITTED FROM SUMMARY TABLE

We list here three different peaks with close masses and widths seen in the mass distributions of  $\omega\omega$ ,  $\eta\eta'$ , and  $K^+ K^-$  final states. ALDE 91B argues that they are of different nature.

 $f_2(1910)$  MASS $f_2(1910) \omega\omega$  MODE

| VALUE (MeV)                                |                                                             | DOCUMENT ID  | TECN | COMMENT                                    |
|--------------------------------------------|-------------------------------------------------------------|--------------|------|--------------------------------------------|
| <b><math>1900 \pm 9</math> OUR AVERAGE</b> | Error includes scale factor of 1.4. See the ideogram below. |              |      |                                            |
| $1890 \pm 10$                              | <sup>1</sup>                                                | AMELIN 06    | VES  | $36 \pi^- p \rightarrow \omega\omega n$    |
| $1897 \pm 11$                              |                                                             | BARBERIS 00F |      | $450 p p \rightarrow p_f \omega\omega p_s$ |
| $1924 \pm 14$                              |                                                             | ALDE 90      | GAM2 | $38 \pi^- p \rightarrow \omega\omega n$    |

NODE=M170215

NODE=M170B01  
NODE=M170B01

NODE=M170B01;LINKAGE=AU

NODE=M170225;NODE=M170

DESIG=5;OUR EST;→ UNCHECKED ←

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=6

DESIG=7

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4;OUR EST;→ UNCHECKED ←

NODE=M170230

NODE=M170R1  
NODE=M170R1

NODE=M170

REFID=55370  
REFID=52242  
REFID=51047  
REFID=49614  
REFID=48576  
REFID=48350  
REFID=44633  
REFID=49668

NODE=M142

NODE=M142

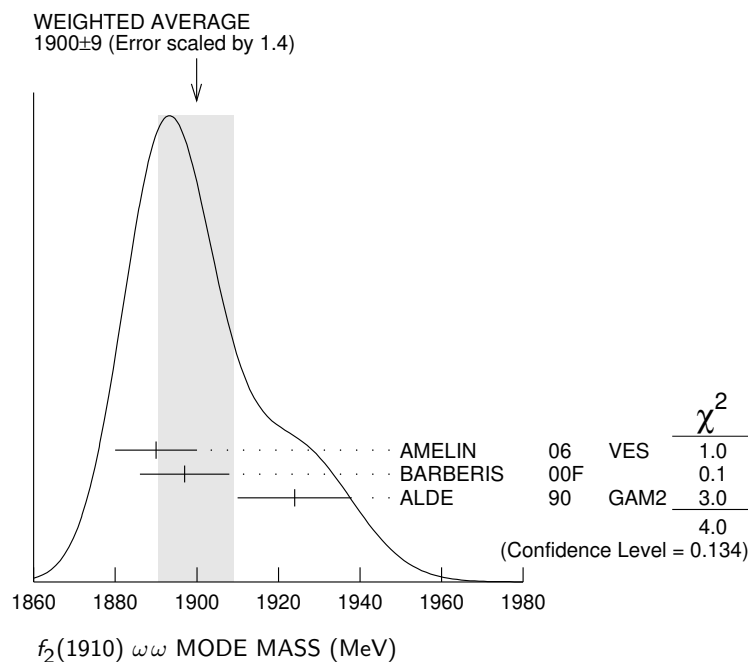
NODE=M142205

NODE=M142MX

NODE=M142M2  
NODE=M142M2

<sup>1</sup> Supersedes BELADIDZE 92B.

NODE=M142M2;LINKAGE=AM

 **$f_2(1910) \eta\eta'$  MODE**

| VALUE (MeV)                                                                   | DOCUMENT ID            | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|------------------------|------|--------------------------------------------|
| <b>1934±16</b>                                                                | <sup>1</sup> BARBERIS  | 00A  | 450 $pp \rightarrow p_f \eta \eta' p_s$    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |                                            |
| 1934±20                                                                       | <sup>2</sup> ANISOVICH | 00J  | SPEC                                       |
| 1911±10                                                                       | ALDE                   | 91B  | GAM2 38 $\pi^- p \rightarrow \eta \eta' n$ |

<sup>1</sup> Also compatible with  $J^{PC}=1^-+$ .<sup>2</sup> Combined fit with  $\eta\eta$ ,  $\pi\pi$ , and  $\eta\pi\pi$ .NODE=M142M3  
NODE=M142M3 **$f_2(1910) K^+ K^-$  MODE**

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|---------------------|------|-------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |      |                                                 |
| 1941±18                                                                       | <sup>1</sup> AMSLER | 06   | CBAR 1.64 $\bar{p} p \rightarrow K^+ K^- \pi^0$ |

<sup>1</sup> Tentative, could be  $f_2(1950)$ .NODE=M142M3;LINKAGE=KS  
NODE=M142M3;LINKAGE=ANNODE=M142M4  
NODE=M142M4

NODE=M142M4;LINKAGE=A

 **$f_2(1910)$  WIDTH**

NODE=M142210

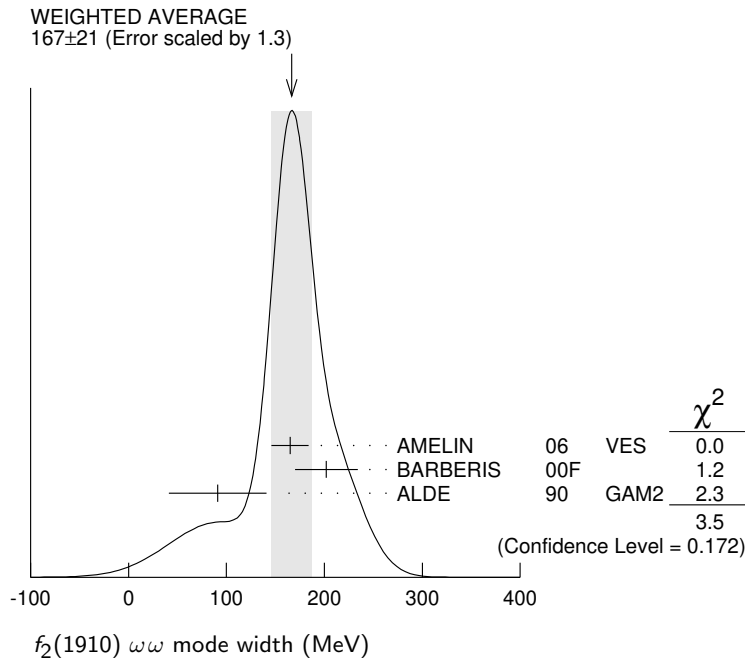
NODE=M142WX

 **$f_2(1910) \omega\omega$  MODE**

| VALUE (MeV)               | DOCUMENT ID                                                 | TECN | COMMENT                                      |
|---------------------------|-------------------------------------------------------------|------|----------------------------------------------|
| <b>167±21 OUR AVERAGE</b> | Error includes scale factor of 1.3. See the ideogram below. |      |                                              |
| 165±19                    | <sup>1</sup> AMELIN                                         | 06   | VES 36 $\pi^- p \rightarrow \omega\omega n$  |
| 202±32                    | BARBERIS                                                    | 00F  | 450 $pp \rightarrow p_f \omega\omega p_s$    |
| 91±50                     | ALDE                                                        | 90   | GAM2 38 $\pi^- p \rightarrow \omega\omega n$ |

<sup>1</sup> Supersedes BELADIDZE 92B.NODE=M142W2  
NODE=M142W2

NODE=M142W2;LINKAGE=AM



### $f_2(1910) \eta\eta'$ MODE

| VALUE (MeV)                                                                   | DOCUMENT ID            | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|------------------------|------|--------------------------------------------|
| <b>141±41</b>                                                                 | <sup>1</sup> BARBERIS  | 00A  | 450 $p p \rightarrow p_f \eta \eta' p_s$   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |      |                                            |
| 271±25                                                                        | <sup>2</sup> ANISOVICH | 00J  | SPEC                                       |
| 90±35                                                                         | ALDE                   | 91B  | GAM2 38 $\pi^- p \rightarrow \eta \eta' n$ |
| <sup>1</sup> Also compatible with $J^{PC}=1^-+$ .                             |                        |      |                                            |
| <sup>2</sup> Combined fit with $\eta\eta$ , $\pi\pi$ , and $\eta\pi\pi$ .     |                        |      |                                            |

NODE=M142W3  
NODE=M142W3

NODE=M142W3;LINKAGE=KS  
NODE=M142W3;LINKAGE=AN

### $f_2(1910) K^+ K^-$ MODE

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT                                         |
|-------------|-------------|------|-------------------------------------------------|
| 120±40      | AMSLER      | 06   | CBAR 1.64 $\bar{p} p \rightarrow K^+ K^- \pi^0$ |

NODE=M142W4  
NODE=M142W4

### $f_2(1910)$ DECAY MODES

| Mode                         | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------|--------------------------------|
| $\Gamma_1 \pi^0 \pi^0$       |                                |
| $\Gamma_2 K^+ K^-$           | seen                           |
| $\Gamma_3 K_S^0 K_S^0$       |                                |
| $\Gamma_4 \eta \eta$         | seen                           |
| $\Gamma_5 \omega \omega$     | seen                           |
| $\Gamma_6 \eta \eta'$        | seen                           |
| $\Gamma_7 \eta' \eta'$       |                                |
| $\Gamma_8 \rho \rho$         | seen                           |
| $\Gamma_9 a_2(1320) \pi$     | seen                           |
| $\Gamma_{10} f_2(1270) \eta$ | seen                           |

NODE=M142215;NODE=M142

DESIG=6

DESIG=11

DESIG=8

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4;OUR EST;→ UNCHECKED ←

DESIG=5;OUR EST;→ UNCHECKED ←

DESIG=9

DESIG=10;OUR EST;→ UNCHECKED ←

DESIG=12;OUR EST;→ UNCHECKED ←

DESIG=13;OUR EST;→ UNCHECKED ←

### $f_2(1910)$ BRANCHING RATIOS

| $\Gamma(K^+ K^-)/\Gamma_{\text{total}}$        |                     |      |                                                 | $\Gamma_2/\Gamma$ |
|------------------------------------------------|---------------------|------|-------------------------------------------------|-------------------|
| VALUE                                          | DOCUMENT ID         | TECN | COMMENT                                         |                   |
| <b>seen</b>                                    | <sup>1</sup> AMSLER | 06   | CBAR 1.64 $\bar{p} p \rightarrow K^+ K^- \pi^0$ |                   |
| <sup>1</sup> Tentative, could be $f_2(1950)$ . |                     |      |                                                 |                   |

NODE=M142225

NODE=M142R11  
NODE=M142R11

NODE=M142R11;LINKAGE=A

| $\Gamma(\pi^0 \pi^0)/\Gamma(\eta \eta')$ |             |      |                                            | $\Gamma_1/\Gamma_6$ |
|------------------------------------------|-------------|------|--------------------------------------------|---------------------|
| VALUE                                    | DOCUMENT ID | TECN | COMMENT                                    |                     |
| <0.1                                     | ALDE        | 89   | GAM2 38 $\pi^- p \rightarrow \eta \eta' n$ |                     |

NODE=M142R4  
NODE=M142R4

$\Gamma(K_S^0 K_S^0)/\Gamma(\eta\eta')$

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|-----|-------------|------|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                          |
| <0.066                                                                        | 90  | BALOSHIN    | 86   | SPEC $40\pi p \rightarrow K_S^0 K_S^0 n$ |

$\Gamma_3/\Gamma_6$

NODE=M142R7  
NODE=M142R7

$\Gamma(\eta\eta)/\Gamma(\eta\eta')$

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|-----|-------------|------|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                          |
| <0.05                                                                         | 90  | ALDE        | 91B  | GAM2 $38\pi^- p \rightarrow \eta\eta' n$ |

$\Gamma_4/\Gamma_6$

NODE=M142R6  
NODE=M142R6

$\Gamma(\omega\omega)/\Gamma(\eta\eta')$

| VALUE                                                                         | DOCUMENT ID  | COMMENT                                    |
|-------------------------------------------------------------------------------|--------------|--------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                                            |
| $2.6 \pm 0.6$                                                                 | BARBERIS 00F | 450 $pp \rightarrow p_f \omega \omega p_s$ |

$\Gamma_5/\Gamma_6$

NODE=M142R10  
NODE=M142R10

$\Gamma(\eta'\eta')/\Gamma_{\text{total}}$

| VALUE                                                                         | DOCUMENT ID   | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|---------------|------|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |               |      |                                          |
| probably not seen                                                             | BARBERIS 00A  |      | 450 $pp \rightarrow p_f \eta' \eta' p_s$ |
| possibly seen                                                                 | BELADIDZE 92D | VES  | 37 $\pi^- p \rightarrow \eta' \eta' n$   |

$\Gamma_7/\Gamma$

NODE=M142R8  
NODE=M142R8

$\Gamma(\rho\rho)/\Gamma(\omega\omega)$

| VALUE                                                                         | DOCUMENT ID  | COMMENT                                    |
|-------------------------------------------------------------------------------|--------------|--------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                                            |
| $2.6 \pm 0.4$                                                                 | BARBERIS 00F | 450 $pp \rightarrow p_f \omega \omega p_s$ |

$\Gamma_8/\Gamma_5$

NODE=M142R9  
NODE=M142R9

$\Gamma(f_2(1270)\eta)/\Gamma(a_2(1320)\pi)$

| VALUE              | DOCUMENT ID               | TECN | COMMENT             |
|--------------------|---------------------------|------|---------------------|
| <b>0.09 ± 0.05</b> | <sup>1</sup> ANISOVICH 11 | SPEC | 0.9–1.94 $p\bar{p}$ |

$\Gamma_{10}/\Gamma_9$

NODE=M142R12  
NODE=M142R12

<sup>1</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M142R12;LINKAGE=AN

## $f_2(1910)$ REFERENCES

|                              |              |                              |                           |
|------------------------------|--------------|------------------------------|---------------------------|
| ANISOVICH 11                 | EPJ C71 1511 | A.V. Anisovich <i>et al.</i> | (LOQM, RAL, PNPI)         |
| AMELIN 06                    | PAN 69 690   | D.V. Amelin <i>et al.</i>    | (VES Collab.)             |
| Translated from YAF 69 715.  |              |                              |                           |
| AMSLER 06                    | PL B639 165  | C. Amsler <i>et al.</i>      | (Crystal Barrel Collab.)  |
| ANISOVICH 00E                | PL B477 19   | A.V. Anisovich <i>et al.</i> |                           |
| ANISOVICH 00J                | PL B491 47   | A.V. Anisovich <i>et al.</i> | (RAL, LOQM, PNPI+)        |
| BARBERIS 00A                 | PL B471 429  | D. Barberis <i>et al.</i>    | (WA 102 Collab.)          |
| BARBERIS 00F                 | PL B484 198  | D. Barberis <i>et al.</i>    | (WA 102 Collab.)          |
| ADOMEIT 96                   | ZPHY C71 227 | J. Adomeit <i>et al.</i>     | (Crystal Barrel Collab.)  |
| BELADIDZE 92B                | ZPHY C54 367 | G.M. Beladidze <i>et al.</i> | (VES Collab.)             |
| BELADIDZE 92D                | ZPHY C57 13  | G.M. Beladidze <i>et al.</i> | (VES Collab.)             |
| ALDE 91B                     | SJNP 54 455  | D.M. Alde <i>et al.</i>      | (SERP, BELG, LANL, LAPP+) |
| Translated from YAF 54 751.  |              |                              |                           |
| Also                         | PL B276 375  | D.M. Alde <i>et al.</i>      | (BELG, SERP, KEK, LANL+)  |
| ALDE 90                      | PL B241 600  | D.M. Alde <i>et al.</i>      | (SERP, BELG, LANL, LAPP+) |
| ALDE 89                      | PL B216 447  | D.M. Alde <i>et al.</i>      | (SERP, BELG, LANL, LAPP)  |
| Also                         | SJNP 48 1035 | D.M. Alde <i>et al.</i>      | (BELG, SERP, LANL, LAPP)  |
| Translated from YAF 48 1724. |              |                              |                           |
| BALOSHIN 86                  | SJNP 43 959  | O.N. Baloshin <i>et al.</i>  | (ITEP)                    |
| Translated from YAF 43 1487. |              |                              |                           |

NODE=M142

REFID=53631  
REFID=51574

REFID=51136  
REFID=47945  
REFID=47950  
REFID=47957  
REFID=47962  
REFID=45202  
REFID=42172  
REFID=43309  
REFID=41844

REFID=41911  
REFID=40935  
REFID=40727  
REFID=44697

REFID=40734

**$a_0(1950)$** 

$$I^G(J^{PC}) = 1^-(0^{++})$$

OMITTED FROM SUMMARY TABLE

Needs confirmation. Seen in  $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\bar{K}\pi$  by LEES 16A  
with significance  $2.5\sigma$  in  $K_S^0 K^\pm \pi^\mp$  and  $4.2\sigma$  in  $K^+ K^- \pi^0$ .

NODE=M227

NODE=M227

 **$a_0(1950)$  MASS**

NODE=M227M

| VALUE (MeV)                                                                                                                    | EVTS | DOCUMENT ID         | TECN     | COMMENT                                                               |
|--------------------------------------------------------------------------------------------------------------------------------|------|---------------------|----------|-----------------------------------------------------------------------|
| <b><math>1931 \pm 14 \pm 22</math></b>                                                                                         | 12k  | <sup>1,2</sup> LEES | 16A BABR | $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\bar{K}\pi$         |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                  |      |                     |          |                                                                       |
| $1949 \pm 32 \pm 76$                                                                                                           | 8k   | <sup>1</sup> LEES   | 16A BABR | $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K_S^0 K^\pm \pi^\mp$ |
| $1927 \pm 15 \pm 23$                                                                                                           | 4k   | <sup>1</sup> LEES   | 16A BABR | $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K^+ K^- \pi^0$       |
| <sup>1</sup> From a model-independent partial wave analysis fit to a relativistic Breit-Wigner function with a floating width. |      |                     |          |                                                                       |
| <sup>2</sup> Weighted average of the $K_S^0 K^\pm$ and $K^+ K^-$ decay modes.                                                  |      |                     |          |                                                                       |

NODE=M227M

OCCUR=3

OCCUR=2

NODE=M227M;LINKAGE=A

NODE=M227M;LINKAGE=B

 **$a_0(1950)$  WIDTH**

NODE=M227W

| VALUE (MeV)                                                                                                                   | EVTS | DOCUMENT ID         | TECN     | COMMENT                                                               |
|-------------------------------------------------------------------------------------------------------------------------------|------|---------------------|----------|-----------------------------------------------------------------------|
| <b><math>271 \pm 22 \pm 29</math></b>                                                                                         | 12k  | <sup>1,2</sup> LEES | 16A BABR | $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\bar{K}\pi$         |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                 |      |                     |          |                                                                       |
| $265 \pm 36 \pm 110$                                                                                                          | 8k   | <sup>1</sup> LEES   | 16A BABR | $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K_S^0 K^\pm \pi^\mp$ |
| $274 \pm 28 \pm 30$                                                                                                           | 4k   | <sup>1</sup> LEES   | 16A BABR | $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K^+ K^- \pi^0$       |
| <sup>1</sup> From a model-independent partial wave analysis fit to a relativistic Breit-Wigner function with a floating mass. |      |                     |          |                                                                       |
| <sup>2</sup> Weighted average of the $K_S^0 K^\pm$ and $K^+ K^-$ decay modes.                                                 |      |                     |          |                                                                       |

NODE=M227W

OCCUR=3

OCCUR=2

NODE=M227W;LINKAGE=A

NODE=M227W;LINKAGE=B

 **$a_0(1950)$  DECAY MODES**

NODE=M227215;NODE=M227

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1 \quad K\bar{K}$ | seen                           |

DESIG=1

 **$a_0(1950)$  BRANCHING RATIOS**

NODE=M227225

| $\Gamma(K\bar{K})/\Gamma_{\text{total}}$                     |             |                    |             |                                                               | $\Gamma_1/\Gamma$ |
|--------------------------------------------------------------|-------------|--------------------|-------------|---------------------------------------------------------------|-------------------|
| <u>VALUE</u>                                                 | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>                                                |                   |
| <b>seen</b>                                                  | 12k         | <sup>1</sup> LEES  | 16A BABR    | $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\bar{K}\pi$ |                   |
| <sup>1</sup> From a model-independent partial wave analysis. |             |                    |             |                                                               |                   |

NODE=M227R01  
NODE=M227R01

NODE=M227R01;LINKAGE=A

 **$a_0(1950)$  REFERENCES**

NODE=M227

LEES 16A PR D93 012005 J.P. Lees *et al.* (BABAR Collab.)

REFID=57125



NODE=M135

**$f_2(1950)$**

$I^G(J^{PC}) = 0^+(2^{++})$

**$f_2(1950)$  MASS**

NODE=M135M

NODE=M135M

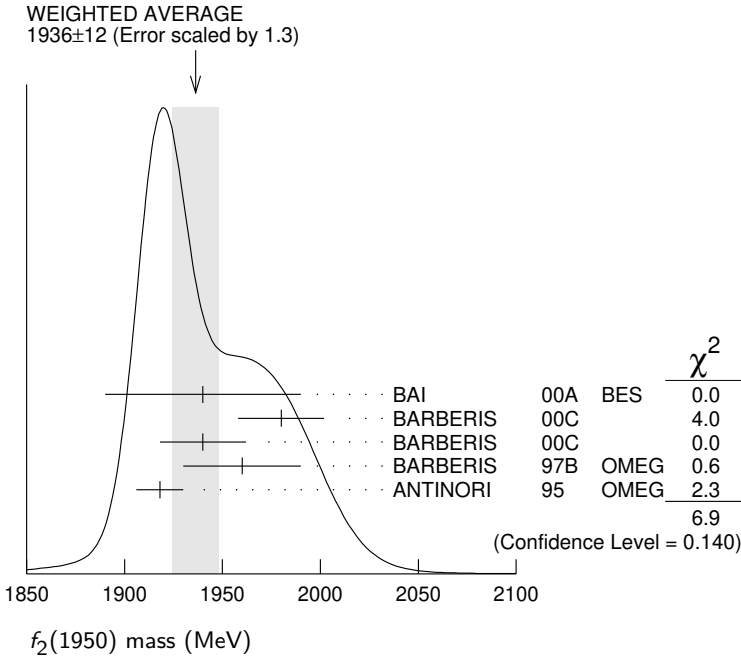
| VALUE (MeV)                                                                   | DOCUMENT ID                                                 | TECN     | COMMENT                                                                |
|-------------------------------------------------------------------------------|-------------------------------------------------------------|----------|------------------------------------------------------------------------|
| <b>1936 ±12 OUR AVERAGE</b>                                                   | Error includes scale factor of 1.3. See the ideogram below. |          |                                                                        |
| 1940 ±50                                                                      | BAI                                                         | 00A BES  | $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^+\pi^-)$                      |
| 1980 ±22                                                                      | <sup>1</sup> BARBERIS                                       | 00C      | $450\ p\bar{p} \rightarrow p\bar{p}4\pi$                               |
| 1940 ±22                                                                      | <sup>2</sup> BARBERIS                                       | 00C      | $450\ p\bar{p} \rightarrow p\bar{p}2\pi2\pi^0$                         |
| 1960 ±30                                                                      | BARBERIS                                                    | 97B OMEG | $450\ p\bar{p} \rightarrow p\bar{p}2(\pi^+\pi^-)$                      |
| 1918 ±12                                                                      | ANTINORI                                                    | 95 OMEG  | $300,450\ p\bar{p} \rightarrow p\bar{p}2(\pi^+\pi^-)$                  |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                                                             |          |                                                                        |
| 1978.2± 1.8 <sup>+28.4</sup> <sub>-16.9</sub>                                 | <sup>3</sup> ALBRECHT                                       | 20 RVUE  | $0.9\ \bar{p}p \rightarrow \pi^0\pi^0\eta, \pi^0\eta\eta, \pi^0K^+K^-$ |
| 2038 <sup>+13</sup> <sub>-11</sub> <sup>+12</sup> <sub>-73</sub>              | <sup>4</sup> UEHARA                                         | 09 BELL  | $10.6\ e^+e^- \rightarrow e^+e^-\pi^0\pi^0$                            |
| 1930 ±25                                                                      | <sup>5</sup> BINON                                          | 05 GAMS  | $33\ \pi^-\bar{p} \rightarrow \eta\eta n$                              |
| 1980 ± 2 ±14                                                                  | ABE                                                         | 04 BELL  | $10.6\ e^+e^- \rightarrow e^+e^-K^+K^-$                                |
| 1867 ±46                                                                      | <sup>6</sup> AMSLER                                         | 02 CBAR  | $0.9\ \bar{p}p \rightarrow \pi^0\eta\eta, \pi^0\pi^0\pi^0$             |
| 2010 ±25                                                                      | ANISOVICH                                                   | 00J SPEC |                                                                        |
| 1980 ±50                                                                      | ANISOVICH                                                   | 99B SPEC | $1.35\text{--}1.94\ p\bar{p} \rightarrow \eta\eta\pi^0$                |
| ~ 1990                                                                        | <sup>7</sup> OAKDEN                                         | 94 RVUE  | $0.36\text{--}1.55\ \bar{p}p \rightarrow \pi\pi$                       |
| 1950 ±15                                                                      | <sup>8</sup> ASTON                                          | 91 LASS  | $11\ K^-\bar{p} \rightarrow \Lambda K\bar{K}\pi\pi$                    |

OCCUR=2

- <sup>1</sup>Decaying into  $\pi^+\pi^-2\pi^0$ .
- <sup>2</sup>Decaying into  $2(\pi^+\pi^-)$ .
- <sup>3</sup>T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).
- <sup>4</sup>Taking into account  $f_4(2050)$ .
- <sup>5</sup>First solution, PWA is ambiguous.
- <sup>6</sup>T-matrix pole.
- <sup>7</sup>From solution B of amplitude analysis of data on  $\bar{p}p \rightarrow \pi\pi$ . See however KLOET 96 who fit  $\pi^+\pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.
- <sup>8</sup>Cannot determine spin to be 2.

NODE=M135M;LINKAGE=A4  
NODE=M135M;LINKAGE=B4  
NODE=M135M;LINKAGE=B  
  
NODE=M135M;LINKAGE=UE  
NODE=M135M;LINKAGE=BI  
NODE=M135M;LINKAGE=E  
NODE=M135M;LINKAGE=BB

NODE=M135M;LINKAGE=A



**$f_2(1950)$  WIDTH**

NODE=M135W

| VALUE (MeV)                                                                                                                                                                                                                  | DOCUMENT ID           | TECN | COMMENT                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|----------------------------------------------------------------------------|
| <b>464 ± 24 OUR AVERAGE</b>                                                                                                                                                                                                  |                       |      |                                                                            |
| 380 <sup>+120</sup> <sub>-90</sub>                                                                                                                                                                                           | BAI                   | 00A  | BES $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^+\pi^-)$                      |
| 520 ± 50                                                                                                                                                                                                                     | <sup>1</sup> BARBERIS | 00C  | 450 $pp \rightarrow pp4\pi$                                                |
| 485 ± 55                                                                                                                                                                                                                     | <sup>2</sup> BARBERIS | 00C  | 450 $pp \rightarrow pp4\pi$                                                |
| 460 ± 40                                                                                                                                                                                                                     | BARBERIS              | 97B  | OMEG 450 $pp \rightarrow pp2(\pi^+\pi^-)$                                  |
| 390 ± 60                                                                                                                                                                                                                     | ANTINORI              | 95   | OMEG 300,450 $pp \rightarrow pp2(\pi^+\pi^-)$                              |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                                                                                                                                                |                       |      |                                                                            |
| 237.6 ± 1.6 <sup>+41.6</sup> <sub>-15.5</sub>                                                                                                                                                                                | <sup>3</sup> ALBRECHT | 20   | RVUE 0.9 $\bar{p}p \rightarrow \pi^0\pi^0\eta, \pi^0\eta\eta, \pi^0K^+K^-$ |
| 441 <sup>+27</sup> <sub>-25</sub> <sup>+28</sup> <sub>-192</sub>                                                                                                                                                             | <sup>4</sup> UEHARA   | 09   | BELL 10.6 $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$                            |
| 450 ± 50                                                                                                                                                                                                                     | <sup>5</sup> BINON    | 05   | GAMS 33 $\pi^-p \rightarrow \eta\eta n$                                    |
| 297 ± 12 ± 6                                                                                                                                                                                                                 | ABE                   | 04   | BELL 10.6 $e^+e^- \rightarrow e^+e^-K^+K^-$                                |
| 385 ± 58                                                                                                                                                                                                                     | <sup>6</sup> AMSLER   | 02   | CBAR 0.9 $\bar{p}p \rightarrow \pi^0\eta\eta, \pi^0\pi^0\pi^0$             |
| 495 ± 35                                                                                                                                                                                                                     | ANISOVICH             | 00J  | SPEC                                                                       |
| 500 ± 100                                                                                                                                                                                                                    | ANISOVICH             | 99B  | SPEC 1.35–1.94 $p\bar{p} \rightarrow \eta\eta\pi^0$                        |
| ~ 100                                                                                                                                                                                                                        | <sup>7</sup> OAKDEN   | 94   | RVUE 0.36–1.55 $\bar{p}p \rightarrow \pi\pi$                               |
| 250 ± 50                                                                                                                                                                                                                     | <sup>8</sup> ASTON    | 91   | LASS 11 $K^-p \rightarrow \Lambda K\bar{K}\pi\pi$                          |
| <sup>1</sup> Decaying into $\pi^+\pi^-2\pi^0$ .                                                                                                                                                                              |                       |      |                                                                            |
| <sup>2</sup> Decaying into $2(\pi^+\pi^-)$ .                                                                                                                                                                                 |                       |      |                                                                            |
| <sup>3</sup> T-matrix pole, 4 poles, 4 channels, including scattering data from HYAMS 75 ( $\pi\pi$ ), LONGACRE 86 ( $K\bar{K}$ ), BINON 83 ( $\eta\eta$ ).                                                                  |                       |      |                                                                            |
| <sup>4</sup> Taking into account $f_4(2050)$ .                                                                                                                                                                               |                       |      |                                                                            |
| <sup>5</sup> First solution, PWA is ambiguous.                                                                                                                                                                               |                       |      |                                                                            |
| <sup>6</sup> T-matrix pole.                                                                                                                                                                                                  |                       |      |                                                                            |
| <sup>7</sup> From solution B of amplitude analysis of data on $\bar{p}p \rightarrow \pi\pi$ . See however KLOET 96 who fit $\pi^+\pi^-$ only and find waves only up to $J=3$ to be important but not significantly resonant. |                       |      |                                                                            |
| <sup>8</sup> Cannot determine spin to be 2.                                                                                                                                                                                  |                       |      |                                                                            |

NODE=M135W

OCCUR=2

NODE=M135W;LINKAGE=A4  
 NODE=M135W;LINKAGE=B4  
 NODE=M135W;LINKAGE=B

NODE=M135W;LINKAGE=UE  
 NODE=M135W;LINKAGE=BI  
 NODE=M135W;LINKAGE=TT  
 NODE=M135W;LINKAGE=BB

NODE=M135W;LINKAGE=A

 **$f_2(1950)$  DECAY MODES**

NODE=M135215;NODE=M135

| Mode                                | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------|--------------------------------|
| $\Gamma_1$ $K^*(892)\bar{K}^*(892)$ | seen                           |
| $\Gamma_2$ $\pi\pi$                 |                                |
| $\Gamma_3$ $\pi^+\pi^-$             | seen                           |
| $\Gamma_4$ $\pi^0\pi^0$             | seen                           |
| $\Gamma_5$ $4\pi$                   | seen                           |
| $\Gamma_6$ $\pi^+\pi^-\pi^+\pi^-$   |                                |
| $\Gamma_7$ $a_2(1320)\pi$           |                                |
| $\Gamma_8$ $f_2(1270)\pi\pi$        |                                |
| $\Gamma_9$ $\eta\eta$               | seen                           |
| $\Gamma_{10}$ $K\bar{K}$            | seen                           |
| $\Gamma_{11}$ $\gamma\gamma$        | seen                           |
| $\Gamma_{12}$ $p\bar{p}$            | seen                           |

DESIG=1  
 DESIG=11  
 DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=10;OUR EST;→ UNCHECKED ←  
 DESIG=7;OUR EST;→ UNCHECKED ←  
 DESIG=3  
 DESIG=4  
 DESIG=5  
 DESIG=6;OUR EST;→ UNCHECKED ←  
 DESIG=8;OUR EST;→ UNCHECKED ←  
 DESIG=9;OUR EST;→ UNCHECKED ←  
 DESIG=12

 **$f_2(1950) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

NODE=M135225

| $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | $\Gamma_{10}\Gamma_{11}/\Gamma$ |
|----------------------------------------------------------------------|---------------------------------|
| VALUE (eV)                                                           | DOCUMENT ID TECN COMMENT        |

NODE=M135G1  
 NODE=M135G1

|                                                                               |                  |    |                                             |
|-------------------------------------------------------------------------------|------------------|----|---------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                  |    |                                             |
| 122 ± 4 ± 26                                                                  | <sup>1</sup> ABE | 04 | BELL 10.6 $e^+e^- \rightarrow e^+e^-K^+K^-$ |
| <sup>1</sup> Assuming spin 2.                                                 |                  |    |                                             |

NODE=M135G1;LINKAGE=AB

| $\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | $\Gamma_2\Gamma_{11}/\Gamma$ |
|--------------------------------------------------------------------|------------------------------|
| VALUE                                                              | DOCUMENT ID TECN COMMENT     |

NODE=M135G2  
 NODE=M135G2

|                                                                               |                     |    |                                                 |
|-------------------------------------------------------------------------------|---------------------|----|-------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                     |    |                                                 |
| 162 <sup>+69</sup> <sub>-42</sub> <sup>+1137</sup> <sub>-204</sub>            | <sup>1</sup> UEHARA | 09 | BELL 10.6 $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$ |
| <sup>1</sup> Taking into account $f_4(2050)$ .                                |                     |    |                                                 |

NODE=M135G2;LINKAGE=UE

**$f_2(1950)$  BRANCHING RATIOS**

NODE=M135220

 **$\Gamma(K^*(892)\bar{K}^*(892))/\Gamma_{\text{total}}$**   **$\Gamma_1/\Gamma$** NODE=M135R1  
NODE=M135R1

| VALUE | DOCUMENT ID | TECN | CHG  | COMMENT                                            |
|-------|-------------|------|------|----------------------------------------------------|
| seen  | ASTON       | 91   | LASS | 0 11 $K^- p \rightarrow \Lambda K \bar{K} \pi \pi$ |

 **$\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$**   **$\Gamma_7/\Gamma$** NODE=M135R3  
NODE=M135R3

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |          |          |                                               |
|---------------|----------|----------|-----------------------------------------------|
| not seen      | BARBERIS | 00B      | 450 $pp \rightarrow p_f \eta \pi^+ \pi^- p_s$ |
| not seen      | BARBERIS | 00C      | 450 $pp \rightarrow p_f 4\pi p_s$             |
| possibly seen | BARBERIS | 97B OMEG | 450 $pp \rightarrow p p 2(\pi^+ \pi^-)$       |

 **$\Gamma(\eta\eta)/\Gamma(4\pi)$**   **$\Gamma_9/\Gamma_5$** NODE=M135R5  
NODE=M135R5

| VALUE | CL% | DOCUMENT ID | COMMENT |
|-------|-----|-------------|---------|
|-------|-----|-------------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |    |          |                                            |
|-----------------------|----|----------|--------------------------------------------|
| $<5.0 \times 10^{-3}$ | 90 | BARBERIS | 00E 450 $pp \rightarrow p_f \eta \eta p_s$ |
|-----------------------|----|----------|--------------------------------------------|

 **$\Gamma(\eta\eta)/\Gamma(\pi^+ \pi^-)$**   **$\Gamma_9/\Gamma_3$** NODE=M135R6  
NODE=M135R6

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|                  |        |    |                                                                     |
|------------------|--------|----|---------------------------------------------------------------------|
| <b>0.14±0.05</b> | AMSLER | 02 | CBAR 0.9 $\bar{p} p \rightarrow \pi^0 \eta \eta, \pi^0 \pi^0 \pi^0$ |
|------------------|--------|----|---------------------------------------------------------------------|

 **$\Gamma(p\bar{p})/\Gamma_{\text{total}}$**   **$\Gamma_{12}/\Gamma$** NODE=M135R07  
NODE=M135R07

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT                                      |
|-------|------|-------------|------|----------------------------------------------|
| seen  | 111  | ALEXANDER   | 10   | CLEO $\psi(2S) \rightarrow \gamma p \bar{p}$ |

 **$f_2(1950)$  REFERENCES**

NODE=M135

|           |     |                             |                              |                          |
|-----------|-----|-----------------------------|------------------------------|--------------------------|
| ALBRECHT  | 20  | EPJ C80 453                 | M. Albrecht <i>et al.</i>    | (Crystal Barrel Collab.) |
| ALEXANDER | 10  | PR D82 092002               | J.P. Alexander <i>et al.</i> | (CLEO Collab.)           |
| UEHARA    | 09  | PR D79 052009               | S. Uehara <i>et al.</i>      | (BELLE Collab.)          |
| BINON     | 05  | PAN 68 960                  | F. Binon <i>et al.</i>       |                          |
|           |     | Translated from YAF 68 998. |                              |                          |
| ABE       | 04  | EPJ C32 323                 | K. Abe <i>et al.</i>         | (BELLE Collab.)          |
| AMSLER    | 02  | EPJ C23 29                  | C. Amsler <i>et al.</i>      |                          |
| ANISOVICH | 00J | PL B491 47                  | A.V. Anisovich <i>et al.</i> | (RAL, LOQM, PNPI+)       |
| BAI       | 00A | PL B472 207                 | J.Z. Bai <i>et al.</i>       | (BES Collab.)            |
| BARBERIS  | 00B | PL B471 435                 | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| BARBERIS  | 00C | PL B471 440                 | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| BARBERIS  | 00E | PL B479 59                  | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| ANISOVICH | 99B | PL B449 154                 | A.V. Anisovich <i>et al.</i> |                          |
| BARBERIS  | 97B | PL B413 217                 | D. Barberis <i>et al.</i>    | (WA 102 Collab.)         |
| KLOET     | 96  | PR D53 6120                 | W.M. Kloet, F. Myhrer        | (RUTG, NORD)             |
| ANTINORI  | 95  | PL B353 589                 | F. Antinori <i>et al.</i>    | (ATHU, BARI, BIRM+) JP   |
| OAKDEN    | 94  | NP A574 731                 | M.N. Oakden, M.R. Pennington | (DURH)                   |
| ASTON     | 91  | NPBPS B21 5                 | D. Aston <i>et al.</i>       | (LASS Collab.)           |
| LONGACRE  | 86  | PL B177 223                 | R.S. Longacre <i>et al.</i>  | (BNL, BRAN, CUNY+)       |
| BINON     | 83  | NC 78A 313                  | F.G. Binon <i>et al.</i>     | (BELG, LAPP, SERP+)      |
| HYAMS     | 75  | NP B100 205                 | B.D. Hyams <i>et al.</i>     | (CERN, MPIM)             |

REFID=60439  
REFID=53525  
REFID=52761  
REFID=50780  
  
REFID=49650  
REFID=48580  
REFID=47950  
REFID=47426  
REFID=47958  
REFID=47959  
REFID=47961  
REFID=46886  
REFID=45758  
REFID=45212  
REFID=44437  
REFID=45210  
REFID=41746  
REFID=20768  
REFID=20750  
REFID=20355

**$a_4(1970)$** 

$$I^G(J^{PC}) = 1^-(4^{++})$$

was  $a_4(2040)$ 

NODE=M017

 **$a_4(1970)$  MASS**

NODE=M017M

| VALUE (MeV)                                 | EVTS | DOCUMENT ID                                                 | TECN | CHG  | COMMENT                                           |
|---------------------------------------------|------|-------------------------------------------------------------|------|------|---------------------------------------------------|
| <b><math>1967 \pm 16</math> OUR AVERAGE</b> |      | Error includes scale factor of 2.1. See the ideogram below. |      |      |                                                   |
| $1935^{+11}_{-13}$                          | 46M  | <sup>1</sup> AGHASYAN                                       | 18B  | COMP | $190 \pi^- p \rightarrow \pi^- \pi^+ \pi^- p$     |
| $1900^{+80}_{-20}$                          |      | ADOLPH                                                      | 15   | COMP | $191 \pi^- p \rightarrow \eta^{(\prime)} \pi^- p$ |
| $1985 \pm 10 \pm 13$                        | 145k | LU                                                          | 05   | B852 | $18 \pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| $1996 \pm 25 \pm 43$                        |      | CHUNG                                                       | 02   | B852 | $18.3 \pi^- p \rightarrow 3\pi p$                 |
| $2000 \pm 40^{+60}_{-20}$                   |      | IVANOV                                                      | 01   | B852 | $18 \pi^- p \rightarrow \eta' \pi^- p$            |
| $2010 \pm 20$                               |      | <sup>2</sup> DONSKOV                                        | 96   | GAM2 | $38 \pi^- p \rightarrow \eta \pi^0 n$             |
| $2040 \pm 30$                               |      | <sup>3</sup> CLELAND                                        | 82B  | SPEC | $50 \pi p \rightarrow K_S^0 K^\pm p$              |

NODE=M017M

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |      |                        |     |      |                                                             |
|--------------------------|------|------------------------|-----|------|-------------------------------------------------------------|
| $1885 \pm 13^{+50}_{-2}$ | 420k | <sup>4</sup> ALEKSEEV  | 10  | COMP | $190 \pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$            |
| $2004 \pm 6$             | 80k  | <sup>5</sup> UMAN      | 06  | E835 | $5.2 \bar{p} p \rightarrow \eta \eta \pi_0^0$               |
| $2005^{+25}_{-45}$       |      | <sup>6</sup> ANISOVICH | 01F | SPEC | $2.0 \bar{p} p \rightarrow 3\pi^0, \pi^0 \eta, \pi^0 \eta'$ |
| $1944 \pm 8 \pm 50$      |      | <sup>7</sup> AMELIN    | 99  | VES  | $37 \pi^- A \rightarrow \omega \pi^- \pi^0 A^*$             |
| $1903 \pm 10$            |      | <sup>8</sup> BALDI     | 78  | SPEC | $10 \pi^- p \rightarrow p K_S^0 K^-$                        |
| $2030 \pm 50$            |      | <sup>9</sup> CORDEN    | 78C | OMEG | $15 \pi^- p \rightarrow 3\pi n$                             |

<sup>1</sup> Statistical error negligible.

<sup>2</sup> From a simultaneous fit to the  $G_+$  and  $G_0$  wave intensities.

<sup>3</sup> From an amplitude analysis.

<sup>4</sup> Superseded by AGHASYAN 2018B.

<sup>5</sup> Statistical error only.

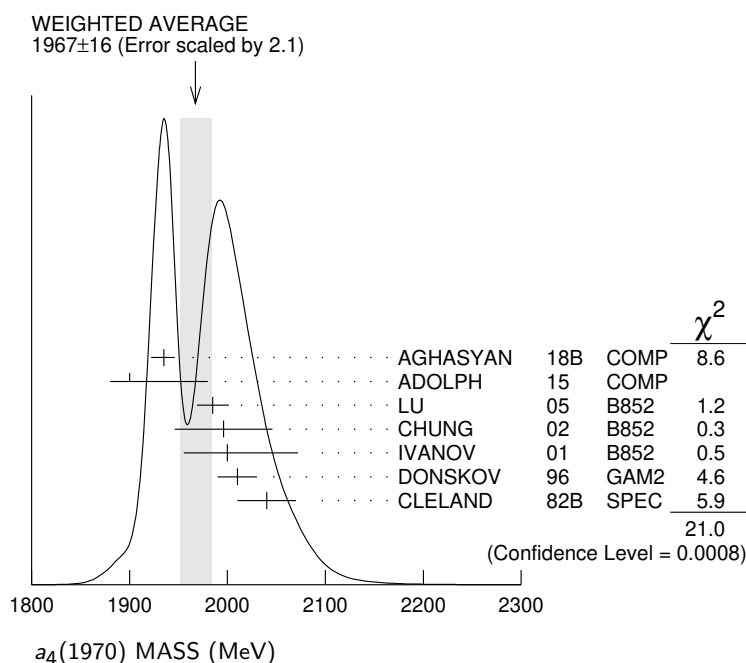
<sup>6</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99E, and ANISOVICH 01F.

<sup>7</sup> May be a different state.

<sup>8</sup> From a fit to the  $Y_8^0$  moment. Limited by phase space.

<sup>9</sup>  $J^P = 4^+$  is favored, though  $J^P = 2^+$  cannot be excluded.

NODE=M017M;LINKAGE=B  
 NODE=M017M;LINKAGE=A  
 NODE=M017M;LINKAGE=C  
 NODE=M017M;LINKAGE=D  
 NODE=M017M;LINKAGE=ST  
 NODE=M017M;LINKAGE=AN  
 NODE=M017M;LINKAGE=DM  
 NODE=M017M;LINKAGE=Y  
 NODE=M017M;LINKAGE=M

 **$a_4(1970)$  WIDTH**

NODE=M017W

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

NODE=M017W

**324<sup>+</sup><sub>-18</sub> OUR AVERAGE**

|                                           |      |                       |     |            |                                                   |
|-------------------------------------------|------|-----------------------|-----|------------|---------------------------------------------------|
| 333 <sup>+</sup> <sub>-21</sub>           | 46M  | <sup>1</sup> AGHASYAN | 18B | COMP       | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$     |
| 300 <sup>+</sup> <sub>-100</sub>          |      | ADOLPH                | 15  | COMP       | 191 $\pi^- p \rightarrow \eta^{(\prime)} \pi^- p$ |
| 231 $\pm$ 30 $\pm$ 46                     | 145k | LU                    | 05  | B852       | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$     |
| 298 $\pm$ 81 $\pm$ 85                     |      | CHUNG                 | 02  | B852       | 18.3 $\pi^- p \rightarrow 3\pi p$                 |
| 350 $\pm$ 100 <sup>+</sup> <sub>-50</sub> |      | IVANOV                | 01  | B852       | 18 $\pi^- p \rightarrow \eta' \pi^- p$            |
| 370 $\pm$ 80                              |      | <sup>2</sup> DONSKOV  | 96  | GAM2 0     | 38 $\pi^- p \rightarrow \eta \pi^0 n$             |
| 380 $\pm$ 150                             |      | <sup>3</sup> CLELAND  | 82B | SPEC $\pm$ | 50 $\pi p \rightarrow K_S^0 K^\pm p$              |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                          |      |                        |     |          |                                                             |
|------------------------------------------|------|------------------------|-----|----------|-------------------------------------------------------------|
| 294 $\pm$ 25 <sup>+</sup> <sub>-19</sub> | 420k | <sup>4</sup> ALEKSEEV  | 10  | COMP     | 190 $\pi^- Pb \rightarrow \pi^- \pi^- \pi^+ Pb'$            |
| 401 $\pm$ 16                             | 80k  | <sup>5</sup> UMAN      | 06  | E835     | 5.2 $\bar{p} p \rightarrow \eta \eta \pi^0$                 |
| 180 $\pm$ 30                             |      | <sup>6</sup> ANISOVICH | 01F | SPEC     | 2.0 $\bar{p} p \rightarrow 3\pi^0, \pi^0 \eta, \pi^0 \eta'$ |
| 324 $\pm$ 26 $\pm$ 75                    |      | <sup>7</sup> AMELIN    | 99  | VES      | 37 $\pi^- A \rightarrow \omega \pi^- \pi^0 A^*$             |
| 166 $\pm$ 43                             |      | <sup>8</sup> BALDI     | 78  | SPEC $-$ | 10 $\pi^- p \rightarrow p K_S^0 K^-$                        |
| 510 $\pm$ 200                            |      | <sup>9</sup> CORDEN    | 78C | OMEG 0   | 15 $\pi^- p \rightarrow 3\pi n$                             |

<sup>1</sup> Statistical error negligible.<sup>2</sup> From a simultaneous fit to the  $G_+$  and  $G_0$  wave intensities.<sup>3</sup> From an amplitude analysis.<sup>4</sup> Superseded by AGHASYAN 2018B.<sup>5</sup> Statistical error only.<sup>6</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99E, and ANISOVICH 01F.<sup>7</sup> May be a different state.<sup>8</sup> From a fit to the  $Y_8^0$  moment. Limited by phase space.<sup>9</sup>  $J^P = 4^+$  is favored, though  $J^P = 2^+$  cannot be excluded.

NODE=M017W;LINKAGE=B  
 NODE=M017W;LINKAGE=A  
 NODE=M017W;LINKAGE=C  
 NODE=M017W;LINKAGE=D  
 NODE=M017W;LINKAGE=ST  
 NODE=M017W;LINKAGE=AN  
 NODE=M017W;LINKAGE=DM  
 NODE=M017W;LINKAGE=Y  
 NODE=M017W;LINKAGE=M

 **$a_4(1970)$  DECAY MODES**

NODE=M017215;NODE=M017

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1$ $K \bar{K}$          | seen                           |
| $\Gamma_2$ $\pi^+ \pi^- \pi^0$  | seen                           |
| $\Gamma_3$ $\rho \pi$           | seen                           |
| $\Gamma_4$ $f_2(1270) \pi$      | seen                           |
| $\Gamma_5$ $\omega \pi^- \pi^0$ | seen                           |
| $\Gamma_6$ $\omega \rho$        | seen                           |
| $\Gamma_7$ $\eta \pi$           | seen                           |
| $\Gamma_8$ $\eta'(958) \pi$     | seen                           |

DESIG=1  
 DESIG=2  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=6;OUR EST;→ UNCHECKED ←  
 DESIG=7;OUR EST;→ UNCHECKED ←  
 DESIG=8  
 DESIG=3  
 DESIG=4;OUR EST;→ UNCHECKED ←

 **$a_4(1970)$  BRANCHING RATIOS**

NODE=M017220

| $\Gamma(K\bar{K})/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$ |      |      |         |                                      |
|------------------------------------------|-------------------|------|------|---------|--------------------------------------|
| VALUE                                    | DOCUMENT ID       | TECN | CHG  | COMMENT |                                      |
| seen                                     | BALDI             | 78   | SPEC | $\pm$   | 10 $\pi^- p \rightarrow K_S^0 K^- p$ |

NODE=M017R1  
 NODE=M017R1

| $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ | $\Gamma_2/\Gamma$ |      |        |                                 |
|-------------------------------------------------|-------------------|------|--------|---------------------------------|
| VALUE                                           | DOCUMENT ID       | TECN | CHG    | COMMENT                         |
| seen                                            | CORDEN            | 78C  | OMEG 0 | 15 $\pi^- p \rightarrow 3\pi n$ |

NODE=M017R2  
 NODE=M017R2

| $\Gamma(\rho\pi)/\Gamma(f_2(1270)\pi)$ |      |             |      |         | $\Gamma_3/\Gamma_4$ |
|----------------------------------------|------|-------------|------|---------|---------------------|
| VALUE                                  | EVTs | DOCUMENT ID | TECN | COMMENT |                     |

NODE=M017R4  
 NODE=M017R4

**1.7<sup>+</sup><sub>-0.8</sub> OUR AVERAGE** Error includes scale factor of 3.7.

|                                  |     |                       |     |      |                                               |
|----------------------------------|-----|-----------------------|-----|------|-----------------------------------------------|
| 2.9 <sup>+</sup> <sub>-0.4</sub> | 46M | <sup>1</sup> AGHASYAN | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ |
| 1.1 $\pm$ 0.2 $\pm$ 0.2          |     | CHUNG                 | 02  | B852 | 18.3 $\pi^- p \rightarrow 3\pi p$             |

<sup>1</sup> Statistical error negligible.

NODE=M017R4;LINKAGE=A

| $\Gamma(\eta\pi)/\Gamma_{\text{total}}$    |      |             |      |         |         | $\Gamma_7/\Gamma$                        |
|--------------------------------------------|------|-------------|------|---------|---------|------------------------------------------|
| VALUE                                      |      | DOCUMENT ID | TECN | CHG     | COMMENT |                                          |
| seen                                       |      | DONSKOV     | 96   | GAM2    | 0       | $38\pi^-p\rightarrow\eta\pi^0n$          |
| $\Gamma(\eta'(958)\pi)/\Gamma(\eta\pi)$    |      |             |      |         |         | $\Gamma_8/\Gamma_7$                      |
| VALUE                                      |      | DOCUMENT ID | TECN | COMMENT |         |                                          |
| 0.23±0.07                                  |      | ADOLPH      | 15   | COMP    | 191     | $\pi^-p\rightarrow\eta^{(\prime)}\pi^-p$ |
| $\Gamma(\omega\rho)/\Gamma_{\text{total}}$ |      |             |      |         |         | $\Gamma_6/\Gamma$                        |
| VALUE                                      | EVTS | DOCUMENT ID | TECN | COMMENT |         |                                          |
| seen                                       | 145k | LU          | 05   | B852    | 18      | $\pi^-p\rightarrow\omega\pi^-\pi^0p$     |

NODE=M017R3  
NODE=M017R3

NODE=M017R01  
NODE=M017R01

NODE=M017R5  
NODE=M017R5

a<sub>4</sub>(1970) REFERENCES

NODE=M017

|                              |     |                |                              |                        |
|------------------------------|-----|----------------|------------------------------|------------------------|
| AGHASYAN                     | 18B | PR D98 092003  | M. Aghasyan <i>et al.</i>    | (COMPASS Collab.)      |
| ADOLPH                       | 15  | PL B740 303    | M. Adolph <i>et al.</i>      | (COMPASS Collab.)      |
| ALEKSEEV                     | 10  | PRL 104 241803 | M.G. Alekseev <i>et al.</i>  | (COMPASS Collab.)      |
| UMAN                         | 06  | PR D73 052009  | I. Uman <i>et al.</i>        | (FNAL E835)            |
| LU                           | 05  | PRL 94 032002  | M. Lu <i>et al.</i>          | (BNL E852 Collab.)     |
| CHUNG                        | 02  | PR D65 072001  | S.U. Chung <i>et al.</i>     | (BNL E852 Collab.)     |
| ANISOVICH                    | 01F | PL B517 261    | A.V. Anisovich <i>et al.</i> |                        |
| IVANOV                       | 01  | PRL 86 3977    | E.I. Ivanov <i>et al.</i>    | (BNL E852 Collab.)     |
| AMELIN                       | 99  | PAN 62 445     | D.V. Amelin <i>et al.</i>    | (VES Collab.)          |
| Translated from YAF 62 487.  |     |                |                              |                        |
| ANISOVICH                    | 99C | PL B452 173    | A.V. Anisovich <i>et al.</i> |                        |
| ANISOVICH                    | 99E | PL B452 187    | A.V. Anisovich <i>et al.</i> |                        |
| DONSKOV                      | 96  | PAN 59 982     | S.V. Donskov <i>et al.</i>   | (GAMS Collab.) IGJPC   |
| Translated from YAF 59 1027. |     |                |                              |                        |
| CLELAND                      | 82B | NP B208 228    | W.E. Cleland <i>et al.</i>   | (DURH, GEVA, LAUS+)    |
| BALDI                        | 78  | PL 74B 413     | R. Baldi <i>et al.</i>       | (GEVA) JP              |
| CORDEN                       | 78C | NP B136 77     | M.J. Corden <i>et al.</i>    | (BIRM, RHEL, TELA+) JP |

REFID=59471  
REFID=56385  
REFID=53356  
REFID=51063  
REFID=50459  
REFID=48837  
REFID=48352  
REFID=48317  
REFID=46910

REFID=46903  
REFID=46902  
REFID=45207

REFID=21281  
REFID=21783  
REFID=20859

$\rho_3(1990)$

$I^G(J^{PC}) = 1^+(3^{--})$

NODE=M167

OMITTED FROM SUMMARY TABLE

ρ<sub>3</sub>(1990) MASS

NODE=M167M

| VALUE (MeV)                                                                                               |  | DOCUMENT ID            | TECN | COMMENT                                                                    |
|-----------------------------------------------------------------------------------------------------------|--|------------------------|------|----------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                             |  |                        |      |                                                                            |
| 1982±14                                                                                                   |  | <sup>1</sup> ANISOVICH | 02   | SPEC 0.6–1.9 $p\bar{p}\rightarrow\omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |
| ~ 2007                                                                                                    |  | HASAN                  | 94   | RVUE $\bar{p}p\rightarrow\pi\pi$                                           |
| <sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02. |  |                        |      |                                                                            |

NODE=M167M

NODE=M167M;LINKAGE=AY

ρ<sub>3</sub>(1990) WIDTH

NODE=M167W

| VALUE (MeV)                                                                                               |  | DOCUMENT ID            | TECN | COMMENT                                                                    |
|-----------------------------------------------------------------------------------------------------------|--|------------------------|------|----------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                             |  |                        |      |                                                                            |
| 188±24                                                                                                    |  | <sup>2</sup> ANISOVICH | 02   | SPEC 0.6–1.9 $p\bar{p}\rightarrow\omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |
| ~ 287                                                                                                     |  | HASAN                  | 94   | RVUE $\bar{p}p\rightarrow\pi\pi$                                           |
| <sup>2</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02. |  |                        |      |                                                                            |

NODE=M167W

NODE=M167W;LINKAGE=AY

ρ<sub>3</sub>(1990) REFERENCES

NODE=M167

|           |     |             |                              |                    |
|-----------|-----|-------------|------------------------------|--------------------|
| ANISOVICH | 02  | PL B542 8   | A.V. Anisovich <i>et al.</i> |                    |
| ANISOVICH | 01D | PL B508 6   | A.V. Anisovich <i>et al.</i> |                    |
| ANISOVICH | 01E | PL B513 281 | A.V. Anisovich <i>et al.</i> |                    |
| ANISOVICH | 00J | PL B491 47  | A.V. Anisovich <i>et al.</i> | (RAL, LOQM, PNPI+) |
| HASAN     | 94  | PL B334 215 | A. Hasan, D.V. Bugg          | (LOQM)             |

REFID=48828  
REFID=48327  
REFID=48349  
REFID=47950  
REFID=44103

$\pi_2(2005)$ 

$$I^G(J^{PC}) = 1^-(2^-+)$$

NODE=M239

OMITTED FROM SUMMARY TABLE

 $\pi_2(2005)$  MASS

NODE=M239M

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

NODE=M239M

**1963<sup>+17</sup><sub>-27</sub> OUR AVERAGE**

|                                    |     |                       |     |      |                                               |
|------------------------------------|-----|-----------------------|-----|------|-----------------------------------------------|
| 1962 <sup>+17</sup> <sub>-29</sub> | 46M | <sup>1</sup> AGHASYAN | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ |
|------------------------------------|-----|-----------------------|-----|------|-----------------------------------------------|

|                        |      |    |    |      |                                               |
|------------------------|------|----|----|------|-----------------------------------------------|
| 1974 $\pm$ 14 $\pm$ 83 | 145k | LU | 05 | B852 | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$ |
|------------------------|------|----|----|------|-----------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |  |           |     |      |                                                             |
|---------------|--|-----------|-----|------|-------------------------------------------------------------|
| 2005 $\pm$ 15 |  | ANISOVICH | 01F | SPEC | 2.0 $\bar{p} p \rightarrow 3\pi^0, \pi^0 \eta, \pi^0 \eta'$ |
|---------------|--|-----------|-----|------|-------------------------------------------------------------|

<sup>1</sup> Statistical uncertainty negligible.

NODE=M239M;LINKAGE=A

 $\pi_2(2005)$  WIDTH

NODE=M239W

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

NODE=M239W

**370<sup>+16</sup><sub>-90</sub> OUR AVERAGE**

|                                    |     |                       |     |      |                                               |
|------------------------------------|-----|-----------------------|-----|------|-----------------------------------------------|
| 371 <sup>+16</sup> <sub>-120</sub> | 46M | <sup>1</sup> AGHASYAN | 18B | COMP | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ |
|------------------------------------|-----|-----------------------|-----|------|-----------------------------------------------|

|                        |      |    |    |      |                                               |
|------------------------|------|----|----|------|-----------------------------------------------|
| 341 $\pm$ 61 $\pm$ 139 | 145k | LU | 05 | B852 | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$ |
|------------------------|------|----|----|------|-----------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |  |           |     |      |                                                             |
|--------------|--|-----------|-----|------|-------------------------------------------------------------|
| 200 $\pm$ 40 |  | ANISOVICH | 01F | SPEC | 2.0 $\bar{p} p \rightarrow 3\pi^0, \pi^0 \eta, \pi^0 \eta'$ |
|--------------|--|-----------|-----|------|-------------------------------------------------------------|

<sup>1</sup> Statistical uncertainty negligible.

NODE=M239W;LINKAGE=A

 $\pi_2(2005)$  DECAY MODES

NODE=M239215;NODE=M239

| Mode                                | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi^- \pi^+ \pi^-$  | seen                           |
| $\Gamma_2 \quad \omega \pi^0 \pi^-$ | seen                           |

DESIG=1

DESIG=2

 $\pi_2(2005)$  BRANCHING RATIOS

NODE=M239220

| $\Gamma(\pi^- \pi^+ \pi^-)/\Gamma_{\text{total}}$ | DOCUMENT ID | TECN | COMMENT | $\Gamma_1/\Gamma$                             |
|---------------------------------------------------|-------------|------|---------|-----------------------------------------------|
| seen                                              | AGHASYAN    | 18B  | COMP    | 190 $\pi^- p \rightarrow \pi^- \pi^+ \pi^- p$ |

NODE=M239R00  
NODE=M239R00

| $\Gamma(\omega \pi^0 \pi^-)/\Gamma_{\text{total}}$ | DOCUMENT ID | TECN | COMMENT | $\Gamma_2/\Gamma$                             |
|----------------------------------------------------|-------------|------|---------|-----------------------------------------------|
| seen                                               | LU          | 05   | B852    | 18 $\pi^- p \rightarrow \omega \pi^- \pi^0 p$ |

NODE=M239R01  
NODE=M239R01 $\pi_2(2005)$  REFERENCES

NODE=M239

|           |     |               |                              |                    |
|-----------|-----|---------------|------------------------------|--------------------|
| AGHASYAN  | 18B | PR D98 092003 | M. Aghasyan <i>et al.</i>    | (COMPASS Collab.)  |
| LU        | 05  | PRL 94 032002 | M. Lu <i>et al.</i>          | (BNL E852 Collab.) |
| ANISOVICH | 01F | PL B517 261   | A.V. Anisovich <i>et al.</i> |                    |

REFID=59471  
REFID=50459  
REFID=48352

$f_2(2010)$ 

$$I^G(J^{PC}) = 0^+(2^{++})$$

NODE=M106

 $f_2(2010)$  MASS

NODE=M106M

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN    | COMMENT                                |
|-------------------------------------------------------------------------------|-----------------------|---------|----------------------------------------|
| $2011^{+62}_{-76}$                                                            | <sup>1</sup> ETKIN    | 88 MPS  | $22 \pi^- p \rightarrow \phi \phi n$   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |         |                                        |
| $2005 \pm 12$                                                                 | VLADIMIRSK...06       | SPEC    | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$ |
| $1980 \pm 20$                                                                 | <sup>2</sup> BOLONKIN | 88 SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$ |
| $2050^{+90}_{-50}$                                                            | ETKIN                 | 85 MPS  | $22 \pi^- p \rightarrow 2 \phi n$      |
| $2120^{+20}_{-120}$                                                           | LINDENBAUM            | 84 RVUE |                                        |
| $2160 \pm 50$                                                                 | ETKIN                 | 82 MPS  | $22 \pi^- p \rightarrow 2 \phi n$      |

NODE=M106M

<sup>1</sup> Includes data of ETKIN 85. The percentage of the resonance going into  $\phi \phi 2^{++} S_2$ ,  $D_2$ , and  $D_0$  is  $98^{+1}_{-3}$ ,  $0^{+1}_{-0}$ , and  $2^{+2}_{-1}$ , respectively.

<sup>2</sup> Statistically very weak, only 1.4 s.d.

NODE=M106M;LINKAGE=C

NODE=M106M;LINKAGE=E

 $f_2(2010)$  WIDTH

NODE=M106W

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN    | COMMENT                                |
|-------------------------------------------------------------------------------|-----------------------|---------|----------------------------------------|
| $202^{+67}_{-62}$                                                             | <sup>3</sup> ETKIN    | 88 MPS  | $22 \pi^- p \rightarrow \phi \phi n$   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |         |                                        |
| $209 \pm 32$                                                                  | VLADIMIRSK...06       | SPEC    | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$ |
| $145 \pm 50$                                                                  | <sup>4</sup> BOLONKIN | 88 SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$ |
| $200^{+160}_{-50}$                                                            | ETKIN                 | 85 MPS  | $22 \pi^- p \rightarrow 2 \phi n$      |
| $300^{+150}_{-50}$                                                            | LINDENBAUM            | 84 RVUE |                                        |
| $310 \pm 70$                                                                  | ETKIN                 | 82 MPS  | $22 \pi^- p \rightarrow 2 \phi n$      |

NODE=M106W

<sup>3</sup> Includes data of ETKIN 85.

<sup>4</sup> Statistically very weak, only 1.4 s.d.

NODE=M106W;LINKAGE=C

NODE=M106W;LINKAGE=E

 $f_2(2010)$  DECAY MODES

NODE=M106215;NODE=M106

| Mode                       | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------|--------------------------------|
| $\Gamma_1 \quad \phi \phi$ | seen                           |
| $\Gamma_2 \quad K \bar{K}$ | seen                           |

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=2

 $f_2(2010)$  BRANCHING RATIOS

NODE=M106230

| $\Gamma(K\bar{K})/\Gamma_{\text{total}}$ | DOCUMENT ID     | TECN | COMMENT                                | $\Gamma_2/\Gamma$ |
|------------------------------------------|-----------------|------|----------------------------------------|-------------------|
| VALUE                                    |                 |      |                                        |                   |
| seen                                     | VLADIMIRSK...06 | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$ |                   |

NODE=M106R01  
NODE=M106R01

 $f_2(2010)$  REFERENCES

NODE=M106

|                  |                             |                                |                |
|------------------|-----------------------------|--------------------------------|----------------|
| VLADIMIRSK... 06 | PAN 69 493                  | V.V. Vladimirsky <i>et al.</i> | (ITEP, Moscow) |
|                  | Translated from YAF 69 515. |                                |                |
| BOLONKIN 88      | NP B309 426                 | B.V. Bolonkin <i>et al.</i>    | (ITEP, SERP)   |
| ETKIN 88         | PL B201 568                 | A. Etkin <i>et al.</i>         | (BNL, CUNY)    |
| ETKIN 85         | PL 165B 217                 | A. Etkin <i>et al.</i>         | (BNL, CUNY)    |
| LINDENBAUM 84    | CNPP 13 285                 | S.J. Lindenbaum                | (CUNY)         |
| ETKIN 82         | PRL 49 1620                 | A. Etkin <i>et al.</i>         | (BNL, CUNY)    |
| Also             | Brighton Conf. 351          | S.J. Lindenbaum                | (BNL, CUNY)    |

REFID=51191

REFID=40580  
REFID=40285  
REFID=21871  
REFID=21869  
REFID=21866  
REFID=21867



**$f_0(2020)$** 

$$I^G(J^{PC}) = 0^+(0^{++})$$

OMITTED FROM SUMMARY TABLE  
Needs confirmation.

 **$f_0(2020)$  MASS**

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID                 | TECN | COMMENT                                             |
|-------------------------------------------------------------------------------|------|-----------------------------|------|-----------------------------------------------------|
| <b>1992±16</b>                                                                |      | <sup>1,2</sup> BARBERIS 00C |      | 450 $pp \rightarrow p_f 4\pi p_S$                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                             |      |                                                     |
| 1910±50                                                                       |      | <sup>3</sup> ROPERTZ 18     | RVUE | $\bar{B}_s^0 \rightarrow J/\psi(\pi^+\pi^-/K^+K^-)$ |
| 2037±8                                                                        | 80k  | <sup>4</sup> UMAN 06        | E835 | 5.2 $\bar{p}p \rightarrow \eta\eta\pi^0$            |
| 2040±38                                                                       |      | ANISOVICH 00J               | SPEC |                                                     |
| 2010±60                                                                       |      | ALDE 98                     | GAM4 | 100 $\pi^-p \rightarrow \pi^0\pi^0n$                |
| 2020±35                                                                       |      | BARBERIS 97B                | OMEG | 450 $pp \rightarrow pp2(\pi^+\pi^-)$                |

<sup>1</sup> Average between  $\pi^+\pi^-2\pi^0$  and  $2(\pi^+\pi^-)$ .

<sup>2</sup> T-matrix pole.

<sup>3</sup> T-matrix pole of 3 channel unitary model fit to data from AAIJ 14BR and AAIJ 17V extracted using Pade approximants.

<sup>4</sup> Statistical error only.

 **$f_0(2020)$  WIDTH**

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID                 | TECN | COMMENT                                             |
|-------------------------------------------------------------------------------|------|-----------------------------|------|-----------------------------------------------------|
| <b>442±60</b>                                                                 |      | <sup>1,2</sup> BARBERIS 00C |      | 450 $pp \rightarrow p_f 4\pi p_S$                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                             |      |                                                     |
| 400±80                                                                        |      | <sup>3</sup> ROPERTZ 18     | RVUE | $\bar{B}_s^0 \rightarrow J/\psi(\pi^+\pi^-/K^+K^-)$ |
| 296±17                                                                        | 80k  | <sup>4</sup> UMAN 06        | E835 | 5.2 $\bar{p}p \rightarrow \eta\eta\pi^0$            |
| 405±40                                                                        |      | ANISOVICH 00J               | SPEC |                                                     |
| 240±100                                                                       |      | ALDE 98                     | GAM4 | 100 $\pi^-p \rightarrow \pi^0\pi^0n$                |
| 410±50                                                                        |      | BARBERIS 97B                | OMEG | 450 $pp \rightarrow pp2(\pi^+\pi^-)$                |

<sup>1</sup> Average between  $\pi^+\pi^-2\pi^0$  and  $2(\pi^+\pi^-)$ .

<sup>2</sup> T-matrix pole.

<sup>3</sup> T-matrix pole of 3 channel unitary model fit to data from AAIJ 14BR and AAIJ 17V extracted using Pade approximants.

<sup>4</sup> Statistical error only.

 **$f_0(2020)$  DECAY MODES**

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $\rho\pi\pi^0$ | seen                           |
| $\Gamma_2$ $\pi^0\pi^0$   | seen                           |
| $\Gamma_3$ $\rho\rho$     | seen                           |
| $\Gamma_4$ $\omega\omega$ | seen                           |
| $\Gamma_5$ $\eta\eta$     | seen                           |

 **$f_0(2020)$  BRANCHING RATIOS**

**$\Gamma(\rho\rho)/\Gamma(\omega\omega)$**   **$\Gamma_3/\Gamma_4$**

| VALUE                                                                         | DOCUMENT ID  | COMMENT                                    |
|-------------------------------------------------------------------------------|--------------|--------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                                            |
| ~3                                                                            | BARBERIS 00F | 450 $pp \rightarrow p_f \omega \omega p_S$ |

**$\Gamma(\eta\eta)/\Gamma_{\text{total}}$**   **$\Gamma_5/\Gamma$**

| VALUE | DOCUMENT ID | TECN | COMMENT                                  |
|-------|-------------|------|------------------------------------------|
| seen  | UMAN 06     | E835 | 5.2 $\bar{p}p \rightarrow \eta\eta\pi^0$ |

 **$f_0(2020)$  REFERENCES**

|               |                                           |                                               |
|---------------|-------------------------------------------|-----------------------------------------------|
| ROPERTZ 18    | EPJ C78 1000                              | S. Ropertz, C. Hanhart, B. Kubis (BONN, JULI) |
| AAIJ 17V      | JHEP 1708 037                             | R. Aaij et al. (LHCb Collab.)                 |
| AAIJ 14BR     | PR D89 092006                             | R. Aaij et al. (LHCb Collab.)                 |
| UMAN 06       | PR D73 052009                             | I. Uman et al. (FNAL E835)                    |
| ANISOVICH 00J | PL B491 47                                | A.V. Anisovich et al. (RAL, LOQM, PNPI+)      |
| BARBERIS 00C  | PL B471 440                               | D. Barberis et al. (WA 102 Collab.)           |
| BARBERIS 00F  | PL B484 198                               | D. Barberis et al. (WA 102 Collab.)           |
| ALDE 98       | EPJ A3 361                                | D. Alde et al. (GAM4 Collab.)                 |
| Also          | PAN 62 405                                | D. Alde et al. (GAMS Collab.)                 |
| BARBERIS 97B  | Translated from YAF 62 446<br>PL B413 217 | D. Barberis et al. (WA 102 Collab.)           |

NODE=M156

NODE=M156

NODE=M156M

NODE=M156M

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NODE=M156M;LINKAGE=PP

NODE=M156M;LINKAGE=A

NODE=M156M;LINKAGE=ST

NODE=M156W

NODE=M156W

NODE=M156W;LINKAGE=PC

NODE=M156W;LINKAGE=PP

NODE=M156W;LINKAGE=A

NODE=M156W;LINKAGE=ST

NODE=M156215;NODE=M156

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DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4;OUR EST;→ UNCHECKED ←

DESIG=5

NODE=M156220

NODE=M156R1

NODE=M156R1

NODE=M156R01

NODE=M156R01

NODE=M156

REFID=59332

REFID=57828

REFID=56035

REFID=51063

REFID=47950

REFID=47959

REFID=47962

REFID=46605

REFID=46914

REFID=45758

$f_4(2050)$ 

$$I^G(J^{PC}) = 0^+(4^{++})$$

NODE=M016

 **$f_4(2050)$  MASS**

NODE=M016M

NODE=M016M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN | COMMENT                                                                                             |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------|
| <b>2018±11 OUR AVERAGE</b>                                                    |      | Error includes scale factor of 2.1. See the ideogram below. |      |                                                                                                     |
| 1960±15                                                                       |      | AMELIN                                                      | 06   | VES 36 $\pi^- p \rightarrow \omega \omega n$                                                        |
| 2005±10                                                                       |      | <sup>1</sup> BINON                                          | 05   | GAMS 33 $\pi^- p \rightarrow \eta \eta n$                                                           |
| 1998±15                                                                       |      | ALDE                                                        | 98   | GAM4 100 $\pi^- p \rightarrow \pi^0 \pi^0 n$                                                        |
| 2060±20                                                                       |      | ALDE                                                        | 90   | GAM2 38 $\pi^- p \rightarrow \omega \omega n$                                                       |
| 2038±30                                                                       |      | AUGUSTIN                                                    | 87   | DM2 $J/\psi \rightarrow \gamma \pi^+ \pi^-$                                                         |
| 2086±15                                                                       |      | BALTRUSAIT..                                                | 87   | MRK3 $J/\psi \rightarrow \gamma \pi^+ \pi^-$                                                        |
| 2000±60                                                                       |      | ALDE                                                        | 86D  | GAM4 100 $\pi^- p \rightarrow n 2 \eta$                                                             |
| 2020±20                                                                       | 40k  | <sup>2</sup> BINON                                          | 84B  | GAM2 38 $\pi^- p \rightarrow n 2 \pi^0$                                                             |
| 2015±28                                                                       |      | <sup>3</sup> CASON                                          | 82   | STRC 8 $\pi^+ p \rightarrow \Delta^{++} \pi^0 \pi^0$                                                |
| 2031 <sup>+25</sup> <sub>-36</sub>                                            |      | ETKIN                                                       | 82B  | MPS 23 $\pi^- p \rightarrow n 2 K_S^0$                                                              |
| 2020±30                                                                       | 700  | APEL                                                        | 75   | NICE 40 $\pi^- p \rightarrow n 2 \pi^0$                                                             |
| 2050±25                                                                       |      | BLUM                                                        | 75   | ASPK 18.4 $\pi^- p \rightarrow n K^+ K^-$                                                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                             |      |                                                                                                     |
| 1966±25                                                                       |      | <sup>4</sup> ANISOVICH                                      | 09   | RVUE 0.0 $\bar{p} p, \pi N$                                                                         |
| 1885 <sup>+14+218</sup> <sub>-13-25</sub>                                     |      | <sup>5</sup> UEHARA                                         | 09   | BELL 10.6 $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$                                                 |
| 2018± 6                                                                       |      | ANISOVICH                                                   | 00J  | SPEC 2.0 $\bar{p} p \rightarrow \eta \pi^0 \pi^0, \pi^0 \pi^0,$<br>$\eta \eta, \eta \eta', \pi \pi$ |
| ~ 2000                                                                        |      | <sup>6</sup> MARTIN                                         | 98   | RVUE $\bar{N} N \rightarrow \pi \pi$                                                                |
| ~ 2010                                                                        |      | <sup>7</sup> MARTIN                                         | 97   | RVUE $\bar{N} N \rightarrow \pi \pi$                                                                |
| ~ 2040                                                                        |      | <sup>8</sup> OAKDEN                                         | 94   | RVUE 0.36-1.55 $\bar{p} p \rightarrow \pi \pi$                                                      |
| ~ 1990                                                                        |      | <sup>9</sup> OAKDEN                                         | 94   | RVUE 0.36-1.55 $\bar{p} p \rightarrow \pi \pi$                                                      |
| 1978± 5                                                                       |      | <sup>10</sup> ALPER                                         | 80   | CNTR 62 $\pi^- p \rightarrow K^+ K^- n$                                                             |
| 2040±10                                                                       |      | <sup>10</sup> ROZANSKA                                      | 80   | SPRK 18 $\pi^- p \rightarrow p \bar{p} n$                                                           |
| 1935±13                                                                       |      | <sup>10</sup> CORDEN                                        | 79   | OMEG 12-15 $\pi^- p \rightarrow n 2 \pi$                                                            |
| 1988± 7                                                                       |      | EVANGELIS...                                                | 79B  | OMEG 10 $\pi^- p \rightarrow K^+ K^- n$                                                             |
| 1922±14                                                                       |      | <sup>11</sup> ANTIPOV                                       | 77   | CIBS 25 $\pi^- p \rightarrow p 3 \pi$                                                               |

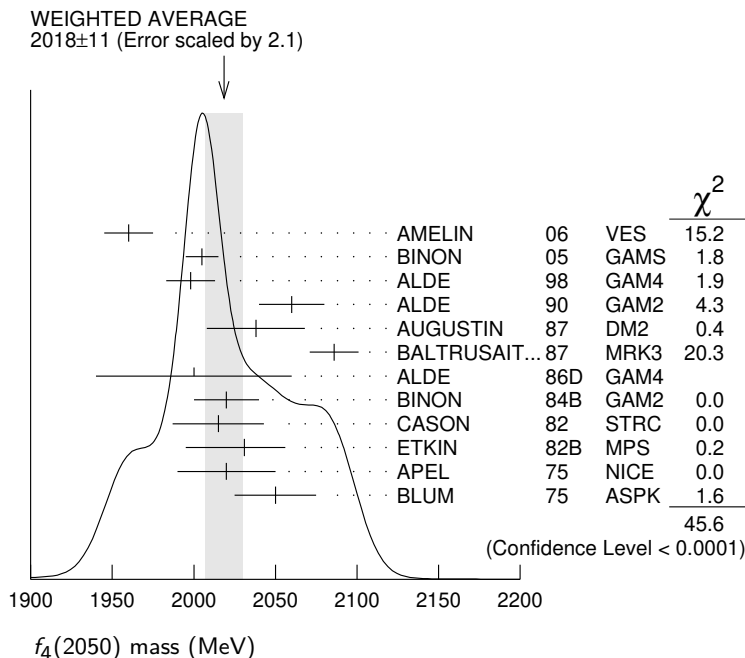
<sup>1</sup> From the first PWA solution.<sup>2</sup> From a partial-wave analysis of the data.<sup>3</sup> From an amplitude analysis of the reaction  $\pi^+ \pi^- \rightarrow 2 \pi^0$ .<sup>4</sup> K matrix pole.<sup>5</sup> Taking into account the  $f_2(1950)$ . Helicity-2 production favored.<sup>6</sup> Energy-dependent analysis.<sup>7</sup> Single energy analysis.<sup>8</sup> From solution A of amplitude analysis of data on  $\bar{p} p \rightarrow \pi \pi$ . See however KLOET 96 who fit  $\pi^+ \pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.<sup>9</sup> From solution B of amplitude analysis of data on  $\bar{p} p \rightarrow \pi \pi$ . See however KLOET 96 who fit  $\pi^+ \pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.<sup>10</sup>  $I(J^P) = 0(4^+)$  from amplitude analysis assuming one-pion exchange.<sup>11</sup> Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

NODE=M016M;LINKAGE=BI  
 NODE=M016M;LINKAGE=N  
 NODE=M016M;LINKAGE=NN  
 NODE=M016M;LINKAGE=KM  
 NODE=M016M;LINKAGE=UE  
 NODE=M016M;LINKAGE=RB  
 NODE=M016M;LINKAGE=BR  
 NODE=M016M;LINKAGE=B

NODE=M016M;LINKAGE=BB

NODE=M016M;LINKAGE=M  
 NODE=M016M;LINKAGE=T

OCCUR=2



### $f_4(2050)$ WIDTH

NODE=M016W

| VALUE (MeV)                        | EVTS | DOCUMENT ID                                                 | TECN | COMMENT                                              |
|------------------------------------|------|-------------------------------------------------------------|------|------------------------------------------------------|
| <b>237± 18 OUR AVERAGE</b>         |      | Error includes scale factor of 1.9. See the ideogram below. |      |                                                      |
| 290± 20                            |      | AMELIN                                                      | 06   | VES $36 \pi^- p \rightarrow \omega \omega n$         |
| 340± 80                            |      | <sup>12</sup> BINON                                         | 05   | GAMS $33 \pi^- p \rightarrow \eta \eta n$            |
| 395± 40                            |      | ALDE                                                        | 98   | GAM4 $100 \pi^- p \rightarrow \pi^0 \pi^0 n$         |
| 170± 60                            |      | ALDE                                                        | 90   | GAM2 $38 \pi^- p \rightarrow \omega \omega n$        |
| 304± 60                            |      | AUGUSTIN                                                    | 87   | DM2 $J/\psi \rightarrow \gamma \pi^+ \pi^-$          |
| 210± 63                            |      | BALTRUSAIT..                                                | 87   | MRK3 $J/\psi \rightarrow \gamma \pi^+ \pi^-$         |
| 400±100                            |      | ALDE                                                        | 86D  | GAM4 $100 \pi^- p \rightarrow n 2 \eta$              |
| 240± 40                            | 40k  | <sup>13</sup> BINON                                         | 84B  | GAM2 $38 \pi^- p \rightarrow n 2 \pi^0$              |
| 190± 14                            |      | DENNEY                                                      | 83   | LASS $10 \pi^+ n / \pi^+ p$                          |
| 186 <sup>+103</sup> <sub>-58</sub> |      | <sup>14</sup> CASON                                         | 82   | STRC $8 \pi^+ p \rightarrow \Delta^{++} \pi^0 \pi^0$ |
| 305 <sup>+36</sup> <sub>-119</sub> |      | ETKIN                                                       | 82B  | MPS $23 \pi^- p \rightarrow n 2 K_S^0$               |
| 180± 60                            | 700  | APEL                                                        | 75   | NICE $40 \pi^- p \rightarrow n 2 \pi^0$              |
| 225 <sup>+120</sup> <sub>-70</sub> |      | BLUM                                                        | 75   | ASPK $18.4 \pi^- p \rightarrow n K^+ K^-$            |

NODE=M016W

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                        |               |              |     |      |                                                                                                |
|----------------------------------------|---------------|--------------|-----|------|------------------------------------------------------------------------------------------------|
| 260± 40                                | <sup>15</sup> | ANISOVICH    | 09  | RVUE | 0.0 $\bar{p} p, \pi N$                                                                         |
| 453± 20 <sup>+31</sup> <sub>-129</sub> | <sup>16</sup> | UEHARA       | 09  | BELL | 10.6 $e^+ e^- \rightarrow e^+ e^- \pi^0 \pi^0$                                                 |
| 182± 7                                 |               | ANISOVICH    | 00J | SPEC | 2.0 $\bar{p} p \rightarrow \eta \pi^0 \pi^0, \pi^0 \pi^0,$<br>$\eta \eta, \eta \eta', \pi \pi$ |
| ~ 170                                  | <sup>17</sup> | MARTIN       | 98  | RVUE | $N \bar{N} \rightarrow \pi \pi$                                                                |
| ~ 200                                  | <sup>18</sup> | MARTIN       | 97  | RVUE | $\bar{N} N \rightarrow \pi \pi$                                                                |
| ~ 60                                   | <sup>19</sup> | OAKDEN       | 94  | RVUE | 0.36-1.55 $\bar{p} p \rightarrow \pi \pi$                                                      |
| ~ 80                                   | <sup>20</sup> | OAKDEN       | 94  | RVUE | 0.36-1.55 $\bar{p} p \rightarrow \pi \pi$                                                      |
| 243± 16                                | <sup>21</sup> | ALPER        | 80  | CNTR | 62 $\pi^- p \rightarrow K^+ K^- n$                                                             |
| 140± 15                                | <sup>21</sup> | ROZANSKA     | 80  | SPRK | 18 $\pi^- p \rightarrow p \bar{p} n$                                                           |
| 263± 57                                | <sup>21</sup> | CORDEN       | 79  | OMEG | 12-15 $\pi^- p \rightarrow n 2 \pi$                                                            |
| 100± 28                                |               | EVANGELIS... | 79B | OMEG | 10 $\pi^- p \rightarrow K^+ K^- n$                                                             |
| 107± 56                                | <sup>22</sup> | ANTIPOV      | 77  | CIBS | 25 $\pi^- p \rightarrow p 3 \pi$                                                               |

OCCUR=2

<sup>12</sup> From the first PWA solution.

<sup>13</sup> From a partial-wave analysis of the data.

<sup>14</sup> From an amplitude analysis of the reaction  $\pi^+ \pi^- \rightarrow 2 \pi^0$ .

<sup>15</sup> K matrix pole.

<sup>16</sup> Taking into account the  $f_2(1950)$ . Helicity-2 production favored.

<sup>17</sup> Energy-dependent analysis.

<sup>18</sup> Single energy analysis.

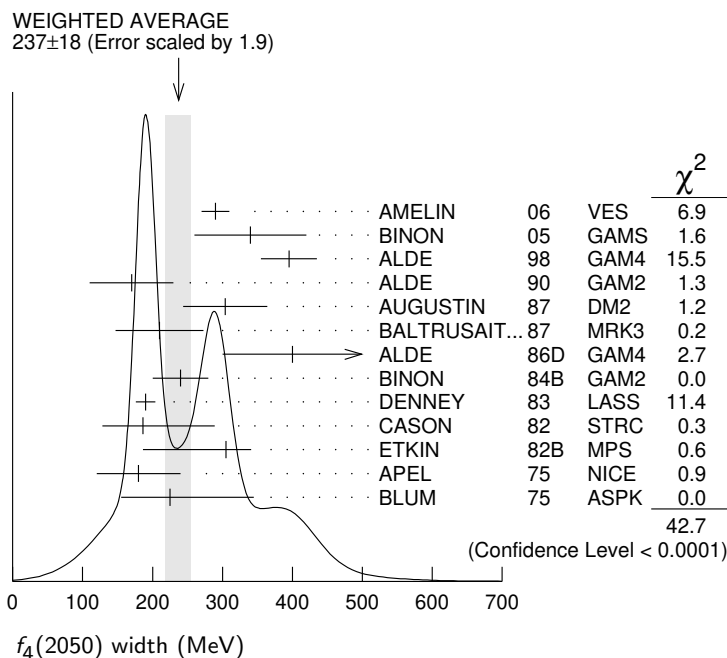
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 NODE=M016W;LINKAGE=NN  
 NODE=M016W;LINKAGE=KM  
 NODE=M016W;LINKAGE=UE  
 NODE=M016W;LINKAGE=RB  
 NODE=M016W;LINKAGE=BR

- 19 From solution A of amplitude analysis of data on  $\bar{p}p \rightarrow \pi\pi$ . See however KLOET 96 who fit  $\pi^+\pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.
- 20 From solution B of amplitude analysis of data on  $\bar{p}p \rightarrow \pi\pi$ . See however KLOET 96 who fit  $\pi^+\pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.
- 21  $I(J^P) = 0(4^+)$  from amplitude analysis assuming one-pion exchange.
- 22 Width errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

NODE=M016W;LINKAGE=BW

NODE=M016W;LINKAGE=BB

NODE=M016W;LINKAGE=M  
NODE=M016W;LINKAGE=T

 **$f_4(2050)$  DECAY MODES**

NODE=M016215;NODE=M016

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ )                             |
|-------------------------------|------------------------------------------------------------|
| $\Gamma_1 \quad \omega\omega$ | seen                                                       |
| $\Gamma_2 \quad \pi\pi$       | (17.0±1.5) %                                               |
| $\Gamma_3 \quad K\bar{K}$     | ( 6.8 <sup>+3.4</sup> <sub>-1.8</sub> ) × 10 <sup>-3</sup> |
| $\Gamma_4 \quad \eta\eta$     | ( 2.1±0.8) × 10 <sup>-3</sup>                              |
| $\Gamma_5 \quad 4\pi^0$       | < 1.2 %                                                    |
| $\Gamma_6 \quad \gamma\gamma$ | seen                                                       |
| $\Gamma_7 \quad a_2(1320)\pi$ | seen                                                       |

DESIG=6

DESIG=1

DESIG=2

DESIG=3

DESIG=5

DESIG=4

DESIG=7

 **$f_4(2050) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

NODE=M016220

| $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$          | $\Gamma_3\Gamma_6/\Gamma$ |
|-------------------------------------------------------------------------------|---------------------------|
| VALUE (keV) CL% DOCUMENT ID TECN COMMENT                                      |                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                           |
| <0.29 95 ALTHOFF 85B TASS $\gamma\gamma \rightarrow K\bar{K}\pi$              |                           |

NODE=M016G2  
NODE=M016G2

| $\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$                                               | $\Gamma_2\Gamma_6/\Gamma$ |
|------------------------------------------------------------------------------------------------------------------|---------------------------|
| VALUE (eV) CL% EVTS DOCUMENT ID TECN COMMENT                                                                     |                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                    |                           |
| 23.1 <sup>+3.6</sup> <sub>-3.3</sub> +70.5<br>-15.6 23 UEHARA 09 BELL 10.6 $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$ |                           |
| <1100 95 13 ± 4 OEST 90 JADE $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$                                               |                           |
| 23 Taking into account the $f_2(1950)$ . Helicity-2 production favored.                                          |                           |

NODE=M016G3  
NODE=M016G3

NODE=M016G3;LINKAGE=UE

 **$f_4(2050)$  BRANCHING RATIOS**

NODE=M016225

| $\Gamma(\omega\omega)/\Gamma_{\text{total}}$                                  | $\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------|-------------------|
| VALUE DOCUMENT ID TECN COMMENT                                                |                   |
| seen AMELIN 06 VES 36 $\pi^-p \rightarrow \omega\omega n$                     |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                   |
| not seen BARBERIS 00F 450 $pp \rightarrow pf\omega\omega p_S$                 |                   |

NODE=M016R7  
NODE=M016R7

$\Gamma(\omega\omega)/\Gamma(\pi\pi)$ 

| VALUE          | DOCUMENT ID | TECN | COMMENT                                      |
|----------------|-------------|------|----------------------------------------------|
| <b>1.5±0.3</b> | ALDE        | 90   | GAM2 38 $\pi^- p \rightarrow \omega\omega n$ |

 $\Gamma_1/\Gamma_2$ 

NODE=M016R5  
 NODE=M016R5

 $\Gamma(\pi\pi)/\Gamma_{\text{total}}$ 

| VALUE                          | DOCUMENT ID          | TECN | COMMENT                                       |
|--------------------------------|----------------------|------|-----------------------------------------------|
| <b>0.170±0.015 OUR AVERAGE</b> |                      |      |                                               |
| 0.18 ±0.03                     | <sup>24</sup> BINON  | 83C  | GAM2 38 $\pi^- p \rightarrow n4\gamma$        |
| 0.16 ±0.03                     | <sup>24</sup> CASON  | 82   | STRC 8 $\pi^+ p \rightarrow \Delta^{++}\pi^0$ |
| 0.17 ±0.02                     | <sup>24</sup> CORDEN | 79   | OMEG 12-15 $\pi^- p \rightarrow n2\pi$        |

 $\Gamma_2/\Gamma$ 

NODE=M016R1  
 NODE=M016R1

<sup>24</sup> Assuming one pion exchange.

NODE=M016R1;LINKAGE=A

 $\Gamma(K\bar{K})/\Gamma(\pi\pi)$ 

| VALUE                                       | DOCUMENT ID | TECN | COMMENT                              |
|---------------------------------------------|-------------|------|--------------------------------------|
| <b>0.04<sup>+0.02</sup><sub>-0.01</sub></b> | ETKIN       | 82B  | MPS 23 $\pi^- p \rightarrow n2K_S^0$ |

 $\Gamma_3/\Gamma_2$ 

NODE=M016R2  
 NODE=M016R2

 $\Gamma(\eta\eta)/\Gamma_{\text{total}}$ 

| VALUE (units 10 <sup>-3</sup> ) | DOCUMENT ID | TECN | COMMENT                                 |
|---------------------------------|-------------|------|-----------------------------------------|
| <b>2.1±0.8</b>                  | ALDE        | 86D  | GAM4 100 $\pi^- p \rightarrow n4\gamma$ |

 $\Gamma_4/\Gamma$ 

NODE=M016R3  
 NODE=M016R3

 $\Gamma(4\pi^0)/\Gamma_{\text{total}}$ 

| VALUE            | DOCUMENT ID | TECN | COMMENT                                 |
|------------------|-------------|------|-----------------------------------------|
| <b>&lt;0.012</b> | ALDE        | 87   | GAM4 100 $\pi^- p \rightarrow 4\pi^0 n$ |

 $\Gamma_5/\Gamma$ 

NODE=M016R4  
 NODE=M016R4

 $\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$ 

| VALUE       | DOCUMENT ID | TECN | COMMENT                                       |
|-------------|-------------|------|-----------------------------------------------|
| <b>seen</b> | AMELIN      | 00   | VES 37 $\pi^- p \rightarrow \eta\pi^+\pi^- n$ |

 $\Gamma_7/\Gamma$ 

NODE=M016R6  
 NODE=M016R6

**f<sub>4</sub>(2050) REFERENCES**

NODE=M016

|               |     |                              |                                 |                             |             |
|---------------|-----|------------------------------|---------------------------------|-----------------------------|-------------|
| ANISOVICH     | 09  | IJMP A24 2481                | V.V. Anisovich, A.V. Sarantsev  |                             | REFID=52719 |
| UEHARA        | 09  | PR D79 052009                | S. Uehara <i>et al.</i>         | (BELLE Collab.)             | REFID=52761 |
| AMELIN        | 06  | PAN 69 690                   | D.V. Amelin <i>et al.</i>       | (VES Collab.)               | REFID=51574 |
|               |     | Translated from YAF 69 715.  |                                 |                             |             |
| BINON         | 05  | PAN 68 960                   | F. Binon <i>et al.</i>          |                             | REFID=50780 |
|               |     | Translated from YAF 68 998.  |                                 |                             |             |
| AMELIN        | 00  | NP A668 83                   | D. Amelin <i>et al.</i>         | (VES Collab.)               | REFID=47432 |
| ANISOVICH     | 00J | PL B491 47                   | A.V. Anisovich <i>et al.</i>    | (RAL, LOQM, PNPI+)          | REFID=47950 |
| BARBERIS      | 00F | PL B484 198                  | D. Barberis <i>et al.</i>       | (WA 102 Collab.)            | REFID=47962 |
| ALDE          | 98  | EPJ A3 361                   | D. Alde <i>et al.</i>           | (GAM4 Collab.)              | REFID=46605 |
| Also          |     | PAN 62 405                   | D. Alde <i>et al.</i>           | (GAMS Collab.)              | REFID=46914 |
|               |     | Translated from YAF 62 446.  |                                 |                             |             |
| MARTIN        | 98  | PR C57 3492                  | B.R. Martin <i>et al.</i>       |                             | REFID=46373 |
| MARTIN        | 97  | PR C56 1114                  | B.R. Martin, G.C. Oades         | (LOUC, AARH)                | REFID=45685 |
| KLOET         | 96  | PR D53 6120                  | W.M. Kloet, F. Myhrer           | (RUTG, NORD)                | REFID=45212 |
| OAKDEN        | 94  | NP A574 731                  | M.N. Oakden, M.R. Pennington    | (DURH)                      | REFID=45210 |
| ALDE          | 90  | PL B241 600                  | D.M. Alde <i>et al.</i>         | (SERP, BELG, LANL, LAPP+)   | REFID=40935 |
| OEST          | 90  | ZPHY C47 343                 | T. Oest <i>et al.</i>           | (JADE Collab.)              | REFID=41358 |
| ALDE          | 87  | PL B198 286                  | D.M. Alde <i>et al.</i>         | (LANL, BRUX, SERP, LAPP)    | REFID=40221 |
| AUGUSTIN      | 87  | ZPHY C36 369                 | J.E. Augustin <i>et al.</i>     | (LALO, CLER, FRAS+)         | REFID=40268 |
| BALTRUSAIT... | 87  | PR D35 2077                  | R.M. Baltrusaitis <i>et al.</i> | (Mark III Collab.)          | REFID=40010 |
| ALDE          | 86D | NP B269 485                  | D.M. Alde <i>et al.</i>         | (BELG, LAPP, SERP, CERN+)   | REFID=20765 |
| ALTHOFF       | 85B | ZPHY C29 189                 | M. Althoff <i>et al.</i>        | (TASSO Collab.)             | REFID=21349 |
| BINON         | 84B | LNC 39 41                    | F.G. Binon <i>et al.</i>        | (SERP, BELG, LAPP)          | REFID=21780 |
| BINON         | 83C | SJNP 38 723                  | F.G. Binon <i>et al.</i>        | (SERP, BRUX+)               | REFID=40288 |
|               |     | Translated from YAF 38 1199. |                                 |                             |             |
| DENNEY        | 83  | PR D28 2726                  | D.L. Denney <i>et al.</i>       | (IOWA, MICH)                | REFID=20754 |
| CASON         | 82  | PRL 48 1316                  | N.M. Cason <i>et al.</i>        | (NDAM, ANL)                 | REFID=20746 |
| ETKIN         | 82B | PR D25 1786                  | A. Etkin <i>et al.</i>          | (BNL, CUNY, TUFTS, VAND)    | REFID=20390 |
| ALPER         | 80  | PL 94B 422                   | B. Alper <i>et al.</i>          | (AMST, CERN, CRAC, MPIM+)   | REFID=21665 |
| ROZANSKA      | 80  | NP B162 505                  | M. Rozanska <i>et al.</i>       | (MPIM, CERN)                | REFID=21774 |
| CORDEN        | 79  | NP B157 250                  | M.J. Corden <i>et al.</i>       | (BIRM, RHEL, TELA+)         | REFID=20374 |
| EVANGELIS...  | 79B | NP B154 381                  | C. Evangelista <i>et al.</i>    | (BARI, BONN, CERN+)         | REFID=21967 |
| ANTIPOV       | 77  | NP B119 45                   | Y.M. Antipov <i>et al.</i>      | (SERP, GEVA)                | REFID=20728 |
| APEL          | 75  | PL 57B 398                   | W.D. Apel <i>et al.</i>         | (KARLK, KARLE, PISA, SERP+) | REFID=20720 |
| BLUM          | 75  | PL 57B 403                   | W. Blum <i>et al.</i>           | (CERN, MPIM)                | REFID=21651 |

$\pi_2(2100)$

$I^G(J^{PC}) = 1^-(2^-+)$

OMITTED FROM SUMMARY TABLE  
Needs confirmation.

NODE=M020

NODE=M020

NODE=M020M

NODE=M020M

NODE=M020M;LINKAGE=AX  
NODE=M020M;LINKAGE=L

NODE=M020W

NODE=M020W

NODE=M020W;LINKAGE=AX  
NODE=M020W;LINKAGE=L

NODE=M020215;NODE=M020

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=2;OUR EST;→ UNCHECKED ←  
DESIG=3;OUR EST;→ UNCHECKED ←  
DESIG=4;OUR EST;→ UNCHECKED ←

NODE=M020220

NODE=M020R1  
NODE=M020R1

NODE=M020R2  
NODE=M020R2

NODE=M020R3  
NODE=M020R3

NODE=M020R4  
NODE=M020R4

NODE=M020R;LINKAGE=L

NODE=M020

REFID=44433  
REFID=20872

| $\pi_2(2100)$ MASS                                                             |                     |          |                                              |  |
|--------------------------------------------------------------------------------|---------------------|----------|----------------------------------------------|--|
| VALUE (MeV)                                                                    | DOCUMENT ID         | TECN     | COMMENT                                      |  |
| <b>2090<math>\pm</math> 29 OUR AVERAGE</b>                                     |                     |          |                                              |  |
| 2090 $\pm$ 30                                                                  | <sup>1</sup> AMELIN | 95B VES  | 36 $\pi^- A \rightarrow \pi^+ \pi^- \pi^- A$ |  |
| 2100 $\pm$ 150                                                                 | <sup>2</sup> DAUM   | 81B CNTR | 63,94 $\pi^- p \rightarrow 3\pi X$           |  |
| <sup>1</sup> From a fit to $J^{PC} = 2^- + f_2(1270)\pi, (\pi\pi)_S\pi$ waves. |                     |          |                                              |  |
| <sup>2</sup> From a two-resonance fit to four $2^-0^+$ waves.                  |                     |          |                                              |  |

| $\pi_2(2100)$ WIDTH                                                           |                                     |          |                                              |  |
|-------------------------------------------------------------------------------|-------------------------------------|----------|----------------------------------------------|--|
| VALUE (MeV)                                                                   | DOCUMENT ID                         | TECN     | COMMENT                                      |  |
| <b>625± 50 OUR AVERAGE</b>                                                    | Error includes scale factor of 1.2. |          |                                              |  |
| 520±100                                                                       | <sup>3</sup> AMELIN                 | 95B VES  | $36 \pi^- A \rightarrow \pi^+ \pi^- \pi^- A$ |  |
| 651± 50                                                                       | <sup>4</sup> DAUM                   | 81B CNTR | $63,94 \pi^- p \rightarrow 3\pi X$           |  |
| <sup>3</sup> From a fit to $J^{PC} = 2^-+ f_2(1270)\pi, (\pi\pi)_S\pi$ waves. |                                     |          |                                              |  |
| <sup>4</sup> From a two-resonance fit to four $2^-0^+$ waves.                 |                                     |          |                                              |  |

| $\pi_2(2100)$ DECAY MODES  |                                |  |
|----------------------------|--------------------------------|--|
| Mode                       | Fraction ( $\Gamma_i/\Gamma$ ) |  |
| $\Gamma_1$ $3\pi$          | seen                           |  |
| $\Gamma_2$ $\rho\pi$       | seen                           |  |
| $\Gamma_3$ $f_2(1270)\pi$  | seen                           |  |
| $\Gamma_4$ $(\pi\pi)_s\pi$ | seen                           |  |

| $\pi_2(2100)$ BRANCHING RATIOS                                                   |                   |          |                 |                     |
|----------------------------------------------------------------------------------|-------------------|----------|-----------------|---------------------|
| $\Gamma(\rho\pi)/\Gamma(3\pi)$                                                   |                   |          |                 | $\Gamma_2/\Gamma_1$ |
| VALUE                                                                            | DOCUMENT ID       | TECN     | COMMENT         |                     |
| <b>0.19±0.05</b>                                                                 | <sup>5</sup> DAUM | 81B CNTR | 63,94 $\pi^- p$ |                     |
| $\Gamma(f_2(1270)\pi)/\Gamma(3\pi)$                                              |                   |          |                 | $\Gamma_3/\Gamma_1$ |
| VALUE                                                                            | DOCUMENT ID       | TECN     | COMMENT         |                     |
| <b>0.36±0.09</b>                                                                 | <sup>5</sup> DAUM | 81B CNTR | 63,94 $\pi^- p$ |                     |
| $\Gamma((\pi\pi)_s\pi)/\Gamma(3\pi)$                                             |                   |          |                 | $\Gamma_4/\Gamma_1$ |
| VALUE                                                                            | DOCUMENT ID       | TECN     | COMMENT         |                     |
| <b>0.45±0.07</b>                                                                 | <sup>5</sup> DAUM | 81B CNTR | 63,94 $\pi^- p$ |                     |
| <b>D-wave/S-wave RATIO FOR <math>\pi_2(2100) \rightarrow f_2(1270)\pi</math></b> |                   |          |                 |                     |
| VALUE                                                                            | DOCUMENT ID       | TECN     | COMMENT         |                     |
| <b>0.39±0.23</b>                                                                 | <sup>5</sup> DAUM | 81B CNTR | 63,94 $\pi^- p$ |                     |
| <sup>5</sup> From a two-resonance fit to four $2^-0^+$ waves.                    |                   |          |                 |                     |

| $\pi_2(2100)$ REFERENCES |     |             |                           |                           |
|--------------------------|-----|-------------|---------------------------|---------------------------|
| AMELIN                   | 95B | PL B356 595 | D.V. Amelin <i>et al.</i> | (SERP, TBIL)              |
| DAUM                     | 81B | NP B182 269 | C. Daum <i>et al.</i>     | (AMST, CERN, CRAC, MPIM+) |

$f_0(2100)$ 

$$J^G(J^{PC}) = 0^+(0^{++})$$

OMITTED FROM SUMMARY TABLE

Needs confirmation.

NODE=M168

NODE=M168

NODE=M168M

NODE=M168M

 $f_0(2100)$  MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**2086<sup>+20</sup><sub>-24</sub> OUR AVERAGE**

|                                                                               |      |                        |          |                                                                                        |
|-------------------------------------------------------------------------------|------|------------------------|----------|----------------------------------------------------------------------------------------|
| 2081±13 <sup>+24</sup> <sub>-36</sub>                                         | 5.5k | <sup>1</sup> ABLIKIM   | 13N BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$                                 |
| 2090±30                                                                       |      | BAI                    | 00A BES  | $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^+\pi^-)$                                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |          |                                                                                        |
| 2090±10±6                                                                     | 529  | <sup>2,3</sup> DOBBS   | 15       | $J/\psi \rightarrow \gamma\pi^+\pi^-$                                                  |
| 2099±17±8                                                                     | 283  | <sup>2,3</sup> DOBBS   | 15       | $\psi(2S) \rightarrow \gamma\pi^+\pi^-$                                                |
| 2105±8                                                                        | 80k  | <sup>4</sup> UMAN      | 06 E835  | $5.2 \bar{p}p \rightarrow \eta\eta\pi^0$                                               |
| 2102±13                                                                       |      | <sup>5</sup> ANISOVICH | 00J SPEC | $2.0 \bar{p}p \rightarrow \eta\pi^0\pi^0, \pi^0\pi^0, \eta\eta, \eta\eta', \pi^+\pi^-$ |
| 2105±10                                                                       |      | ANISOVICH              | 99K SPEC | $0.6-1.94 \bar{p}p \rightarrow \eta\eta, \eta\eta'$                                    |
| ~ 2104                                                                        |      | BUGG                   | 95       | $J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$                                        |
| ~ 2122                                                                        |      | HASAN                  | 94 RVUE  | $\bar{p}p \rightarrow \pi\pi$                                                          |

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

<sup>2</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>3</sup> From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 209$  MeV.

<sup>4</sup> Statistical error only.

<sup>5</sup> Includes the data of ANISOVICH 00B indicating to exotic decay pattern.

OCCUR=2

NODE=M168M;LINKAGE=A

NODE=M168M;LINKAGE=B

NODE=M168M;LINKAGE=C

NODE=M168M;LINKAGE=ST

NODE=M168M;LINKAGE=AN

 $f_0(2100)$  WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**284<sup>+60</sup><sub>-32</sub> OUR AVERAGE**

|                                                                               |      |                        |          |                                                                                        |
|-------------------------------------------------------------------------------|------|------------------------|----------|----------------------------------------------------------------------------------------|
| 273 <sup>+27</sup> <sub>-24</sub> <sup>+70</sup> <sub>-23</sub>               | 5.5k | <sup>6</sup> ABLIKIM   | 13N BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\eta\eta$                                 |
| 330±100                                                                       |      | BAI                    | 00A BES  | $J/\psi \rightarrow \gamma(\pi^+\pi^-\pi^+\pi^-)$                                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |          |                                                                                        |
| 236±14                                                                        | 80k  | <sup>7</sup> UMAN      | 06 E835  | $5.2 \bar{p}p \rightarrow \eta\eta\pi^0$                                               |
| 211±29                                                                        |      | <sup>8</sup> ANISOVICH | 00J SPEC | $2.0 \bar{p}p \rightarrow \eta\pi^0\pi^0, \pi^0\pi^0, \eta\eta, \eta\eta', \pi^+\pi^-$ |
| 200±25                                                                        |      | ANISOVICH              | 99K SPEC | $0.6-1.94 \bar{p}p \rightarrow \eta\eta, \eta\eta'$                                    |
| ~ 203                                                                         |      | BUGG                   | 95       | $J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$                                        |
| ~ 273                                                                         |      | HASAN                  | 94 RVUE  | $\bar{p}p \rightarrow \pi\pi$                                                          |

<sup>6</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

<sup>7</sup> Statistical error only.

<sup>8</sup> Includes the data of ANISOVICH 00B indicating to exotic decay pattern.

NODE=M168W

NODE=M168W

NODE=M168W;LINKAGE=A

NODE=M168W;LINKAGE=ST

NODE=M168W;LINKAGE=AN

 $f_0(2100)$  REFERENCES

|           |     |               |                              |                    |
|-----------|-----|---------------|------------------------------|--------------------|
| DOBBS     | 15  | PR D91 052006 | S. Dobbs <i>et al.</i>       | (NWES)             |
| ABLIKIM   | 13N | PR D87 092009 | Ablikim M. <i>et al.</i>     | (BESIII Collab.)   |
| UMAN      | 06  | PR D73 052009 | I. Uman <i>et al.</i>        | (FNAL E835)        |
| ANISOVICH | 00B | NP A662 319   | A.V. Anisovich <i>et al.</i> |                    |
| ANISOVICH | 00J | PL B491 47    | A.V. Anisovich <i>et al.</i> | (RAL, LOQM, PNPI+) |
| BAI       | 00A | PL B472 207   | J.Z. Bai <i>et al.</i>       | (BES Collab.)      |
| ANISOVICH | 99K | PL B468 309   | A.V. Anisovich <i>et al.</i> |                    |
| BUGG      | 95  | PL B353 378   | D.V. Bugg <i>et al.</i>      | (LOQM, PNPI, WASH) |
| HASAN     | 94  | PL B334 215   | A. Hasan, D.V. Bugg          | (LOQM)             |

NODE=M168

REFID=56805

REFID=55387

REFID=51063

REFID=47942

REFID=47950

REFID=47426

REFID=47472

REFID=44438

REFID=44103

**$f_2(2150)$** 

$$I^G(J^{PC}) = 0^+(2^{++})$$

OMITTED FROM SUMMARY TABLE

This entry was previously called  $T_0$ .

NODE=M042

NODE=M042

NODE=M042205

NODE=M042M  
NODE=M042M

NODE=M042M;LINKAGE=ST

NODE=M042M3  
NODE=M042M3NODE=M042M3;LINKAGE=K3  
NODE=M042M3;LINKAGE=ANODE=M042M4  
NODE=M042M4

NODE=M042M4;LINKAGE=AD

NODE=M042M1  
NODE=M042M1

OCCUR=2

NODE=M042M1;LINKAGE=B

NODE=M042M1;LINKAGE=BB  
NODE=M042M1;LINKAGE=P  
NODE=M042M1;LINKAGE=LNODE=M042M2  
NODE=M042M2NODE=M042M2;LINKAGE=I  
NODE=M042M2;LINKAGE=E  
NODE=M042M2;LINKAGE=M **$f_2(2150)$  MASS** **$f_2(2150)$  MASS, COMBINED MODES (MeV)**

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**2157±12 OUR AVERAGE** Includes data from the datablock that follows this one.

• • • We do not use the following data for averages, fits, limits, etc. • • •

2170±6      80k      <sup>1</sup> UMAN      06      E835      5.2  $\bar{p}p \rightarrow \eta\eta\pi^0$ <sup>1</sup> Statistical error only. **$\eta\eta$  MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

The data in this block is included in the average printed for a previous datablock.

**2157±12 OUR AVERAGE**

|         |            |     |                                                                                 |
|---------|------------|-----|---------------------------------------------------------------------------------|
| 2151±16 | BARBERIS   | 00E | 450 $pp \rightarrow pf\eta\eta p_S$                                             |
| 2175±20 | PROKOSHKIN | 95D | GAM4 300 $\pi^- N \rightarrow \pi^- N 2\eta$ ,<br>450 $pp \rightarrow pp 2\eta$ |
| 2130±35 | SINGOVSKI  | 94  | GAM4 450 $pp \rightarrow pp 2\eta$                                              |

• • • We do not use the following data for averages, fits, limits, etc. • • •

2140±30      <sup>2</sup> ABELE      99B      CBAR      1.94  $\bar{p}p \rightarrow \pi^0\eta\eta$ 2104±20      <sup>3</sup> ARMSTRONG      93C      E760       $\bar{p}p \rightarrow \pi^0\eta\eta \rightarrow 6\gamma$ <sup>2</sup> Spin not determined.<sup>3</sup> No  $J^{PC}$  determination. **$\eta\pi\pi$  MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

2135±20±45      <sup>4</sup> ADOMEIT      96      CBAR      0      1.94  $\bar{p}p \rightarrow \eta 3\pi^0$ <sup>4</sup> ANISOVICH 00E recommends to withdraw ADOMEIT 96 that assumed a single  $J^P = 2^+$  resonance. **$\bar{p}p \rightarrow \pi\pi$** 

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

~ 2090      <sup>5</sup> OAKDEN      94      RVUE      0.36–1.55  $\bar{p}p \rightarrow \pi\pi$ ~ 2120      <sup>6</sup> OAKDEN      94      RVUE      0.36–1.55  $\bar{p}p \rightarrow \pi\pi$ ~ 2170      <sup>7</sup> MARTIN      80B      RVUE~ 2150      <sup>7</sup> MARTIN      80C      RVUE~ 2150      <sup>8</sup> DULUDE      78B      OSPK      1–2  $\bar{p}p \rightarrow \pi^0\pi^0$ <sup>5</sup> OAKDEN 94 makes an amplitude analysis of LEAR data on  $\bar{p}p \rightarrow \pi\pi$  using a method based on Barrelet zeros. This is solution A. The amplitude analysis of HASAN 94 includes earlier data as well, and assume that the data can be parametrized in terms of towers of nearly degenerate resonances on the leading Regge trajectory. See also KLOET 96 and MARTIN 97 who make related analyses.<sup>6</sup> From solution B of amplitude analysis of data on  $\bar{p}p \rightarrow \pi\pi$ .<sup>7</sup>  $I(J^P) = 0(2^+)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^-\pi^+$  and  $\pi^0\pi^0$ .<sup>8</sup>  $I^G(J^P) = 0^+(2^+)$  from partial-wave amplitude analysis.**S-CHANNEL  $\bar{p}p$ ,  $\bar{N}N$  or  $\bar{K}K$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

2139<sup>+8</sup><sub>-9</sub>      <sup>9</sup> EVANGELIS...      97      SPEC      0.6–2.4  $\bar{p}p \rightarrow K_S^0 K_S^0$ ~ 2190      <sup>9</sup> CUTTS      78B      CNTR      0.97–3  $\bar{p}p \rightarrow \bar{N}N$ 2155±15      <sup>9,10</sup> COUPLAND      77      CNTR      0      0.7–2.4  $\bar{p}p \rightarrow \bar{p}p$ 2193±2      <sup>9,11</sup> ALSPECTOR      73      CNTR       $\bar{p}p$  S channel<sup>9</sup> Isospins 0 and 1 not separated.<sup>10</sup> From a fit to the total elastic cross section.<sup>11</sup> Referred to as  $T$  or  $T$  region by ALSPECTOR 73.



**$K\bar{K}$  MODE**

| VALUE (MeV)                                                                   | DOCUMENT ID     | TECN     | COMMENT                                |
|-------------------------------------------------------------------------------|-----------------|----------|----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                 |          |                                        |
| $2200 \pm 13$                                                                 | VLADIMIRSK...06 | SPEC     | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$ |
| $2150 \pm 20$                                                                 | ABLIKIM         | 04E BES2 | $J/\psi \rightarrow \omega K^+ K^-$    |
| $2130 \pm 35$                                                                 | BARBERIS        | 99 OMEG  | $450 p p \rightarrow p_s p_f K^+ K^-$  |

NODE=M042M5  
NODE=M042M5

 **$f_2(2150)$  WIDTH**

NODE=M042210

 **$f_2(2150)$  WIDTH, COMBINED MODES (MeV)**

**152 $\pm$ 30 OUR AVERAGE** Includes data from the datablock that follows this one. Error includes scale factor of 1.4. See the ideogram below.

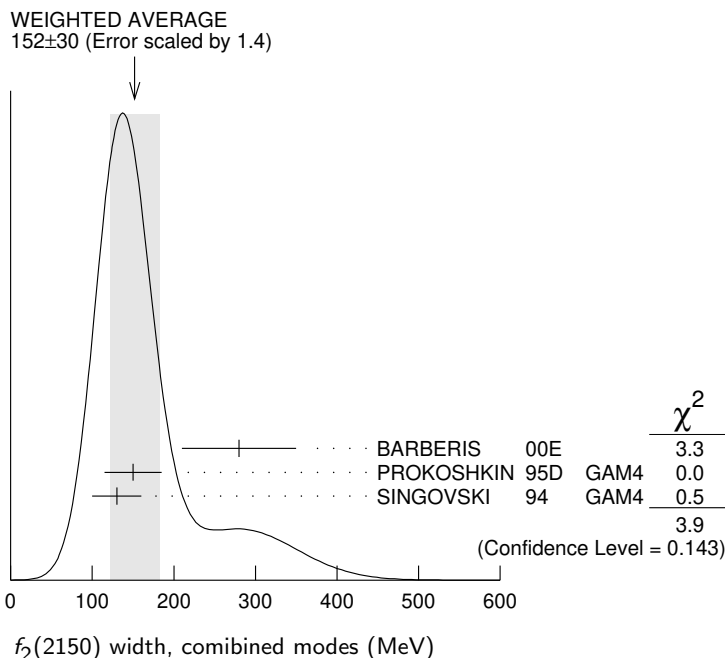
NODE=M042W  
NODE=M042W

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |     |                    |    |      |                                             |
|--------------|-----|--------------------|----|------|---------------------------------------------|
| $182 \pm 11$ | 80k | <sup>12</sup> UMAN | 06 | E835 | $5.2 \bar{p} p \rightarrow \eta \eta \pi^0$ |
|--------------|-----|--------------------|----|------|---------------------------------------------|

<sup>12</sup> Statistical error only.

NODE=M042W;LINKAGE=ST

 **$\eta\eta$  MODE**

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

NODE=M042W3  
NODE=M042W3

The data in this block is included in the average printed for a previous datablock.

**152 $\pm$ 30 OUR AVERAGE** Error includes scale factor of 1.4. See the ideogram below.

|              |                |      |                                                                             |
|--------------|----------------|------|-----------------------------------------------------------------------------|
| $280 \pm 70$ | BARBERIS       | 00E  | $450 p p \rightarrow p_f \eta \eta p_s$                                     |
| $150 \pm 35$ | PROKOSHKIN 95D | GAM4 | $300 \pi^- N \rightarrow \pi^- N 2\eta,$<br>$450 p p \rightarrow p p 2\eta$ |
| $130 \pm 30$ | SINGOVSKI 94   | GAM4 | $450 p p \rightarrow p p 2\eta$                                             |

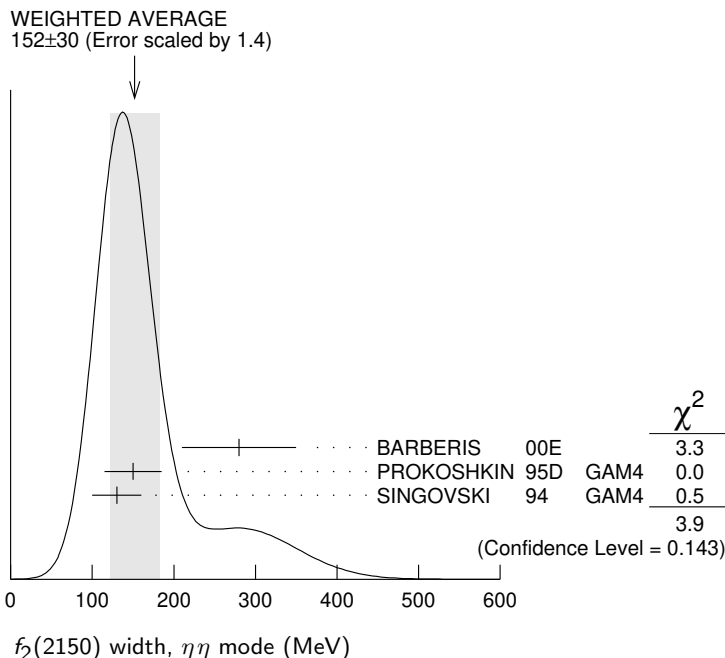
• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |                         |     |      |                                                             |
|--------------|-------------------------|-----|------|-------------------------------------------------------------|
| $310 \pm 50$ | <sup>13</sup> ABELE     | 99B | CBAR | $1.94 \bar{p} p \rightarrow \pi^0 \eta \eta$                |
| $203 \pm 10$ | <sup>14</sup> ARMSTRONG | 93C | E760 | $\bar{p} p \rightarrow \pi^0 \eta \eta \rightarrow 6\gamma$ |

<sup>13</sup> Spin not determined.

<sup>14</sup> No  $J^{PC}$  determination.

NODE=M042W3;LINKAGE=K3  
NODE=M042W3;LINKAGE=A



### $\eta\pi\pi$ MODE

| VALUE (MeV)                                                                                                | DOCUMENT ID           | TECN | CHG  | COMMENT                                   |
|------------------------------------------------------------------------------------------------------------|-----------------------|------|------|-------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                              |                       |      |      |                                           |
| 250±25±45                                                                                                  | <sup>15</sup> ADOMEIT | 96   | CBAR | 0 1.94 $\bar{p}p \rightarrow \eta 3\pi^0$ |
| <sup>15</sup> ANISOVICH 00E recommends to withdraw ADOMEIT 96 that assumed a single $J^P = 2^+$ resonance. |                       |      |      |                                           |

NODE=M042W4  
NODE=M042W4

NODE=M042W4;LINKAGE=AD

### $\bar{p}p \rightarrow \pi\pi$

| VALUE (MeV)                                                                                                                                    | DOCUMENT ID          | TECN | COMMENT                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|----------------------------------------------|
| <b>250 OUR ESTIMATE</b>                                                                                                                        |                      |      |                                              |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                  |                      |      |                                              |
| ~ 70                                                                                                                                           | <sup>16</sup> OAKDEN | 94   | RVUE 0.36–1.55 $\bar{p}p \rightarrow \pi\pi$ |
| ~ 250                                                                                                                                          | <sup>17</sup> MARTIN | 80B  | RVUE                                         |
| ~ 250                                                                                                                                          | <sup>17</sup> MARTIN | 80C  | RVUE                                         |
| ~ 250                                                                                                                                          | <sup>18</sup> DULUDE | 78B  | OSPK 1–2 $\bar{p}p \rightarrow \pi^0\pi^0$   |
| <sup>16</sup> See however KLOET 96 who fit $\pi^+\pi^-$ only and find waves only up to $J = 3$ to be important but not significantly resonant. |                      |      |                                              |
| <sup>17</sup> $I(J^P) = 0(2^+)$ from simultaneous analysis of $p\bar{p} \rightarrow \pi^-\pi^+$ and $\pi^0\pi^0$ .                             |                      |      |                                              |
| <sup>18</sup> $I^G(J^P) = 0^+(2^+)$ from partial-wave amplitude analysis.                                                                      |                      |      |                                              |

NODE=M042W1  
NODE=M042W1  
→ UNCHECKED ←

NODE=M042W1;LINKAGE=CC

NODE=M042W1;LINKAGE=P  
NODE=M042W1;LINKAGE=L

### S-CHANNEL $\bar{p}p$ , $\bar{N}N$ or $\bar{K}K$

| VALUE (MeV)                                                                   | DOCUMENT ID                | TECN | CHG  | COMMENT                                    |
|-------------------------------------------------------------------------------|----------------------------|------|------|--------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                            |      |      |                                            |
| 56 <sup>+31</sup> <sub>-16</sub>                                              | <sup>19</sup> EVANGELIS... | 97   | SPEC | 0.6–2.4 $\bar{p}p \rightarrow K_S^0 K_S^0$ |
| 135±75                                                                        | <sup>20,21</sup> COUPLAND  | 77   | CNTR | 0 0.7–2.4 $\bar{p}p \rightarrow \bar{p}p$  |
| 98±8                                                                          | <sup>21</sup> ALSPECTOR    | 73   | CNTR | $\bar{p}p$ S channel                       |
| <sup>19</sup> Isospin 0 and 2 not separated.                                  |                            |      |      |                                            |
| <sup>20</sup> From a fit to the total elastic cross section.                  |                            |      |      |                                            |
| <sup>21</sup> Isospins 0 and 1 not separated.                                 |                            |      |      |                                            |

NODE=M042W2  
NODE=M042W2

NODE=M042W2;LINKAGE=F  
NODE=M042W2;LINKAGE=E  
NODE=M042W2;LINKAGE=I

### $K\bar{K}$ MODE

| VALUE (MeV)                                                                   | DOCUMENT ID     | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|-----------------|------|-------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                 |      |                                                 |
| 91±62                                                                         | VLADIMIRSK...06 | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$          |
| 150±30                                                                        | ABLIKIM         | 04E  | BES2 $J/\psi \rightarrow \omega K^+ K^-$        |
| 270±50                                                                        | BARBERIS        | 99   | OMEG 450 $p\bar{p} \rightarrow p_S p_f K^+ K^-$ |

NODE=M042W5  
NODE=M042W5

**$f_2(2150)$  DECAY MODES**

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $\pi\pi$         |                                |
| $\Gamma_2$ $\eta\eta$       | seen                           |
| $\Gamma_3$ $K\bar{K}$       | seen                           |
| $\Gamma_4$ $f_2(1270)\eta$  | seen                           |
| $\Gamma_5$ $a_2(1320)\pi$   | seen                           |
| $\Gamma_6$ $\rho\bar{\rho}$ | seen                           |

NODE=M042215;NODE=M042

DESIG=1

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4;OUR EST;→ UNCHECKED ←

DESIG=5;OUR EST;→ UNCHECKED ←

DESIG=6

 **$f_2(2150)$  BRANCHING RATIOS**

NODE=M042220

 **$\Gamma(K\bar{K})/\Gamma(\eta\eta)$**   **$\Gamma_3/\Gamma_2$** 

| VALUE            | CL% | DOCUMENT ID | TECN | COMMENT                                      |
|------------------|-----|-------------|------|----------------------------------------------|
| <b>1.28±0.23</b> |     | BARBERIS    | 00E  | 450 $p\bar{p} \rightarrow p_f \eta \eta p_s$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                              |      |                                                                                   |
|------|----|------------------------------|------|-----------------------------------------------------------------------------------|
| <0.1 | 95 | <sup>22</sup> PROKOSHKIN 95D | GAM4 | 300 $\pi^- N \rightarrow \pi^- N 2\eta$ ,<br>450 $p\bar{p} \rightarrow p p 2\eta$ |
|------|----|------------------------------|------|-----------------------------------------------------------------------------------|

<sup>22</sup> Using data from ARMSTRONG 89D.

NODE=M042R1;LINKAGE=A

 **$\Gamma(\pi\pi)/\Gamma(\eta\eta)$**   **$\Gamma_1/\Gamma_2$** 

| VALUE | CL% | DOCUMENT ID                  | TECN | COMMENT                                                                           |
|-------|-----|------------------------------|------|-----------------------------------------------------------------------------------|
| <0.33 | 95  | <sup>23</sup> PROKOSHKIN 95D | GAM4 | 300 $\pi^- N \rightarrow \pi^- N 2\eta$ ,<br>450 $p\bar{p} \rightarrow p p 2\eta$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                              |      |                                                                                   |
|-------|----|------------------------------|------|-----------------------------------------------------------------------------------|
| <0.33 | 95 | <sup>23</sup> PROKOSHKIN 95D | GAM4 | 300 $\pi^- N \rightarrow \pi^- N 2\eta$ ,<br>450 $p\bar{p} \rightarrow p p 2\eta$ |
|-------|----|------------------------------|------|-----------------------------------------------------------------------------------|

<sup>23</sup> Derived from a  $\pi^0\pi^0/\eta\eta$  limit.

NODE=M042R2

NODE=M042R2

NODE=M042R2;LINKAGE=A

 **$\Gamma(f_2(1270)\eta)/\Gamma(a_2(1320)\pi)$**   **$\Gamma_4/\Gamma_5$** 

| VALUE            | DOCUMENT ID              | TECN | COMMENT                                 |
|------------------|--------------------------|------|-----------------------------------------|
| <b>0.79±0.11</b> | <sup>24</sup> ADOMEIT 96 | CBAR | 1.94 $\bar{p}p \rightarrow \eta 3\pi^0$ |

<sup>24</sup> Using  $B(a_2(1320) \rightarrow \eta\pi) = 0.145$ 

NODE=M042R3

NODE=M042R3

NODE=M042R3;LINKAGE=A

 **$\Gamma(\rho\bar{\rho})/\Gamma_{\text{total}}$**   **$\Gamma_6/\Gamma$** 

| VALUE       | EVTS | DOCUMENT ID  | TECN | COMMENT                                |
|-------------|------|--------------|------|----------------------------------------|
| <b>seen</b> | 73   | ALEXANDER 10 | CLEO | $\psi(2S) \rightarrow \gamma p\bar{p}$ |

NODE=M042R04

NODE=M042R04

 **$f_2(2150)$  REFERENCES**

NODE=M042

|                  |                               |                                  |                          |
|------------------|-------------------------------|----------------------------------|--------------------------|
| ALEXANDER 10     | PR D82 092002                 | J.P. Alexander <i>et al.</i>     | (CLEO Collab.)           |
| UMAN 06          | PR D73 052009                 | I. Uman <i>et al.</i>            | (FNAL E835)              |
| VLADIMIRSK... 06 | PAN 69 493                    | V.V. Vladimirovsky <i>et al.</i> | (ITEP, Moscow)           |
|                  | Translated from YAF 69 515.   |                                  |                          |
| ABLIKIM 04E      | PL B603 138                   | M. Ablikim <i>et al.</i>         | (BES Collab.)            |
| ANISOVICH 00E    | PL B477 19                    | A.V. Anisovich <i>et al.</i>     |                          |
| BARBERIS 00E     | PL B479 59                    | D. Barberis <i>et al.</i>        | (WA 102 Collab.)         |
| ABELE 99B        | EPJ C8 67                     | A. Abele <i>et al.</i>           | (Crystal Barrel Collab.) |
| BARBERIS 99      | PL B453 305                   | D. Barberis <i>et al.</i>        | (Omega Expt.)            |
| EVANGELIS... 97  | PR D56 3803                   | C. Evangelista <i>et al.</i>     | (LEAR Collab.)           |
| MARTIN 97        | PR C56 1114                   | B.R. Martin, G.C. Oades          | (LOUC, AARH)             |
| ADOMEIT 96       | ZPHY C71 227                  | J. Adomeit <i>et al.</i>         | (Crystal Barrel Collab.) |
| KLOET 96         | PR D53 6120                   | W.M. Kloet, F. Myhrer            | (RUTG, NORD)             |
| PROKOSHKIN 95D   | PD 40 495                     | Y.D. Prokoshkin                  | (SERP) IGJPC             |
|                  | Translated from DANS 344 469. |                                  |                          |
| HASAN 94         | PL B334 215                   | A. Hasan, D.V. Bugg              | (LOQM)                   |
| OAKDEN 94        | NP A574 731                   | M.N. Oakden, M.R. Pennington     | (DURH)                   |
| SINGOVSKI 94     | NC A107 1911                  | A.V. Singovsky                   | (SERP)                   |
| ARMSTRONG 93C    | PL B307 394                   | T.A. Armstrong <i>et al.</i>     | (FNAL, FERR, GENO+)      |
| ARMSTRONG 89D    | PL B227 186                   | T.A. Armstrong, M. Benayoun      | (ATHU, BARI, BIRM+)      |
| MARTIN 80B       | NP B176 355                   | B.R. Martin, D. Morgan           | (LOUC, RHEL) JP          |
| MARTIN 80C       | NP B169 216                   | A.D. Martin, M.R. Pennington     | (DURH) JP                |
| CUTTS 78B        | PR D17 16                     | D. Cutts <i>et al.</i>           | (STON, WISC)             |
| DULUDE 78B       | PL 79B 335                    | R.S. Dulude <i>et al.</i>        | (BROW, MIT, BARI) JP     |
| COUPLAND 77      | PL 71B 460                    | M. Coupland <i>et al.</i>        | (LOQM, RHEL)             |
| ALSPECTOR 73     | PRL 30 511                    | J. Alspector <i>et al.</i>       | (RUTG, UPNJ)             |

REFID=53525

REFID=51063

REFID=51191

REFID=50174

REFID=47945

REFID=47961

REFID=46904

REFID=46921

REFID=45687

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REFID=44648

REFID=43587

REFID=41010

REFID=21838

REFID=21837

REFID=21733

REFID=21850

REFID=21830

REFID=21813

**$\rho(2150)$** 

$$I^G(J^{PC}) = 1^+(1^--)$$

OMITTED FROM SUMMARY TABLE

This entry was previously called  $T_1(2190)$ . See our mini-review under the  $\rho(1700)$ .

NODE=M032

NODE=M032

 **$\rho(2150)$  MASS**

NODE=M032205

 **$e^+e^-$  PRODUCED**NODE=M032M3  
NODE=M032M3

| VALUE (MeV)                                                                                                | EVTs | DOCUMENT ID          | TECN      | COMMENT                                                      |
|------------------------------------------------------------------------------------------------------------|------|----------------------|-----------|--------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                              |      |                      |           |                                                              |
| 2034 $\pm 13$ $\pm 9$                                                                                      |      | <sup>1</sup> ABLIKIM | 21A BES3  | $e^+e^- \rightarrow \omega\pi^0$                             |
| 2255 $\begin{smallmatrix} +17 \\ -18 \end{smallmatrix}$ $\begin{smallmatrix} +50 \\ -41 \end{smallmatrix}$ | 1.8k | <sup>2</sup> ABLIKIM | 20F BES3  | $\psi(2S) \rightarrow K^+K^-\eta$                            |
| 2201 $\pm 19$                                                                                              |      | <sup>3</sup> LEES    | 20 BABR   | $e^+e^- \rightarrow K^+K^-\gamma$                            |
| 2227 $\pm 9$ $\pm 9$                                                                                       |      | <sup>4</sup> LEES    | 20 RVUE   | $e^+e^- \rightarrow K^+K^-$                                  |
| 2039 $\pm 8$ $\begin{smallmatrix} +36 \\ -18 \end{smallmatrix}$                                            |      | <sup>5</sup> ABLIKIM | 19AQ BES  | $J/\psi \rightarrow K^+K^-\pi^0$                             |
| 2239.2 $\pm 7.1$ $\pm 11.3$                                                                                |      | <sup>6</sup> ABLIKIM | 19L BES3  | $e^+e^- \rightarrow K^+K^-$                                  |
| 2254 $\pm 22$                                                                                              |      | <sup>7</sup> LEES    | 12G BABR  | $e^+e^- \rightarrow \pi^+\pi^-\gamma$                        |
| 2150 $\pm 40$ $\pm 50$                                                                                     |      | AUBERT               | 07AU BABR | 10.6 $e^+e^- \rightarrow f_1(1285)\pi^+\pi^-\gamma$          |
| 1990 $\pm 80$                                                                                              |      | AUBERT               | 07AU BABR | 10.6 $e^+e^- \rightarrow \eta'\pi^+\pi^-\gamma$              |
| 2153 $\pm 37$                                                                                              |      | BIAGINI              | 91 RVUE   | $e^+e^- \rightarrow \pi^+\pi^-$ ,<br>$K^+K^-$                |
| 2110 $\pm 50$                                                                                              |      | <sup>8</sup> CLEGG   | 90 RVUE   | $e^+e^- \rightarrow 3(\pi^+\pi^-)$ ,<br>$2(\pi^+\pi^-\pi^0)$ |

OCCUR=2

OCCUR=2

<sup>1</sup> From a fit to the cross section between 2.00 and 3.08 GeV with a coherent sum of Breit-Wigner amplitudes, including contributions from  $\rho(770)$ ,  $\rho(1450)$  and  $\rho(1700)$ . Could be another state.

<sup>2</sup> Seen in  $\psi(2S)$  decay with branching ratio  $\psi(2S) \rightarrow X\eta \rightarrow K^+K^-\eta = (21.7 \pm 1.9 \pm 7.7) \times 10^{-6}$ .

<sup>3</sup> From the fit to the BABAR data of LEES 13Q assuming a coherent sum of a single Breit-Wigner resonance and a nonresonant contribution. The resonance significance is  $3.5\sigma$ .

<sup>4</sup> From the fit to the BABAR data of LEES 13Q and BESIII data of ABLIKIM 19L assuming a coherent sum of a single Breit-Wigner resonance and a nonresonant contribution.

<sup>5</sup> Could also be another state. Seen in  $J/\psi$  decay with branching ratio  $J/\psi \rightarrow X\pi^0 \rightarrow K^+K^-\pi^0 = (6.7 \pm 1.1 \pm 2.2) \times 10^{-6}$ .

<sup>6</sup> The observed structure can be due to both the  $\phi(2170)$  and  $\rho(2150)$ .

<sup>7</sup> Using the GOUNARIS 68 parametrization of the pion form factor leaving the masses and widths of the  $\rho(1450)$ ,  $\rho(1700)$ , and  $\rho(2150)$  resonances as free parameters of the fit.

<sup>8</sup> Includes ATKINSON 85.

NODE=M032M3;LINKAGE=G

NODE=M032M3;LINKAGE=F

NODE=M032M3;LINKAGE=C

NODE=M032M3;LINKAGE=D

NODE=M032M3;LINKAGE=B

NODE=M032M3;LINKAGE=E

NODE=M032M3;LINKAGE=LE

NODE=M032M3;LINKAGE=A

 **$\bar{p}p \rightarrow \pi\pi$** NODE=M032M1  
NODE=M032M1

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN     | COMMENT                                 |
|-------------------------------------------------------------------------------|---------------------|----------|-----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |          |                                         |
| $\sim 2191$                                                                   | HASAN               | 94 RVUE  | $\bar{p}p \rightarrow \pi\pi$           |
| $\sim 2070$                                                                   | <sup>1</sup> OAKDEN | 94 RVUE  | 0.36–1.55 $\bar{p}p \rightarrow \pi\pi$ |
| $\sim 2170$                                                                   | <sup>2</sup> MARTIN | 80B RVUE |                                         |
| $\sim 2100$                                                                   | <sup>2</sup> MARTIN | 80C RVUE |                                         |

<sup>1</sup> See however KLOET 96 who fit  $\pi^+\pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.

<sup>2</sup>  $I(J^P) = 1(1^-)$  from simultaneous analysis of  $\bar{p}p \rightarrow \pi^-\pi^+$  and  $\pi^0\pi^0$ .

NODE=M032M1;LINKAGE=CC

NODE=M032M;LINKAGE=P

**S-CHANNEL  $\bar{N}N$** NODE=M032M2  
NODE=M032M2

| VALUE (MeV)                                                                   | DOCUMENT ID              | TECN     | COMMENT                                                                 |
|-------------------------------------------------------------------------------|--------------------------|----------|-------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |          |                                                                         |
| 2110 $\pm 35$                                                                 | <sup>1</sup> ANISOVICH   | 02 SPEC  | 0.6–1.9 $\bar{p}p \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |
| $\sim 2190$                                                                   | <sup>2</sup> CUTTS       | 78B CNTR | 0.97–3 $\bar{p}p \rightarrow \bar{N}N$                                  |
| 2155 $\pm 15$                                                                 | <sup>2,3</sup> COUPLAND  | 77 CNTR  | 0.7–2.4 $\bar{p}p \rightarrow \bar{p}p$                                 |
| 2193 $\pm 2$                                                                  | <sup>2,4</sup> ALSPECTOR | 73 CNTR  | $\bar{p}p$ S channel                                                    |
| 2190 $\pm 10$                                                                 | <sup>5</sup> ABRAMS      | 70 CNTR  | S channel $\bar{p}N$                                                    |

<sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

<sup>2</sup> Isospins 0 and 1 not separated.

<sup>3</sup> From a fit to the total elastic cross section.

<sup>4</sup> Referred to as  $T$  or  $T$  region by ALSPECTOR 73.

<sup>5</sup> Seen as bump in  $I = 1$  state. See also COOPER 68. PEASLEE 75 confirm  $\bar{p}p$  results of ABRAMS 70, no narrow structure.

NODE=M032M;LINKAGE=AY

NODE=M032M;LINKAGE=I

NODE=M032M;LINKAGE=E

NODE=M032M;LINKAGE=M

NODE=M032M;LINKAGE=B

**$\pi^- p \rightarrow \omega \pi^0 n$** 

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                               |
| 2140 ± 30                                                                     | ALDE        | 95   | GAM2 38 $\pi^- p \rightarrow \omega \pi^0 n$  |
| 2170 ± 30                                                                     | ALDE        | 92C  | GAM4 100 $\pi^- p \rightarrow \omega \pi^0 n$ |

NODE=M032M4  
 NODE=M032M4

 **$\rho(2150)$  WIDTH**

NODE=M032210

 **$e^+ e^-$  PRODUCED**

| VALUE (MeV)                                                                   | EPTS | DOCUMENT ID          | TECN      | COMMENT                                                    |
|-------------------------------------------------------------------------------|------|----------------------|-----------|------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |           |                                                            |
| 234 ± 30 ± 25                                                                 | 1.8k | <sup>1</sup> ABLIKIM | 21A BES3  | $e^+ e^- \rightarrow \omega \pi^0$                         |
| 460 <sup>+54</sup> <sub>-48</sub> <sup>+160</sup> <sub>-90</sub>              |      | <sup>2</sup> ABLIKIM | 20F BES3  | $\psi(2S) \rightarrow K^+ K^- \eta$                        |
| 70 ± 38                                                                       |      | <sup>3</sup> LEES    | 20 BABR   | $e^+ e^- \rightarrow K^+ K^- \gamma$                       |
| 127 ± 14 ± 4                                                                  |      | <sup>4</sup> LEES    | 20 RVUE   | $e^+ e^- \rightarrow K^+ K^-$                              |
| 196 ± 23 <sup>+25</sup> <sub>-27</sub>                                        |      | <sup>5</sup> ABLIKIM | 19AQ BES  | $J/\psi \rightarrow K^+ K^- \pi^0$                         |
| 139.8 ± 12.3 ± 20.6                                                           |      | <sup>6</sup> ABLIKIM | 19L BES3  | $e^+ e^- \rightarrow K^+ K^-$                              |
| 109 ± 76                                                                      |      | <sup>7</sup> LEES    | 12G BABR  | $e^+ e^- \rightarrow \pi^+ \pi^- \gamma$                   |
| 350 ± 40 ± 50                                                                 |      | AUBERT               | 07AU BABR | 10.6 $e^+ e^- \rightarrow f_1(1285) \pi^+ \pi^- \gamma$    |
| 310 ± 140                                                                     |      | AUBERT               | 07AU BABR | 10.6 $e^+ e^- \rightarrow \eta' \pi^+ \pi^- \gamma$        |
| 389 ± 79                                                                      |      | BIAGINI              | 91 RVUE   | $e^+ e^- \rightarrow \pi^+ \pi^- , K^+ K^-$                |
| 410 ± 100                                                                     |      | <sup>8</sup> CLEGG   | 90 RVUE   | $e^+ e^- \rightarrow 3(\pi^+ \pi^-), 2(\pi^+ \pi^- \pi^0)$ |

NODE=M032W3  
 NODE=M032W3

OCCUR=2

OCCUR=2

<sup>1</sup> From a fit to the cross section between 2.00 and 3.08 GeV with a coherent sum of Breit-Wigner amplitudes, including contributions from  $\rho(770)$ ,  $\rho(1450)$  and  $\rho(1700)$ . Could be another state.

NODE=M032W3;LINKAGE=G

<sup>2</sup> Seen in  $\psi(2S)$  decay with branching ratio  $\psi(2S) \rightarrow X \eta \rightarrow K^+ K^- \eta = (21.7 \pm 1.9^{+7.7}_{-8.3}) \times 10^{-6}$ .

NODE=M032W3;LINKAGE=F

<sup>3</sup> From the fit to the BABAR data of LEES 13Q assuming a coherent sum of a single Breit-Wigner resonance and a nonresonant contribution. The resonance significance is 3.5  $\sigma$ .

NODE=M032W3;LINKAGE=C

<sup>4</sup> From the fit to the BABAR data of LEES 13Q and BESIII data of ABLIKIM 19L assuming a coherent sum of a single Breit-Wigner resonance and a nonresonant contribution.

NODE=M032W3;LINKAGE=D

<sup>5</sup> Could also be another state. Seen in  $J/\psi$  decay with branching ratio  $J/\psi \rightarrow X \pi^0 \rightarrow K^+ K^- \pi^0 = (6.7 \pm 1.1^{+2.2}_{-1.8}) \times 10^{-6}$ .

NODE=M032W3;LINKAGE=B

<sup>6</sup> The observed structure can be due to both the  $\phi(2170)$  and  $\rho(2150)$ .

NODE=M032W3;LINKAGE=E

<sup>7</sup> Using the GOUNARIS 68 parametrization of the pion form factor leaving the masses and widths of the  $\rho(1450)$ ,  $\rho(1700)$ , and  $\rho(2150)$  resonances as free parameters of the fit.

NODE=M032W3;LINKAGE=LE

<sup>8</sup> Includes ATKINSON 85.

NODE=M032W3;LINKAGE=A

 **$\bar{p} p \rightarrow \pi \pi$** 

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|---------------------|------|------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |      |                                                |
| ~ 296                                                                         | HASAN               | 94   | RVUE $\bar{p} p \rightarrow \pi \pi$           |
| ~ 40                                                                          | <sup>1</sup> OAKDEN | 94   | RVUE 0.36–1.55 $\bar{p} p \rightarrow \pi \pi$ |
| ~ 250                                                                         | <sup>2</sup> MARTIN | 80B  | RVUE                                           |
| ~ 200                                                                         | <sup>2</sup> MARTIN | 80C  | RVUE                                           |

NODE=M032W1  
 NODE=M032W1

<sup>1</sup> See however KLOET 96 who fit  $\pi^+ \pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.

NODE=M032W1;LINKAGE=CC

<sup>2</sup>  $I(J^P) = 1(1^-)$  from simultaneous analysis of  $p \bar{p} \rightarrow \pi^- \pi^+$  and  $\pi^0 \pi^0$ .

NODE=M032W;LINKAGE=P

**S-CHANNEL  $\bar{N} N$** 

| VALUE (MeV)                                                                   | DOCUMENT ID             | TECN | COMMENT                                                                           |
|-------------------------------------------------------------------------------|-------------------------|------|-----------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                         |      |                                                                                   |
| 230 ± 50                                                                      | <sup>1</sup> ANISOVICH  | 02   | SPEC 0.6–1.9 $p \bar{p} \rightarrow \omega \pi^0, \omega \eta \pi^0, \pi^+ \pi^-$ |
| 135 ± 75                                                                      | <sup>2,3</sup> COUPLAND | 77   | CNTR 0.7–2.4 $\bar{p} p \rightarrow \bar{p} p$                                    |
| 98 ± 8                                                                        | <sup>3</sup> ALSPECTOR  | 73   | CNTR $\bar{p} p$ S channel                                                        |
| ~ 85                                                                          | <sup>4</sup> ABRAMS     | 70   | CNTR S channel $\bar{p} N$                                                        |

NODE=M032W2  
 NODE=M032W2

<sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M032W;LINKAGE=AY

<sup>2</sup> From a fit to the total elastic cross section.

NODE=M032W;LINKAGE=E

<sup>3</sup> Isospins 0 and 1 not separated.

NODE=M032W;LINKAGE=I

<sup>4</sup> Seen as bump in  $I = 1$  state. See also COOPER 68. PEASLEE 75 confirm  $\bar{p} p$  results of ABRAMS 70, no narrow structure.

NODE=M032W;LINKAGE=B

$\pi^- p \rightarrow \omega \pi^0 n$ 

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                               |
| $320 \pm 70$                                                                  | ALDE        | 95   | GAM2 $38 \pi^- p \rightarrow \omega \pi^0 n$  |
| $\sim 300$                                                                    | ALDE        | 92C  | GAM4 $100 \pi^- p \rightarrow \omega \pi^0 n$ |

NODE=M032W4  
 NODE=M032W4

 $\rho(2150)$  DECAY MODES

| Mode                               | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------------|--------------------------------|
| $\Gamma_1$ $e^+ e^-$               |                                |
| $\Gamma_2$ $\pi^+ \pi^-$           | seen                           |
| $\Gamma_3$ $K^+ K^-$               | seen                           |
| $\Gamma_4$ $3(\pi^+ \pi^-)$        | seen                           |
| $\Gamma_5$ $2(\pi^+ \pi^- \pi^0)$  | seen                           |
| $\Gamma_6$ $\eta' \pi^+ \pi^-$     | seen                           |
| $\Gamma_7$ $f_1(1285) \pi^+ \pi^-$ | seen                           |
| $\Gamma_8$ $\omega \pi^0$          | seen                           |
| $\Gamma_9$ $\omega \pi^0 \eta$     | seen                           |
| $\Gamma_{10}$ $p \bar{p}$          |                                |

NODE=M032215;NODE=M032

DESIG=1

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=3;OUR EVAL;→ UNCHECKED ←

DESIG=4;OUR EVAL;→ UNCHECKED ←

DESIG=5;OUR EVAL;→ UNCHECKED ←

DESIG=6;OUR EVAL;→ UNCHECKED ←

DESIG=7;OUR EVAL;→ UNCHECKED ←

DESIG=8;OUR EVAL;→ UNCHECKED ←

DESIG=9;OUR EVAL;→ UNCHECKED ←

DESIG=10

 $\rho(2150) \Gamma(i) \Gamma(e^+ e^-) / \Gamma(\text{total})$ 

| $\Gamma(\omega\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$             |             |      |         | $\Gamma_8\Gamma_1/\Gamma$        |
|-------------------------------------------------------------------------------|-------------|------|---------|----------------------------------|
| VALUE (eV)                                                                    | DOCUMENT ID | TECN | COMMENT |                                  |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |      |         |                                  |
| $34 \pm 11 \pm 16$                                                            | ABLIKIM     | 21A  | BES3    | $e^+e^- \rightarrow \omega\pi^0$ |

NODE=M032220

NODE=M032R00  
 NODE=M032R00

 $\rho(2150) \Gamma(i) \Gamma(e^+ e^-) / \Gamma^2(\text{total})$ 

| $\Gamma(f_1(1285)\pi^+\pi^-)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ | $\Gamma_7/\Gamma \times \Gamma_1/\Gamma$ |           |                                                      |
|-------------------------------------------------------------------------------------------------|------------------------------------------|-----------|------------------------------------------------------|
| VALUE (units $10^{-7}$ )                                                                        | DOCUMENT ID                              | TECN      | COMMENT                                              |
| <b><math>3.1 \pm 0.6 \pm 0.5</math></b>                                                         | <sup>1</sup> AUBERT                      | 07AU BABR | $10.6\ e^+e^- \rightarrow f_1(1285)\pi^+\pi^-\gamma$ |

<sup>1</sup> Calculated by us from the reported value of cross section at the peak.

NODE=M032230

NODE=M032G01  
 NODE=M032G01

NODE=M032G01;LINKAGE=AU

| $\Gamma(\eta' \pi^+ \pi^-) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$ | $\Gamma_6 / \Gamma \times \Gamma_1 / \Gamma$ |             |                                                                         |
|----------------------------------------------------------------------------------------------------|----------------------------------------------|-------------|-------------------------------------------------------------------------|
| <i>VALUE (units 10<sup>-8</sup>)</i>                                                               | <i>DOCUMENT ID</i>                           | <i>TECN</i> | <i>COMMENT</i>                                                          |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                      |                                              |             |                                                                         |
| 4.9 ± 1.9                                                                                          | <sup>1</sup> AUBERT                          | 07AU BABR   | 10.6 e <sup>+</sup> e <sup>-</sup> → η' π <sup>+</sup> π <sup>-</sup> γ |
| <sup>1</sup> Calculated by us from the reported value of cross section at the peak.                |                                              |             |                                                                         |

NODE=M032G02  
 NODE=M032G02

NODE=M032G02;LINKAGE=AU

 $\rho(2150)$  REFERENCES

|           |      |                |                              |                          |
|-----------|------|----------------|------------------------------|--------------------------|
| ABLIKIM   | 21A  | PL B813 136059 | M. Ablikim <i>et al.</i>     | (BESIII Collab.)         |
| ABLIKIM   | 20F  | PR D101 032008 | M. Ablikim <i>et al.</i>     | (BESIII Collab.)         |
| LEES      | 20   | PR D101 012011 | J.P. Lees <i>et al.</i>      | (BESIII Collab.)         |
| ABLIKIM   | 19AQ | PR D100 032004 | M. Ablikim <i>et al.</i>     | (BESIII Collab.)         |
| ABLIKIM   | 19L  | PR D99 032001  | M. Ablikim <i>et al.</i>     | (BESIII Collab.)         |
| LEES      | 13Q  | PR D88 032013  | J.P. Lees <i>et al.</i>      | (BABAR Collab.)          |
| LEES      | 12G  | PR D86 032013  | J.P. Lees <i>et al.</i>      | (BABAR Collab.)          |
| AUBERT    | 07AU | PR D76 092005  | B. Aubert <i>et al.</i>      | (BABAR Collab.)          |
| ANISOVICH | 02   | PL B542 8      | A.V. Anisovich <i>et al.</i> |                          |
| ANISOVICH | 01D  | PL B508 6      | A.V. Anisovich <i>et al.</i> |                          |
| ANISOVICH | 01E  | PL B513 281    | A.V. Anisovich <i>et al.</i> |                          |
| ANISOVICH | 00J  | PL B491 47     | A.V. Anisovich <i>et al.</i> | (RAL, LOQM, PNPI+)       |
| KLOET     | 96   | PR D53 6120    | W.M. Kloet, F. Myhrer        | (RUTG, NORD)             |
| ALDE      | 95   | ZPHY C66 379   | D.M. Alde <i>et al.</i>      | (GAMS Collab.) JP        |
| HASAN     | 94   | PL B334 215    | A. Hasan, D.V. Bugg          | (LOQM)                   |
| OAKDEN    | 94   | NP A574 731    | M.N. Oakden, M.R. Pennington | (DURH)                   |
| ALDE      | 92C  | ZPHY C54 553   | D.M. Alde <i>et al.</i>      | (BELG, SERP, KEK, LANL+) |
| BIAGINI   | 91   | NC 104A 363    | M.E. Biagini <i>et al.</i>   | (FRAS, PRAG)             |
| CLEGG     | 90   | ZPHY C45 677   | A.B. Clegg, A. Donnachie     | (LANC, MCHS)             |
| ATKINSON  | 85   | ZPHY C29 333   | M. Atkinson <i>et al.</i>    | (BONN, CERN, GLAS+)      |
| MARTIN    | 80B  | NP B176 355    | B.R. Martin, D. Morgan       | (LOUC, RHEL) JP          |
| MARTIN    | 80C  | NP B169 216    | A.D. Martin, M.R. Pennington | (DURH) JP                |
| CUTTS     | 78B  | PR D17 16      | D. Cutts <i>et al.</i>       | (STON, WISC)             |
| COUPLAND  | 77   | PL 71B 460     | M. Coupland <i>et al.</i>    | (LOQM, RHEL)             |
| PEASLEE   | 75   | PL 57B 189     | D.C. Peaslee <i>et al.</i>   | (CANB, BARI, BROW+)      |
| ALSPECTOR | 73   | PRL 30 511     | J. Alspector <i>et al.</i>   | (RUTG, UPNJ)             |
| ABRAMS    | 70   | PR D1 1917     | R.J. Abrams <i>et al.</i>    | (BNL)                    |
| COOPER    | 68   | PRL 20 1059    | W.A. Cooper <i>et al.</i>    | (ANL)                    |
| GOUNARIS  | 68   | PRL 21 244     | G.J. Gounaris, J.J. Sakurai  |                          |

NODE=M032

REFID=61028  
 REFID=60256  
 REFID=60211  
 REFID=59909  
 REFID=59612  
 REFID=55404  
 REFID=54299  
 REFID=52049  
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 REFID=47950  
 REFID=45212  
 REFID=44371  
 REFID=44103  
 REFID=45210  
 REFID=41859  
 REFID=41894  
 REFID=41355  
 REFID=22000  
 REFID=21838  
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 REFID=21824  
 REFID=21813  
 REFID=21807  
 REFID=21805  
 REFID=48054

NODE=M103

 $\phi(2170)$ 

$$J^G(J^{PC}) = 0^-(1^{--})$$

 $\phi(2170)$  MASS

NODE=M103M

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT  
**2159 ± 17 OUR AVERAGE** Error includes scale factor of 1.4. See the ideogram below.  
 [2188 ± 10 MeV OUR 2018 AVERAGE Scale factor = 1.8]

NODE=M103M

NEW

|                                                                               |      |                          |      |      |                                                  |
|-------------------------------------------------------------------------------|------|--------------------------|------|------|--------------------------------------------------|
| 2176 ± 24 ± 3                                                                 |      | <sup>1</sup> ABLIKIM     | 21A  | BES3 | $e^+e^- \rightarrow \omega\eta$                  |
| 2177.5 ± 4.8 ± 19.5                                                           |      | <sup>2</sup> ABLIKIM     | 20M  | BES3 | $e^+e^- \rightarrow \eta'\phi$                   |
| 2126.5 ± 16.8 ± 12.4                                                          |      | <sup>3</sup> ABLIKIM     | 20S  | BES3 | $e^+e^- \rightarrow K^+K^-\pi^0\pi^0$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                          |      |      |                                                  |
| 2135 ± 8 ± 9                                                                  | 95   | ABLIKIM                  | 19I  | BES3 | $e^+e^- \rightarrow \eta\phi f_0(980)$           |
| 2239.2 ± 7.1 ± 11.3                                                           |      | <sup>4</sup> ABLIKIM     | 19L  | BES3 | $e^+e^- \rightarrow K^+K^-$                      |
| 2200 ± 6 ± 5                                                                  | 471  | ABLIKIM                  | 15H  | BES3 | $J/\psi \rightarrow \eta\phi\pi^+\pi^-$          |
| 2180 ± 8 ± 8                                                                  |      | <sup>5,6</sup> LEES      | 12F  | BABR | $10.6 e^+e^- \rightarrow \phi\pi^+\pi^-\gamma$   |
| 2079 ± 13 ± $\begin{smallmatrix} +79 \\ -28 \end{smallmatrix}$                | 4.8k | <sup>7</sup> SHEN        | 09   | BELL | $10.6 e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |
| 2186 ± 10 ± 6                                                                 | 52   | ABLIKIM                  | 08F  | BES  | $J/\psi \rightarrow \eta\phi f_0(980)$           |
| 2125 ± 22 ± 10                                                                | 483  | AUBERT                   | 08S  | BABR | $10.6 e^+e^- \rightarrow \phi\eta\gamma$         |
| 2192 ± 14                                                                     | 116  | <sup>8</sup> AUBERT      | 07AK | BABR | $10.6 e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |
| 2169 ± 20                                                                     | 149  | <sup>8</sup> AUBERT      | 07AK | BABR | $10.6 e^+e^- \rightarrow K^+K^-\pi^0\pi^0\gamma$ |
| 2175 ± 10 ± 15                                                                | 201  | <sup>6,9</sup> AUBERT,BE | 06D  | BABR | $10.6 e^+e^- \rightarrow K^+K^-\pi\pi\gamma$     |

OCCUR=2

<sup>1</sup> From a fit to the cross section between 2.00 and 3.08 GeV with a coherent sum of Breit-Wigner amplitudes, including contributions from  $\omega(1420)$  and  $\omega(1650)/\phi(1680)$ .

NODE=M103M;LINKAGE=F

<sup>2</sup> From a fit using a coherent sum of a phase-space modified Breit-Wigner function and a phase-space term.

NODE=M103M;LINKAGE=D

<sup>3</sup> By a simultaneous fit of the intermediate channels in a partial-wave analysis, assuming the same structure, modelled with a coherent sum of a nonresonant component and a resonant component by a Breit-Wigner function.

NODE=M103M;LINKAGE=E

<sup>4</sup> The observed structure can be due to both the  $\phi(2170)$  and  $\rho(2150)$ .

<sup>5</sup> Fit includes interference with the  $\phi(1680)$ .

<sup>6</sup> From the  $\phi f_0(980)$  component.

NODE=M103M;LINKAGE=C

NODE=M103M;LINKAGE=A

NODE=M103M;LINKAGE=AB

NODE=M103M;LINKAGE=SH

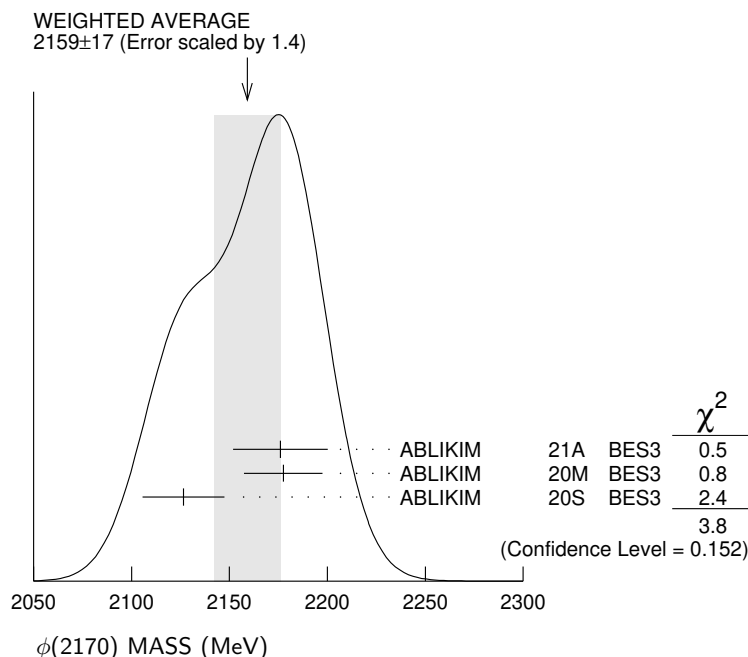
NODE=M103M;LINKAGE=AU

NODE=M103M;LINKAGE=B

<sup>7</sup> From a fit with two incoherent Breit-Wigners.

<sup>8</sup> From the  $K^+K^- f_0(980)$  component.

<sup>9</sup> Superseded by LEES 12F.

 $\phi(2170)$  WIDTH

NODE=M103W

| VALUE (MeV)                                                                                                                                                                                                                           | EVTS | DOCUMENT ID              | TECN      | COMMENT                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------|-----------|--------------------------------------------------|
| <b>137 ±16 OUR AVERAGE</b>                                                                                                                                                                                                            |      |                          |           |                                                  |
| [83 ± 12 MeV OUR 2018 AVERAGE]                                                                                                                                                                                                        |      |                          |           |                                                  |
| 89 ±50 ± 5                                                                                                                                                                                                                            |      | <sup>1</sup> ABLIKIM     | 21A BES3  | $e^+e^- \rightarrow \omega\eta$                  |
| 149.0±15.6± 8.9                                                                                                                                                                                                                       |      | <sup>2</sup> ABLIKIM     | 20M BES3  | $e^+e^- \rightarrow \eta'\phi$                   |
| 106.9±32.1±28.1                                                                                                                                                                                                                       |      | <sup>3</sup> ABLIKIM     | 20S BES3  | $e^+e^- \rightarrow K^+K^-\pi^0\pi^0$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                         |      |                          |           |                                                  |
| 104 ±24 ±12                                                                                                                                                                                                                           | 95   | ABLIKIM                  | 19I BES3  | $e^+e^- \rightarrow \eta\phi f_0(980)$           |
| 139.8±12.3±20.6                                                                                                                                                                                                                       |      | <sup>4</sup> ABLIKIM     | 19L BES3  | $e^+e^- \rightarrow K^+K^-$                      |
| 104 ±15 ±15                                                                                                                                                                                                                           | 471  | ABLIKIM                  | 15H BES3  | $J/\psi \rightarrow \eta\phi\pi^+\pi^-$          |
| 77 ±15 ±10                                                                                                                                                                                                                            |      | <sup>5,6</sup> LEES      | 12F BABR  | $10.6 e^+e^- \rightarrow \phi\pi^+\pi^-\gamma$   |
| 192 ±23 $\begin{smallmatrix} +25 \\ -61 \end{smallmatrix}$                                                                                                                                                                            | 4.8k | <sup>7</sup> SHEN        | 09 BELL   | $10.6 e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |
| 65 ±23 ±17                                                                                                                                                                                                                            | 52   | ABLIKIM                  | 08F BES   | $J/\psi \rightarrow \eta\phi f_0(980)$           |
| 61 ±50 ±13                                                                                                                                                                                                                            | 483  | AUBERT                   | 08S BABR  | $10.6 e^+e^- \rightarrow \phi\eta\gamma$         |
| 71 ±21                                                                                                                                                                                                                                | 116  | <sup>8</sup> AUBERT      | 07AK BABR | $10.6 e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |
| 102 ±27                                                                                                                                                                                                                               | 149  | <sup>8</sup> AUBERT      | 07AK BABR | $10.6 e^+e^- \rightarrow K^+K^-\pi^0\pi^0\gamma$ |
| 58 ±16 ±20                                                                                                                                                                                                                            | 201  | <sup>6,9</sup> AUBERT,BE | 06D BABR  | $10.6 e^+e^- \rightarrow K^+K^-\pi\pi\gamma$     |
| <sup>1</sup> From a fit to the cross section between 2.00 and 3.08 GeV with a coherent sum of Breit-Wigner amplitudes, including contributions from $\omega(1420)$ and $\omega(1650)/\phi(1680)$ .                                    |      |                          |           |                                                  |
| <sup>2</sup> From a fit using a coherent sum of a phase-space modified Breit-Wigner function and a phase-space term.                                                                                                                  |      |                          |           |                                                  |
| <sup>3</sup> By a simultaneous fit of the intermediate channels in a partial-wave analysis, assuming the same structure, modelled with a coherent sum of a nonresonant component and a resonant component by a Breit-Wigner function. |      |                          |           |                                                  |
| <sup>4</sup> The observed structure can be due to both the $\phi(2170)$ and $\rho(2150)$ .                                                                                                                                            |      |                          |           |                                                  |
| <sup>5</sup> Fit includes interference with the $\phi(1680)$ .                                                                                                                                                                        |      |                          |           |                                                  |
| <sup>6</sup> From the $\phi f_0(980)$ component.                                                                                                                                                                                      |      |                          |           |                                                  |
| <sup>7</sup> From a fit with two incoherent Breit-Wigners.                                                                                                                                                                            |      |                          |           |                                                  |
| <sup>8</sup> From the $K^+K^-\phi(980)$ component.                                                                                                                                                                                    |      |                          |           |                                                  |
| <sup>9</sup> Superseded by LEES 12F.                                                                                                                                                                                                  |      |                          |           |                                                  |

NODE=M103W

NEW

OCCUR=2

NODE=M103W;LINKAGE=F

NODE=M103W;LINKAGE=D

NODE=M103W;LINKAGE=E

NODE=M103W;LINKAGE=C

NODE=M103W;LINKAGE=A

NODE=M103W;LINKAGE=AB

NODE=M103W;LINKAGE=SH

NODE=M103W;LINKAGE=AU

NODE=M103W;LINKAGE=B

 **$\phi(2170)$  DECAY MODES**

NODE=M103215;NODE=M103

| Mode                                                         | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------------------------------------|--------------------------------|
| $\Gamma_1$ $e^+e^-$                                          | seen                           |
| $\Gamma_2$ $\phi\eta$                                        |                                |
| $\Gamma_3$ $\omega\eta$                                      |                                |
| $\Gamma_4$ $\phi\eta'$                                       |                                |
| $\Gamma_5$ $\phi\pi\pi$                                      |                                |
| $\Gamma_6$ $\phi f_0(980)$                                   | seen                           |
| $\Gamma_7$ $K^+K^-\pi^+\pi^-$                                |                                |
| $\Gamma_8$ $K^+K^-\phi(980) \rightarrow K^+K^-\pi^+\pi^-$    | seen                           |
| $\Gamma_9$ $K^+K^-\pi^0\pi^0$                                |                                |
| $\Gamma_{10}$ $K^+K^-\phi(980) \rightarrow K^+K^-\pi^0\pi^0$ | seen                           |
| $\Gamma_{11}$ $K^{*0}K^\pm\pi^\mp$                           | not seen                       |
| $\Gamma_{12}$ $K^{*}(892)^0\bar{K}^{*}(892)^0$               | not seen                       |
| $\Gamma_{13}$ $K^{*}(892)^+K^{*}(892)^-$                     |                                |
| $\Gamma_{14}$ $K(1460)^+K^- + c.c.$                          |                                |
| $\Gamma_{15}$ $K_1(1270)^+K^- + c.c.$                        |                                |
| $\Gamma_{16}$ $K_1(1400)^+K^- + c.c.$                        |                                |

DESIG=1;OUR EVAL;→ UNCHECKED ←

DESIG=5

DESIG=16

DESIG=11

DESIG=9

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=3

DESIG=6

DESIG=4

DESIG=7

DESIG=8

DESIG=10

DESIG=15

DESIG=12

DESIG=14

DESIG=13

 **$\phi(2170) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$** 

NODE=M103230

| $\Gamma(\phi\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$                |      |             |          | $\Gamma_2\Gamma_1/\Gamma$                |  |
|-------------------------------------------------------------------------------|------|-------------|----------|------------------------------------------|--|
| VALUE (eV)                                                                    | EVTS | DOCUMENT ID | TECN     | COMMENT                                  |  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |                                          |  |
| 1.7±0.7±1.3                                                                   | 483  | AUBERT      | 08S BABR | $10.6 e^+e^- \rightarrow \phi\eta\gamma$ |  |

NODE=M103G2

NODE=M103G2



$$\Gamma(\omega\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_3\Gamma_1/\Gamma$$

| VALUE (eV)            | DOCUMENT ID          | TECN     | COMMENT                         |
|-----------------------|----------------------|----------|---------------------------------|
| <b>0.43±0.15±0.04</b> | <sup>1</sup> ABLIKIM | 21A BES3 | $e^+e^- \rightarrow \omega\eta$ |

<sup>1</sup> For constructive interference with  $\omega(1420)$  and  $\omega(1650)/\phi(1680)$ . For destructive interference:  $1.25 \pm 0.48 \pm 0.18$  eV.

NODE=M103R09  
NODE=M103R09

NODE=M103R09;LINKAGE=A

$$\Gamma(\phi\eta') \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_4\Gamma_1/\Gamma$$

| VALUE (eV)         | DOCUMENT ID          | TECN     | COMMENT                        |
|--------------------|----------------------|----------|--------------------------------|
| <b>7.1±0.7±0.7</b> | <sup>1</sup> ABLIKIM | 20M BES3 | $e^+e^- \rightarrow \eta'\phi$ |

<sup>1</sup> From a fit using a coherent sum of a phase-space modified Breit-Wigner function and a phase-space term.

NODE=M103R00  
NODE=M103R00

NODE=M103R00;LINKAGE=A

$$\Gamma(\phi f_0(980)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_6\Gamma_1/\Gamma$$

| VALUE (eV)         | EVTS | DOCUMENT ID         | TECN     | COMMENT                                        |
|--------------------|------|---------------------|----------|------------------------------------------------|
| <b>2.3±0.3±0.3</b> |      | <sup>1,2</sup> LEES | 12F BABR | $10.6 e^+e^- \rightarrow \phi\pi^+\pi^-\gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |     |                          |          |                                              |
|-------------|-----|--------------------------|----------|----------------------------------------------|
| 2.5±0.8±0.4 | 201 | <sup>2,3</sup> AUBERT,BE | 06D BABR | $10.6 e^+e^- \rightarrow K^+K^-\pi\pi\gamma$ |
|-------------|-----|--------------------------|----------|----------------------------------------------|

<sup>1</sup> From a fit with constructive interference with the  $\phi(1680)$ . In a fit with destructive interference, the value is larger by a factor of 12.

<sup>2</sup> From the  $\phi f_0(980)$  component.

<sup>3</sup> Superseded by LEES 12F.

NODE=M103G1  
NODE=M103G1

NODE=M103G1;LINKAGE=A

NODE=M103G1;LINKAGE=AB  
NODE=M103G1;LINKAGE=B

$$\Gamma(K^*(892)^+K^*(892)^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{13}\Gamma_1/\Gamma$$

| VALUE (eV)     | CL% | DOCUMENT ID          | TECN     | COMMENT                               |
|----------------|-----|----------------------|----------|---------------------------------------|
| <b>&lt;1.9</b> | 90  | <sup>1</sup> ABLIKIM | 20S BES3 | $e^+e^- \rightarrow K^+K^-\pi^0\pi^0$ |

<sup>1</sup> By a simultaneous fit of the intermediate channels in a partial-wave analysis, assuming the same structure, modelled with a coherent sum of a nonresonant component and a resonant component by a Breit-Wigner function.

NODE=M103R08  
NODE=M103R08

NODE=M103R08;LINKAGE=A

$$\Gamma(K(1460)^+K^- + \text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{14}\Gamma_1/\Gamma$$

| VALUE (eV)     | DOCUMENT ID          | TECN     | COMMENT                               |
|----------------|----------------------|----------|---------------------------------------|
| <b>3.0±3.8</b> | <sup>1</sup> ABLIKIM | 20S BES3 | $e^+e^- \rightarrow K^+K^-\pi^0\pi^0$ |

<sup>1</sup> By a simultaneous fit of the intermediate channels in a partial-wave analysis, assuming the same structure, modelled with a coherent sum of a nonresonant component and a resonant component by a Breit-Wigner function.

NODE=M103R05  
NODE=M103R05

NODE=M103R05;LINKAGE=A

$$\Gamma(K_1(1270)^+K^- + \text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{15}\Gamma_1/\Gamma$$

| VALUE (eV)      | CL% | DOCUMENT ID          | TECN     | COMMENT                               |
|-----------------|-----|----------------------|----------|---------------------------------------|
| <b>&lt;12.5</b> | 90  | <sup>1</sup> ABLIKIM | 20S BES3 | $e^+e^- \rightarrow K^+K^-\pi^0\pi^0$ |

<sup>1</sup> By a simultaneous fit of the intermediate channels in a partial-wave analysis, assuming the same structure, modelled with a coherent sum of a nonresonant component and a resonant component by a Breit-Wigner function. A second solution of the fit with equal fit quality gives an upper limit value of 297.6 eV.

NODE=M103R06  
NODE=M103R06

NODE=M103R06;LINKAGE=A

$$\Gamma(K_1(1400)^+K^- + \text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{16}\Gamma_1/\Gamma$$

| VALUE (eV)     | DOCUMENT ID          | TECN     | COMMENT                               |
|----------------|----------------------|----------|---------------------------------------|
| <b>4.7±3.3</b> | <sup>1</sup> ABLIKIM | 20S BES3 | $e^+e^- \rightarrow K^+K^-\pi^0\pi^0$ |

<sup>1</sup> By a simultaneous fit of the intermediate channels in a partial-wave analysis, assuming the same structure, modelled with a coherent sum of a nonresonant component and a resonant component by a Breit-Wigner function. A second solution of the fit with equal fit quality gives a value of  $98.8 \pm 7.8$  eV.

NODE=M103R07  
NODE=M103R07

NODE=M103R07;LINKAGE=A

$$\phi(2170) \Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$$

NODE=M103220

$$\Gamma(\phi\pi\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_5/\Gamma \times \Gamma_1/\Gamma$$

| VALUE (units $10^{-7}$ ) | EVTS | DOCUMENT ID       | TECN    | COMMENT                                          |
|--------------------------|------|-------------------|---------|--------------------------------------------------|
| <b>1.65±0.15±0.18</b>    | 4.8k | <sup>1</sup> SHEN | 09 BELL | $10.6 e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |

<sup>1</sup> Multiplied by 3/2 to take into account the  $\phi\pi^0\pi^0$  mode. Using  $B(\phi \rightarrow K^+K^-) = (49.2 \pm 0.6)\%$ .

NODE=M103G01  
NODE=M103G01

NODE=M103G01;LINKAGE=SH

$\phi(2170)$  BRANCHING RATIOS $\Gamma(K^+K^-f_0(980) \rightarrow K^+K^-\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_8/\Gamma$ 

| VALUE | DOCUMENT ID | TECN      | COMMENT                                          |
|-------|-------------|-----------|--------------------------------------------------|
| seen  | AUBERT      | 07AK BABR | $10.6 e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |

NODE=M103225

NODE=M103R01  
NODE=M103R01 $\Gamma(K^+K^-f_0(980) \rightarrow K^+K^-\pi^0\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{10}/\Gamma$ 

| VALUE | DOCUMENT ID | TECN      | COMMENT                                          |
|-------|-------------|-----------|--------------------------------------------------|
| seen  | AUBERT      | 07AK BABR | $10.6 e^+e^- \rightarrow K^+K^-\pi^0\pi^0\gamma$ |

NODE=M103R02  
NODE=M103R02 $\Gamma(K^{*0}K^\pm\pi^\mp)/\Gamma_{\text{total}}$   $\Gamma_{11}/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN      | COMMENT                    |
|----------|-------------|-----------|----------------------------|
| not seen | AUBERT      | 07AK BABR | $10.6 \text{ GeV } e^+e^-$ |

NODE=M103R03  
NODE=M103R03 $\Gamma(K^*(892)^0\bar{K}^*(892)^0)/\Gamma_{\text{total}}$   $\Gamma_{12}/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN     | COMMENT                                    |
|----------|-------------|----------|--------------------------------------------|
| not seen | ABLIKIM     | 10C BES2 | $J/\psi \rightarrow \eta K^+\pi^-K^-\pi^+$ |

NODE=M103R04  
NODE=M103R04 $\phi(2170)$  REFERENCES

|           |      |                |                          |                  |
|-----------|------|----------------|--------------------------|------------------|
| ABLIKIM   | 21A  | PL B813 136059 | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| ABLIKIM   | 20M  | PR D102 012008 | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| ABLIKIM   | 20S  | PRL 124 112001 | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| ABLIKIM   | 19I  | PR D99 012014  | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| ABLIKIM   | 19L  | PR D99 032001  | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| ABLIKIM   | 15H  | PR D91 052017  | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| LEES      | 12F  | PR D86 012008  | J.P. Lees <i>et al.</i>  | (BABAR Collab.)  |
| ABLIKIM   | 10C  | PL B685 27     | M. Ablikim <i>et al.</i> | (BES II Collab.) |
| SHEN      | 09   | PR D80 031101  | C.P. Shen <i>et al.</i>  | (BELLE Collab.)  |
| ABLIKIM   | 08F  | PRL 100 102003 | M. Ablikim <i>et al.</i> | (BES Collab.)    |
| AUBERT    | 08S  | PR D77 092002  | B. Aubert <i>et al.</i>  | (BABAR Collab.)  |
| AUBERT    | 07AK | PR D76 012008  | B. Aubert <i>et al.</i>  | (BABAR Collab.)  |
| AUBERT,BE | 06D  | PR D74 091103  | B. Aubert <i>et al.</i>  | (BABAR Collab.)  |

NODE=M103

REFID=61028  
REFID=60337  
REFID=60542  
REFID=59605  
REFID=59612  
REFID=56773  
REFID=54298  
REFID=53349  
REFID=53000  
REFID=52154  
REFID=52242  
REFID=51908  
REFID=51511 $f_0(2200)$ 

$$I^G(J^{PC}) = 0^+(0^{++})$$

NODE=M112

OMITTED FROM SUMMARY TABLE

Seen in  $K_S^0 K_S^0$  (AUGUSTIN 88),  $K^+K^-$  (ABLIKIM 05Q) and  $\eta\eta$  (BINON 05) system. Not seen in  $\Upsilon(1S)$  radiative decays (BARU 89).

NODE=M112

 $f_0(2200)$  MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**2187 $\pm$ 14 OUR AVERAGE**

|                              |              |          |          |                                               |
|------------------------------|--------------|----------|----------|-----------------------------------------------|
| 2170 $\pm$ 20 $^{+10}_{-15}$ |              | ABLIKIM  | 05Q BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-K^+K^-$ |
| 2197 $\pm$ 17                | <sup>1</sup> | AUGUSTIN | 88 DM2   | $J/\psi \rightarrow \gamma K_S^0 K_S^0$       |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                        |     |                      |    |                                      |
|------------------------|-----|----------------------|----|--------------------------------------|
| 2206 $\pm$ 12 $\pm$ 8  | 381 | <sup>2,3</sup> DOBBS | 15 | $J/\psi \rightarrow \gamma K^+K^-$   |
| 2188 $\pm$ 17 $\pm$ 16 | 203 | <sup>2,3</sup> DOBBS | 15 | $\psi(2S) \rightarrow \gamma K^+K^-$ |
| 2210 $\pm$ 50          |     | <sup>4</sup> BINON   | 05 | $33 \pi^- p \rightarrow \eta\eta n$  |
| $\sim$ 2122            |     | HASAN                | 94 | $\bar{p}p \rightarrow \pi\pi$        |
| $\sim$ 2321            |     | HASAN                | 94 | $\bar{p}p \rightarrow \pi\pi$        |

NODE=M112M

NODE=M112M

OCCUR=2

OCCUR=2

<sup>1</sup> Cannot determine spin to be 0.<sup>2</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>3</sup> From a fit to a Breit-Wigner line shape with fixed  $\Gamma = 238 \text{ MeV}$ .<sup>4</sup> First solution, PWA is ambiguous.NODE=M112M;LINKAGE=A  
NODE=M112M;LINKAGE=B  
NODE=M112M;LINKAGE=C  
NODE=M112M;LINKAGE=BI $f_0(2200)$  WIDTH

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**207 $\pm$ 40 OUR AVERAGE**

|                             |                       |          |                                               |
|-----------------------------|-----------------------|----------|-----------------------------------------------|
| 220 $\pm$ 60 $^{+40}_{-45}$ | ABLIKIM               | 05Q BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-K^+K^-$ |
| 201 $\pm$ 51                | <sup>5</sup> AUGUSTIN | 88 DM2   | $J/\psi \rightarrow \gamma K_S^0 K_S^0$       |

NODE=M112W

NODE=M112W

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |                    |    |      |                                      |
|--------------|--------------------|----|------|--------------------------------------|
| $380 \pm 90$ | <sup>6</sup> BINON | 05 | GAMS | $33 \pi^- p \rightarrow \eta \eta n$ |
| $\sim 273$   | HASAN              | 94 | RVUE | $\bar{p} p \rightarrow \pi \pi$      |
| $\sim 223$   | HASAN              | 94 | RVUE | $\bar{p} p \rightarrow \pi \pi$      |

<sup>5</sup> Cannot determine spin to be 0.

<sup>6</sup> First solution, PWA is ambiguous.

OCCUR=2

NODE=M112W;LINKAGE=A

NODE=M112W;LINKAGE=BI

### $f_0(2200)$ REFERENCES

|          |     |                             |                             |               |
|----------|-----|-----------------------------|-----------------------------|---------------|
| DOBBS    | 15  | PR D91 052006               | S. Dobbs <i>et al.</i>      | (NWES)        |
| ABLIKIM  | 05Q | PR D72 092002               | M. Ablikim <i>et al.</i>    | (BES Collab.) |
| BINON    | 05  | PAN 68 960                  | F. Binon <i>et al.</i>      |               |
|          |     | Translated from YAF 68 998. |                             |               |
| HASAN    | 94  | PL B334 215                 | A. Hasan, D.V. Bugg         | (LOQM)        |
| BARU     | 89  | ZPHY C42 505                | S.E. Baru <i>et al.</i>     | (NOVO)        |
| AUGUSTIN | 88  | PRL 60 2238                 | J.E. Augustin <i>et al.</i> | (DM2 Collab.) |

NODE=M112

REFID=56805

REFID=50958

REFID=50780

REFID=44103

REFID=40917

REFID=40574

NODE=M082

$f_J(2220)$

$$I^G(J^{PC}) = 0^+(2^{++} \text{ or } 4^{++})$$

OMITTED FROM SUMMARY TABLE

Needs confirmation. See our mini-review in the 2004 edition of this

Review, PDG 04.

NODE=M082

### $f_J(2220)$ MASS

| VALUE (MeV)                     | EVTS | DOCUMENT ID       | TECN     | COMMENT                                                     |
|---------------------------------|------|-------------------|----------|-------------------------------------------------------------|
| <b>2231.1 ± 3.5 OUR AVERAGE</b> |      |                   |          |                                                             |
| 2235 ± 4 ± 6                    | 74   | BAI               | 96B BES  | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$ |
| 2230 $^{+6}_{-7}$ ± 16          | 46   | BAI               | 96B BES  | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma K^+ K^-$     |
| 2232 $^{+8}_{-7}$ ± 15          | 23   | BAI               | 96B BES  | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma K_S^0 K_S^0$ |
| 2235 ± 4 ± 5                    | 32   | BAI               | 96B BES  | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma p \bar{p}$   |
| 2209 $^{+17}_{-15}$ ± 10        |      | ASTON             | 88F LASS | $11 K^- p \rightarrow K^+ K^- \Lambda$                      |
| 2230 ± 20                       |      | BOLONKIN          | 88 SPEC  | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$                      |
| 2220 ± 10                       | 41   | <sup>1</sup> ALDE | 86B GA24 | $38-100 \pi p \rightarrow n \eta \eta'$                     |
| 2230 ± 6 ± 14                   | 93   | BALTRUSAIT..86D   | MRK3     | $e^+ e^- \rightarrow \gamma K^+ K^-$                        |
| 2232 ± 7 ± 7                    | 23   | BALTRUSAIT..86D   | MRK3     | $e^+ e^- \rightarrow \gamma K_S^0 K_S^0$                    |

NODE=M082M

NODE=M082M

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |                              |         |                                                 |
|--------------|------------------------------|---------|-------------------------------------------------|
| 2223.9 ± 2.5 | <sup>2</sup> VLADIMIRSK...08 | SPEC    | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n + m\pi^0$ |
| 2246 ± 36    | BAI                          | 98H BES | $J/\psi \rightarrow \gamma \pi^0 \pi^0$         |

<sup>1</sup> ALDE 86B uses data from both the GAMS-2000 and GAMS-4000 detectors.

<sup>2</sup>  $J^{PC} = 2^{++}$ . Systematic uncertainties not evaluated

NODE=M082M;LINKAGE=A

NODE=M082M;LINKAGE=VL

### $f_J(2220)$ WIDTH

| VALUE (MeV)                                   | CL% | EVTS | DOCUMENT ID     | TECN     | COMMENT                                                     |
|-----------------------------------------------|-----|------|-----------------|----------|-------------------------------------------------------------|
| <b>23 <math>^{+8}_{-7}</math> OUR AVERAGE</b> |     |      |                 |          |                                                             |
| 19 $^{+13}_{-11}$ ± 12                        |     | 74   | BAI             | 96B BES  | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$ |
| 20 $^{+20}_{-15}$ ± 17                        |     | 46   | BAI             | 96B BES  | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma K^+ K^-$     |
| 20 $^{+25}_{-16}$ ± 14                        |     | 23   | BAI             | 96B BES  | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma K_S^0 K_S^0$ |
| 15 $^{+12}_{-9}$ ± 9                          |     | 32   | BAI             | 96B BES  | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma p \bar{p}$   |
| 60 $^{+107}_{-57}$                            |     |      | ASTON           | 88F LASS | $11 K^- p \rightarrow K^+ K^- \Lambda$                      |
| 80 ± 30                                       |     |      | BOLONKIN        | 88 SPEC  | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$                      |
| 26 $^{+20}_{-16}$ ± 17                        |     | 93   | BALTRUSAIT..86D | MRK3     | $e^+ e^- \rightarrow \gamma K^+ K^-$                        |
| 18 $^{+23}_{-15}$ ± 10                        |     | 23   | BALTRUSAIT..86D | MRK3     | $e^+ e^- \rightarrow \gamma K_S^0 K_S^0$                    |

NODE=M082W

NODE=M082W

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |    |                              |          |    |                                                   |
|-----------|----|------------------------------|----------|----|---------------------------------------------------|
| 8.6 ± 2.5 |    | <sup>1</sup> VLADIMIRSK...08 | SPEC     | 40 | $\pi^- p \rightarrow K_S^0 K_S^0 n$<br>+ $m\pi^0$ |
| <80       | 90 | ALDE                         | 87C GAM2 | 38 | $\pi^- p \rightarrow \eta' \eta n$                |

$1 J^{PC} = 2^{++}$ . Systematic uncertainties not evaluated

NODE=M082W;LINKAGE=VL

 **$f_J(2220)$  DECAY MODES**

NODE=M082215;NODE=M082

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi\pi$         | not seen                       |
| $\Gamma_2 \quad \pi^+\pi^-$     | not seen                       |
| $\Gamma_3 \quad K\bar{K}$       | not seen                       |
| $\Gamma_4 \quad p\bar{p}$       | not seen                       |
| $\Gamma_5 \quad \gamma\gamma$   | not seen                       |
| $\Gamma_6 \quad \eta\eta'(958)$ | seen                           |
| $\Gamma_7 \quad \phi\phi$       | not seen                       |
| $\Gamma_8 \quad \eta\eta$       | not seen                       |

DESIG=5

DESIG=6;OUR EST;→ UNCHECKED ←

DESIG=1

DESIG=4;OUR EST;→ UNCHECKED ←

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=7;OUR EST;→ UNCHECKED ←

DESIG=8;OUR EST;→ UNCHECKED ←

 **$f_J(2220) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

NODE=M082220

| $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$          |     |                               | $\Gamma_3\Gamma_5/\Gamma$ |                                                                                                     |  |
|-------------------------------------------------------------------------------|-----|-------------------------------|---------------------------|-----------------------------------------------------------------------------------------------------|--|
| VALUE (eV)                                                                    | CL% | DOCUMENT ID                   | TECN                      | COMMENT                                                                                             |  |
| < 1.4                                                                         | 95  | <sup>1</sup> ACCIARRI 01H L3  |                           | $\gamma\gamma \rightarrow K_S^0 K_S^0, E_{\text{cm}}^{\text{ee}} = 91, 183\text{--}209 \text{ GeV}$ |  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                               |                           |                                                                                                     |  |
| < 5.6                                                                         | 95  | <sup>1</sup> GODANG 97 CLE2   |                           | $\gamma\gamma \rightarrow K_S^0 K_S^0$                                                              |  |
| < 86                                                                          | 95  | <sup>1</sup> ALBRECHT 90G ARG |                           | $\gamma\gamma \rightarrow K^+ K^-$                                                                  |  |
| <1000                                                                         | 95  | <sup>2</sup> ALTHOFF 85B TASS |                           | $\gamma\gamma, K\bar{K}\pi$                                                                         |  |

NODE=M082G1

NODE=M082G1

| $\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |     |               | $\Gamma_1\Gamma_5/\Gamma$ |                                       |  |
|--------------------------------------------------------------------|-----|---------------|---------------------------|---------------------------------------|--|
| VALUE (eV)                                                         | CL% | DOCUMENT ID   | TECN                      | COMMENT                               |  |
| <2.5                                                               | 95  | ALAM 98C CLE2 |                           | $\gamma\gamma \rightarrow \pi^+\pi^-$ |  |
| <sup>1</sup> Assuming $J^P = 2^+$ .                                |     |               |                           |                                       |  |
| <sup>2</sup> True for $J^P = 0^+$ and $J^P = 2^+$ .                |     |               |                           |                                       |  |

NODE=M082G3

NODE=M082G3

NODE=M082G1;LINKAGE=D

NODE=M082G1;LINKAGE=C

 **$f_J(2220) \Gamma(i)\Gamma(p\bar{p})/\Gamma^2(\text{total})$** 

NODE=M082223

| $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\pi\pi)/\Gamma_{\text{total}}$ |     |                             | $\Gamma_4/\Gamma \times \Gamma_1/\Gamma$ |                                                     |  |
|--------------------------------------------------------------------------------------|-----|-----------------------------|------------------------------------------|-----------------------------------------------------|--|
| VALUE (units $10^{-5}$ )                                                             | CL% | DOCUMENT ID                 | TECN                                     | COMMENT                                             |  |
| <18                                                                                  | 95  | <sup>1</sup> AMSLER 01 CBAR |                                          | $1.4\text{--}1.5 p\bar{p} \rightarrow \pi^0\pi^0$   |  |
| • • • We do not use the following data for averages, fits, limits, etc. • • •        |     |                             |                                          |                                                     |  |
| <(11–42)                                                                             | 99  | <sup>2</sup> HASAN 96 SPEC  |                                          | $1.35\text{--}1.55 p\bar{p} \rightarrow \pi^+\pi^-$ |  |

NODE=M082GG1

NODE=M082GG1

| $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\phi\phi)/\Gamma_{\text{total}}$ |     |                                   | $\Gamma_4/\Gamma \times \Gamma_7/\Gamma$ |                                                 |  |
|----------------------------------------------------------------------------------------|-----|-----------------------------------|------------------------------------------|-------------------------------------------------|--|
| VALUE (units $10^{-5}$ )                                                               | CL% | DOCUMENT ID                       | TECN                                     | COMMENT                                         |  |
| <6                                                                                     | 95  | <sup>3</sup> EVANGELIS... 98 SPEC |                                          | $1.1\text{--}2.0 p\bar{p} \rightarrow \phi\phi$ |  |

NODE=M082GG2

NODE=M082GG2

| $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\eta\eta)/\Gamma_{\text{total}}$ |     |                             | $\Gamma_4/\Gamma \times \Gamma_8/\Gamma$ |                                                 |  |
|----------------------------------------------------------------------------------------|-----|-----------------------------|------------------------------------------|-------------------------------------------------|--|
| VALUE (units $10^{-5}$ )                                                               | CL% | DOCUMENT ID                 | TECN                                     | COMMENT                                         |  |
| <4                                                                                     | 95  | <sup>1</sup> AMSLER 01 CBAR |                                          | $1.4\text{--}1.5 p\bar{p} \rightarrow \eta\eta$ |  |

NODE=M082GG3

NODE=M082GG3

<sup>1</sup> For  $J^P = 2^+$  in the mass range 2222–2240 MeV and the total width between 10 and 20 MeV.

NODE=M082GG;LINKAGE=A

<sup>2</sup> For  $J^P = 2^+$  and  $J^P = 4^+$  in the mass range 2220–2245 MeV and the total width of 15 MeV.

NODE=M082GG;LINKAGE=B

<sup>3</sup> For  $J^P = 2^+$ , the mass of 2235 MeV and the total width of 15 MeV.

NODE=M082GG;LINKAGE=C

 **$f_J(2220)$  BRANCHING RATIOS**

NODE=M082225

| $\Gamma(\pi\pi)/\Gamma_{\text{total}}$ |                       |                                     | $\Gamma_1/\Gamma$ |  |  |
|----------------------------------------|-----------------------|-------------------------------------|-------------------|--|--|
| VALUE                                  | DOCUMENT ID           | COMMENT                             |                   |  |  |
| not seen                               | <sup>1</sup> DOBBS 15 | $J/\psi \rightarrow \gamma\pi\pi$   |                   |  |  |
| not seen                               | <sup>1</sup> DOBBS 15 | $\psi(2S) \rightarrow \gamma\pi\pi$ |                   |  |  |

NODE=M082R00

NODE=M082R00

OCCUR=2

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M082R00;LINKAGE=A

$\Gamma(K\bar{K})/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE    | DOCUMENT ID           | TECN | COMMENT                                |
|----------|-----------------------|------|----------------------------------------|
| not seen | <sup>1</sup> DOBBS 15 |      | $J/\psi \rightarrow \gamma K\bar{K}$   |
| not seen | <sup>1</sup> DOBBS 15 |      | $\psi(2S) \rightarrow \gamma K\bar{K}$ |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M082R01  
NODE=M082R01

OCCUR=2

NODE=M082R01;LINKAGE=A

 $\Gamma(\pi\pi)/\Gamma(K\bar{K})$  $\Gamma_1/\Gamma_3$ 

| VALUE          | DOCUMENT ID | TECN | COMMENT                                                       |
|----------------|-------------|------|---------------------------------------------------------------|
| <b>1.0±0.5</b> | BAI 96B     | BES  | $e^+e^- \rightarrow J/\psi \rightarrow \gamma 2\pi, K\bar{K}$ |

NODE=M082R2  
NODE=M082R2

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE (units 10 <sup>-4</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-----|-------------|------|---------|
|---------------------------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |      |                           |      |      |                                              |
|----------|------|---------------------------|------|------|----------------------------------------------|
| not seen |      | <sup>1</sup> AUBERT       | 07AV | BABR | $B \rightarrow p\bar{p}K^{(*)}$              |
| not seen |      | WANG                      | 05A  | BELL | $B^+ \rightarrow \bar{p}pK^+$                |
| <3.0     | 95   | <sup>2</sup> EVANGELIS... | 97   | SPEC | $1.96-2.40 \bar{p}p \rightarrow K_S^0 K_S^0$ |
| <1.1     | 99.7 | <sup>3</sup> BARNES       | 93   | SPEC | $1.3-1.57 \bar{p}p \rightarrow K_S^0 K_S^0$  |
| <2.6     | 99.7 | <sup>3</sup> BARDIN       | 87   | CNTR | $1.3-1.5 \bar{p}p \rightarrow K^+ K^-$       |
| <3.6     | 99.7 | <sup>3</sup> SCULLI       | 87   | CNTR | $1.29-1.55 \bar{p}p \rightarrow K^+ K^-$     |

<sup>1</sup> Assuming  $\Gamma < 30$  MeV.

<sup>2</sup> Assuming  $\Gamma \sim 20$  MeV,  $J^P = 2^+$  and  $B(f_J(2220) \rightarrow K\bar{K}) = 100\%$ .

<sup>3</sup> Assuming  $\Gamma = 30-35$  MeV,  $J^P = 2^+$  and  $B(f_J(2220) \rightarrow K\bar{K}) = 100\%$ .

NODE=M082R1;LINKAGE=AU  
NODE=M082R1;LINKAGE=C  
NODE=M082R1;LINKAGE=B

 $\Gamma(p\bar{p})/\Gamma(K\bar{K})$  $\Gamma_4/\Gamma_3$ 

| VALUE            | DOCUMENT ID | TECN | COMMENT                                                           |
|------------------|-------------|------|-------------------------------------------------------------------|
| <b>0.17±0.09</b> | BAI 96B     | BES  | $e^+e^- \rightarrow J/\psi \rightarrow \gamma p\bar{p}, K\bar{K}$ |

NODE=M082R3  
NODE=M082R3

 $f_J(2220)$  REFERENCES

|                   |                              |                               |                             |
|-------------------|------------------------------|-------------------------------|-----------------------------|
| DOBBS 15          | PR D91 052006                | S. Dobbs <i>et al.</i>        | (NWES)                      |
| VLADIMIRSK... 08  | PAN 71 2129                  | V.V. Vladimirov <i>et al.</i> | (ITEP)                      |
|                   | Translated from YAF 71 2166. |                               |                             |
| AUBERT 07AV       | PR D76 092004                | B. Aubert <i>et al.</i>       | (BABAR Collab.)             |
| WANG 05A          | PL B617 141                  | M.-Z. Wang <i>et al.</i>      | (BELLE Collab.)             |
| PDG 04            | PL B592 1                    | S. Eidelman <i>et al.</i>     | (PDG Collab.)               |
| ACCIARRI 01H      | PL B501 173                  | M. Acciarri <i>et al.</i>     | (L3 Collab.)                |
| AMSLER 01         | PL B520 175                  | C. Amsler <i>et al.</i>       | (Crystal Barrel Collab.)    |
| ALAM 98C          | PRL 81 3328                  | M.S. Alam <i>et al.</i>       | (CLEO Collab.)              |
| BAI 98H           | PRL 81 1179                  | J.Z. Bai <i>et al.</i>        | (BES Collab.)               |
| EVANGELIS... 98   | PR D57 5370                  | C. Evangelista <i>et al.</i>  | (JETSET Collab.)            |
| EVANGELIS... 97   | PR D56 3803                  | C. Evangelista <i>et al.</i>  | (LEAR Collab.)              |
| GODANG 97         | PRL 79 3829                  | R. Godang <i>et al.</i>       | (CLEO Collab.)              |
| BAI 96B           | PRL 76 3502                  | J.Z. Bai <i>et al.</i>        | (BES Collab.)               |
| HASAN 96          | PL B388 376                  | A. Hasan, D.V. Bugg           | (BRUN, LOQM)                |
| BARNES 93         | PL B309 469                  | P.D. Barnes <i>et al.</i>     | (PS185 Collab.)             |
| ALBRECHT 90G      | ZPHY C48 183                 | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)             |
| ASTON 88F         | PL B215 199                  | D. Aston <i>et al.</i>        | (SLAC, NAGO, CINC, INUS) JP |
| BOLONKIN 88       | NP B309 426                  | B.V. Bolonkin <i>et al.</i>   | (ITEP, SERP)                |
| ALDE 87C          | SJNP 45 255                  | D. Alde <i>et al.</i>         |                             |
|                   | Translated from YAF 45 405.  |                               |                             |
| BARDIN 87         | PL B195 292                  | G. Bardin <i>et al.</i>       | (SACL, FERR, CERN, PADO+)   |
| SCULLI 87         | PRL 58 1715                  | J. Sculli <i>et al.</i>       | (NYU, BNL)                  |
| ALDE 86B          | PL B177 120                  | D.M. Alde <i>et al.</i>       | (SERP, BELG, LANL, LAPP)    |
| BALTRUSAIT... 86D | PRL 56 107                   | R.M. Baltrusaitis             | (CIT, UCSC, ILL, SLAC+)     |
| ALTHOFF 85B       | ZPHY C29 189                 | M. Althoff <i>et al.</i>      | (TASSO Collab.)             |

NODE=M082

REFID=56805  
REFID=52681

REFID=51990  
REFID=50651  
REFID=49653  
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REFID=46365  
REFID=45687  
REFID=45760  
REFID=44736  
REFID=45197  
REFID=43601  
REFID=41374  
REFID=40585  
REFID=40580  
REFID=47474

REFID=40235  
REFID=40023  
REFID=21864  
REFID=21865  
REFID=21349

## OTHER RELATED PAPERS

|                   |                |                                  |                 |
|-------------------|----------------|----------------------------------|-----------------|
| DEL-AMO-SA... 100 | PRL 105 172001 | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.) |
|-------------------|----------------|----------------------------------|-----------------|

REFID=53533

$\eta(2225)$ 

$$I^G(J^{PC}) = 0^+(0^-+)$$

OMITTED FROM SUMMARY TABLE

Seen in  $J/\psi \rightarrow \gamma \phi \phi$ . Possibly seen in  $B \rightarrow \phi \phi K$  by LEES 11A.

NODE=M115

NODE=M115

NODE=M115M

NODE=M115M

 $\eta(2225)$  MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**2221<sup>+13</sup><sub>-10</sub> OUR AVERAGE**

|                                          |          |                      |          |                                                 |
|------------------------------------------|----------|----------------------|----------|-------------------------------------------------|
| 2216 <sup>+4+21</sup> <sub>-5-11</sub>   |          | <sup>1</sup> ABLIKIM | 16N BES3 | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 2240 <sup>+30+30</sup> <sub>-20-20</sub> | 196 ± 19 | ABLIKIM              | 08I BES  | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |
| 2230 ± 25 ± 15                           |          | BAI                  | 90B MRK3 | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 2214 ± 20 ± 13                           |          | BAI                  | 90B MRK3 | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |

OCCUR=2

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

~ 2220

BISELLO 86B DM2  $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$ 

<sup>1</sup> From a partial wave analysis of  $J/\psi \rightarrow \gamma \phi \phi$  that also finds significant signals for for  $\eta(2100)$ ,  $0^-+$  phase space,  $f_0(2100)$ ,  $f_2(2010)$ ,  $f_2(2300)$ ,  $f_2(2340)$ , and a previously unseen  $0^-+$  state  $X(2500)$  ( $M = 2470^{+15+101}_{-19-23}$  MeV,  $\Gamma = 230^{+64+56}_{-35-33}$  MeV).

NODE=M115M;LINKAGE=B

 $\eta(2225)$  WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**185<sup>+40</sup><sub>-20</sub> OUR AVERAGE**

|                                         |          |                      |          |                                                 |
|-----------------------------------------|----------|----------------------|----------|-------------------------------------------------|
| 185 <sup>+12+43</sup> <sub>-14-17</sub> |          | <sup>1</sup> ABLIKIM | 16N BES3 | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 190 ± 30 <sup>+60</sup> <sub>-40</sub>  | 196 ± 19 | ABLIKIM              | 08I BES  | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |
| 150 <sup>+300</sup> <sub>-60</sub> ± 60 |          | BAI                  | 90B MRK3 | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

~ 80

BISELLO 86B DM2  $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$ 

<sup>1</sup> From a partial wave analysis of  $J/\psi \rightarrow \gamma \phi \phi$  that also finds significant signals for for  $\eta(2100)$ ,  $0^-+$  phase space,  $f_0(2100)$ ,  $f_2(2010)$ ,  $f_2(2300)$ ,  $f_2(2340)$ , and a previously unseen  $0^-+$  state  $X(2500)$  ( $M = 2470^{+15+101}_{-19-23}$  MeV,  $\Gamma = 230^{+64+56}_{-35-33}$  MeV).

NODE=M115W;LINKAGE=A

 $\eta(2225)$  REFERENCES

|         |     |               |                          |                    |
|---------|-----|---------------|--------------------------|--------------------|
| ABLIKIM | 16N | PR D93 112011 | M. Ablikim               | (BESIII Collab.)   |
| LEES    | 11A | PR D84 012001 | J.P. Lees <i>et al.</i>  | (BABAR Collab.)    |
| ABLIKIM | 08I | PL B662 330   | M. Ablikim <i>et al.</i> | (BES Collab.)      |
| BAI     | 90B | PRL 65 1309   | Z. Bai <i>et al.</i>     | (Mark III Collab.) |
| BISELLO | 86B | PL B179 294   | D. Bisello <i>et al.</i> | (DM2 Collab.)      |

NODE=M115

REFID=57512  
REFID=16595  
REFID=52255  
REFID=41354  
REFID=22101

**$\rho_3(2250)$** 

$$I^G(J^{PC}) = 1^+(3^{--})$$

NODE=M044

## OMITTED FROM SUMMARY TABLE

Contains results mostly from formation experiments. For further production experiments see the Further States entry. See also  $\rho(2150)$ ,  $f_2(2150)$ ,  $f_4(2300)$ ,  $\rho_5(2350)$ .

NODE=M044

 **$\rho_3(2250)$  MASS**

NODE=M044205

 **$\bar{p}p \rightarrow \pi\pi$  or  $K\bar{K}$** 
 NODE=M044M1  
 NODE=M044M1

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID          | TECN | CHG    | COMMENT                                         |
|-------------------------------------------------------------------------------|------|----------------------|------|--------|-------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |      |        |                                                 |
| $2248 \pm 17^{+59}_{-5}$                                                      | 1.8k | <sup>1</sup> ABLIKIM | 20F  | BES3   | $\psi(2S) \rightarrow K^+ K^- \eta$             |
| $\sim 2232$                                                                   |      | HASAN                | 94   | RVUE   | $\bar{p}p \rightarrow \pi\pi$                   |
| $\sim 2090$                                                                   |      | <sup>2</sup> OAKDEN  | 94   | RVUE   | $0.36\text{--}1.55 \bar{p}p \rightarrow \pi\pi$ |
| $\sim 2250$                                                                   |      | <sup>3</sup> MARTIN  | 80B  | RVUE   |                                                 |
| $\sim 2300$                                                                   |      | <sup>3</sup> MARTIN  | 80C  | RVUE   |                                                 |
| $\sim 2140$                                                                   |      | <sup>4</sup> CARTER  | 78B  | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow K^- K^+$  |
| $\sim 2150$                                                                   |      | <sup>5</sup> CARTER  | 77   | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow \pi\pi$   |

<sup>1</sup> Seen in  $\psi(2S)$  decay with branching ratio  $\psi(2S) \rightarrow X\eta \rightarrow K^+ K^- \eta = (1.9 \pm 0.4^{+0.5}_{-1.3}) \times 10^{-6}$ .

<sup>2</sup> See however KLOET 96 who fit  $\pi^+ \pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.

<sup>3</sup>  $I(J^P) = 1(3^-)$  from simultaneous analysis of  $\bar{p}p \rightarrow \pi^- \pi^+$  and  $\pi^0 \pi^0$ .

<sup>4</sup>  $I = 0, 1$ .  $J^P = 3^-$  from Barrelet-zero analysis.

<sup>5</sup>  $I(J^P) = 1(3^-)$  from amplitude analysis.

NODE=M044M1;LINKAGE=A

NODE=M044M1;LINKAGE=CC

NODE=M044M1;LINKAGE=P

NODE=M044M1;LINKAGE=K

NODE=M044M1;LINKAGE=J

**S-CHANNEL  $\bar{N}N$** 

| VALUE (MeV)                                                                   | DOCUMENT ID              | TECN | CHG    | COMMENT                                                                             |
|-------------------------------------------------------------------------------|--------------------------|------|--------|-------------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |        |                                                                                     |
| $2260 \pm 20$                                                                 | <sup>6</sup> ANISOVICH   | 02   | SPEC   | $0.6\text{--}1.9 \bar{p}p \rightarrow \omega \pi^0, \omega \eta \pi^0, \pi^+ \pi^-$ |
| $\sim 2190$                                                                   | <sup>7</sup> CUTTS       | 78B  | CNTR   | $0.97\text{--}3 \bar{p}p \rightarrow \bar{N}N$                                      |
| $2155 \pm 15$                                                                 | <sup>7,8</sup> COUPLAND  | 77   | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow \bar{p}p$                                     |
| $2193 \pm 2$                                                                  | <sup>7,9</sup> ALSPECTOR | 73   | CNTR   | $\bar{p}p$ S channel                                                                |
| $2190 \pm 10$                                                                 | <sup>10</sup> ABRAMS     | 70   | CNTR   | S channel $\bar{p}N$                                                                |

<sup>6</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

<sup>7</sup> Isospins 0 and 1 not separated.

<sup>8</sup> From a fit to the total elastic cross section.

<sup>9</sup> Referred to as  $T$  or  $T$  region by ALSPECTOR 73.

<sup>10</sup> Seen as bump in  $I = 1$  state. See also COOPER 68. PEASLEE 75 confirm  $\bar{p}p$  results of ABRAMS 70, no narrow structure.

NODE=M044M;LINKAGE=AY

NODE=M044M2;LINKAGE=I

NODE=M044M2;LINKAGE=E

NODE=M044M2;LINKAGE=M

NODE=M044M2;LINKAGE=B

**Other processes**

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|-------------|------|-------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                                 |
| $2290 \pm 20 \pm 30$                                                          | AMELIN      | 00   | VES $37 \pi^- p \rightarrow \eta \pi^+ \pi^- n$ |

 NODE=M044M3  
 NODE=M044M3
 **$\rho_3(2250)$  WIDTH**

NODE=M044210

 **$\bar{p}p \rightarrow \pi\pi$  or  $K\bar{K}$** 
 NODE=M044W1  
 NODE=M044W1

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN | CHG    | COMMENT                                         |
|-------------------------------------------------------------------------------|------|-----------------------|------|--------|-------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |      |        |                                                 |
| $185^{+31}_{-26} +^{17}_{-103}$                                               | 1.8k | <sup>11</sup> ABLIKIM | 20F  | BES3   | $\psi(2S) \rightarrow K^+ K^- \eta$             |
| $\sim 220$                                                                    |      | HASAN                 | 94   | RVUE   | $\bar{p}p \rightarrow \pi\pi$                   |
| $\sim 60$                                                                     |      | <sup>12</sup> OAKDEN  | 94   | RVUE   | $0.36\text{--}1.55 \bar{p}p \rightarrow \pi\pi$ |
| $\sim 250$                                                                    |      | <sup>13</sup> MARTIN  | 80B  | RVUE   |                                                 |
| $\sim 200$                                                                    |      | <sup>13</sup> MARTIN  | 80C  | RVUE   |                                                 |
| $\sim 150$                                                                    |      | <sup>14</sup> CARTER  | 78B  | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow K^- K^+$  |
| $\sim 200$                                                                    |      | <sup>15</sup> CARTER  | 77   | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow \pi\pi$   |

- <sup>11</sup> Seen in  $\psi(2S)$  decay with branching ratio  $\psi(2S) \rightarrow X\eta \rightarrow K^+ K^- \eta = (1.9 \pm 0.4^{+0.5}_{-1.3}) \times 10^{-6}$ .
- <sup>12</sup> See however KLOET 96 who fit  $\pi^+ \pi^-$  only and find waves only up to  $J = 3$  to be important but not significantly resonant.
- <sup>13</sup>  $I(J^P) = 1(3^-)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^- \pi^+$  and  $\pi^0 \pi^0$ .
- <sup>14</sup>  $I = 0, 1$ .  $J^P = 3^-$  from Barrelet-zero analysis.
- <sup>15</sup>  $I(J^P) = 1(3^-)$  from amplitude analysis.

### S-CHANNEL $\bar{N}N$

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |                           |    |      |                                                                                   |
|----------|---------------------------|----|------|-----------------------------------------------------------------------------------|
| 160 ± 25 | <sup>16</sup> ANISOVICH   | 02 | SPEC | 0.6–1.9 $p\bar{p} \rightarrow \omega \pi^0$ ,<br>$\omega \eta \pi^0, \pi^+ \pi^-$ |
| 135 ± 75 | <sup>17,18</sup> COUPLAND | 77 | CNTR | 0.7–2.4 $\bar{p}p \rightarrow \bar{p}p$                                           |
| 98 ± 8   | <sup>18</sup> ALSPECTOR   | 73 | CNTR | $\bar{p}p$ S channel                                                              |
| ~ 85     | <sup>19</sup> ABRAMS      | 70 | CNTR | S channel $\bar{p}N$                                                              |

<sup>16</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

<sup>17</sup> From a fit to the total elastic cross section.

<sup>18</sup> Isospins 0 and 1 not separated.

<sup>19</sup> Seen as bump in  $I = 1$  state. See also COOPER 68. PEASLEE 75 confirm  $\bar{p}p$  results of ABRAMS 70, no narrow structure.

### Other processes

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |        |    |     |                                             |
|---------------|--------|----|-----|---------------------------------------------|
| 230 ± 50 ± 80 | AMELIN | 00 | VES | 37 $\pi^- p \rightarrow \eta \pi^+ \pi^- n$ |
|---------------|--------|----|-----|---------------------------------------------|

### $\rho_3(2250)$ REFERENCES

|           |     |                |                              |                     |
|-----------|-----|----------------|------------------------------|---------------------|
| ABLIKIM   | 20F | PR D101 032008 | M. Ablikim <i>et al.</i>     | (BESIII Collab.)    |
| ANISOVICH | 02  | PL B542 8      | A.V. Anisovich <i>et al.</i> |                     |
| ANISOVICH | 01D | PL B508 6      | A.V. Anisovich <i>et al.</i> |                     |
| ANISOVICH | 01E | PL B513 281    | A.V. Anisovich <i>et al.</i> |                     |
| AMELIN    | 00  | NP A668 83     | D. Amelin <i>et al.</i>      | (VES Collab.)       |
| ANISOVICH | 00J | PL B491 47     | A.V. Anisovich <i>et al.</i> | (RAL, LOQM, PNPI+)  |
| KLOET     | 96  | PR D53 6120    | W.M. Kloet, F. Myhrer        | (RUTG, NORD)        |
| HASAN     | 94  | PL B334 215    | A. Hasan, D.V. Bugg          | (LOQM)              |
| OAKDEN    | 94  | NP A574 731    | M.N. Oakden, M.R. Pennington | (DURH)              |
| MARTIN    | 80B | NP B176 355    | B.R. Martin, D. Morgan       | (LOUC, RHEL) JP     |
| MARTIN    | 80C | NP B169 216    | A.D. Martin, M.R. Pennington | (DURH) JP           |
| CARTER    | 78B | NP B141 467    | A.A. Carter                  | (LOQM)              |
| CUTTS     | 78B | PR D17 16      | D. Cutts <i>et al.</i>       | (STON, WISC)        |
| CARTER    | 77  | PL 67B 117     | A.A. Carter <i>et al.</i>    | (LOQM, RHEL) JP     |
| COUPLAND  | 77  | PL 71B 460     | M. Coupland <i>et al.</i>    | (LOQM, RHEL)        |
| PEASLEE   | 75  | PL 57B 189     | D.C. Peaslee <i>et al.</i>   | (CANB, BARI, BROW+) |
| ALSPECTOR | 73  | PRL 30 511     | J. Alspector <i>et al.</i>   | (RUTG, UPNJ)        |
| ABRAMS    | 70  | PR D1 1917     | R.J. Abrams <i>et al.</i>    | (BNL)               |
| COOPER    | 68  | PRL 20 1059    | W.A. Cooper <i>et al.</i>    | (ANL)               |

NODE=M044W1;LINKAGE=A

NODE=M044W1;LINKAGE=CC

NODE=M044W1;LINKAGE=P

NODE=M044W1;LINKAGE=K

NODE=M044W1;LINKAGE=J

NODE=M044W2

NODE=M044W2

NODE=M044W;LINKAGE=AY

NODE=M044W2;LINKAGE=E

NODE=M044W2;LINKAGE=I

NODE=M044W2;LINKAGE=B

NODE=M044W3

NODE=M044W3

NODE=M044

REFID=60256

REFID=48828

REFID=48327

REFID=48349

REFID=47432

REFID=47950

REFID=45212

REFID=44103

REFID=45210

REFID=21838

REFID=21837

REFID=21964

REFID=21733

REFID=21963

REFID=21830

REFID=21824

REFID=21813

REFID=21807

REFID=21805



$f_2(2300)$ 

$$I^G(J^{PC}) = 0^+(2^{++})$$

NODE=M107

 **$f_2(2300)$  MASS**

NODE=M107M

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|---------------------|------|-------------------------------------------------|
| <b>2297±28</b>                                                                | <sup>1</sup> ETKIN  | 88   | MPS 22 $\pi^- p \rightarrow \phi \phi n$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |      |                                                 |
| 2243 <sup>+7</sup> <sub>-6</sub> <sup>+3</sup> <sub>-29</sub>                 | <sup>2</sup> UEHARA | 13   | BELL $\gamma\gamma \rightarrow K_S^0 K_S^0$     |
| 2270±12                                                                       | VLADIMIRSK...06     | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$          |
| 2327± 9± 6                                                                    | ABE                 | 04   | BELL 10.6 $e^+ e^- \rightarrow e^+ e^- K^+ K^-$ |
| 2231±10                                                                       | BOOTH               | 86   | OMEG 85 $\pi^- Be \rightarrow 2\phi Be$         |
| 2220 <sup>+90</sup> <sub>-20</sub>                                            | LINDENBAUM          | 84   | RVUE                                            |
| 2320±40                                                                       | ETKIN               | 82   | MPS 22 $\pi^- p \rightarrow 2\phi n$            |

<sup>1</sup> Includes data of ETKIN 85. The percentage of the resonance going into  $\phi\phi 2^{++} S_2$ ,  $D_2$ , and  $D_0$  is 6<sup>+15</sup><sub>-5</sub>, 25<sup>+18</sup><sub>-14</sub>, and 69<sup>+16</sup><sub>-27</sub>, respectively.

<sup>2</sup> Spin 2 preferred, tentatively assigned to  $f_2(2300)$ .

NODE=M107M;LINKAGE=C

NODE=M107M;LINKAGE=A

 **$f_2(2300)$  WIDTH**

NODE=M107W

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|---------------------|------|-------------------------------------------------|
| <b>149±41</b>                                                                 | <sup>3</sup> ETKIN  | 88   | MPS 22 $\pi^- p \rightarrow \phi \phi n$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |      |                                                 |
| 145±12 <sup>+27</sup> <sub>-34</sub>                                          | <sup>4</sup> UEHARA | 13   | BELL $\gamma\gamma \rightarrow K_S^0 K_S^0$     |
| 90±29                                                                         | VLADIMIRSK...06     | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 n$          |
| 275±36±20                                                                     | ABE                 | 04   | BELL 10.6 $e^+ e^- \rightarrow e^+ e^- K^+ K^-$ |
| 133±50                                                                        | BOOTH               | 86   | OMEG 85 $\pi^- Be \rightarrow 2\phi Be$         |
| 200±50                                                                        | LINDENBAUM          | 84   | RVUE                                            |
| 220±70                                                                        | ETKIN               | 82   | MPS 22 $\pi^- p \rightarrow 2\phi n$            |

<sup>3</sup> Includes data of ETKIN 85.

<sup>4</sup> Spin 2 preferred, tentatively assigned to  $f_2(2300)$ .

NODE=M107W;LINKAGE=C

NODE=M107W;LINKAGE=A

 **$f_2(2300)$  DECAY MODES**

NODE=M107215;NODE=M107

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $\phi\phi$     | seen                           |
| $\Gamma_2$ $K\bar{K}$     | seen                           |
| $\Gamma_3$ $\gamma\gamma$ | seen                           |

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=3;OUR EST;→ UNCHECKED ←

 **$f_2(2300)$   $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

NODE=M107225

 $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ 
 $\Gamma_2\Gamma_3/\Gamma$ 

| VALUE (eV)                                                          | DOCUMENT ID      | TECN | COMMENT                                         |
|---------------------------------------------------------------------|------------------|------|-------------------------------------------------|
| 3.2 <sup>+0.5</sup> <sub>-0.4</sub> <sup>+1.3</sup> <sub>-2.2</sub> | UEHARA           | 13   | BELL $\gamma\gamma \rightarrow K_S^0 K_S^0$     |
| 44 ±6 ±12                                                           | <sup>5</sup> ABE | 04   | BELL 10.6 $e^+ e^- \rightarrow e^+ e^- K^+ K^-$ |

<sup>5</sup> Assuming spin 2.

NODE=M107G1

NODE=M107G1

NODE=M107G1;LINKAGE=AB

 **$f_2(2300)$  REFERENCES**

NODE=M107

|                 |    |                             |                                  |                    |
|-----------------|----|-----------------------------|----------------------------------|--------------------|
| UEHARA          | 13 | PTEP 2013 123C01            | S. Uehara <i>et al.</i>          | (BELLE Collab.)    |
| VLADIMIRSK...06 |    | PAN 69 493                  | V.V. Vladimirovsky <i>et al.</i> | (ITEP, Moscow)     |
|                 |    | Translated from YAF 69 515. |                                  |                    |
| ABE             | 04 | EPJ C32 323                 | K. Abe <i>et al.</i>             | (BELLE Collab.)    |
| ETKIN           | 88 | PL B201 568                 | A. Etkin <i>et al.</i>           | (BNL, CUNY)        |
| BOOTH           | 86 | NP B273 677                 | P.S.L. Booth <i>et al.</i>       | (LIVP, GLAS, CERN) |
| ETKIN           | 85 | PL 165B 217                 | A. Etkin <i>et al.</i>           | (BNL, CUNY)        |
| LINDENBAUM      | 84 | CNPP 13 285                 | S.J. Lindenbaum                  | (CUNY)             |
| ETKIN           | 82 | PRL 49 1620                 | A. Etkin <i>et al.</i>           | (BNL, CUNY)        |

REFID=55592

REFID=51191

REFID=49650

REFID=40285

REFID=21870

REFID=21871

REFID=21869

REFID=21866

**$f_4(2300)$** 

$$I^G(J^{PC}) = 0^+(4^{++})$$

NODE=M041

## OMITTED FROM SUMMARY TABLE

This entry was previously called  $U_0(2350)$ . Contains results mostly from formation experiments. For further production experiments see the Further States entry. See also  $\rho(2150)$ ,  $f_2(2150)$ ,  $\rho_3(2250)$ ,  $\rho_5(2350)$ .

NODE=M041

 **$f_4(2300)$  MASS**

NODE=M041205

NODE=M041M

 **$\bar{p}p \rightarrow \pi\pi$  or  $\bar{K}K$** 

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|---------------------|------|---------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |      |                                             |
| $\sim 2314$                                                                   | HASAN               | 94   | RVUE $\bar{p}p \rightarrow \pi\pi$          |
| $\sim 2300$                                                                   | <sup>1</sup> MARTIN | 80B  | RVUE                                        |
| $\sim 2300$                                                                   | <sup>1</sup> MARTIN | 80C  | RVUE                                        |
| $\sim 2340$                                                                   | <sup>2</sup> CARTER | 78B  | CNTR $0.7-2.4 \bar{p}p \rightarrow K^- K^+$ |
| $\sim 2330$                                                                   | DULUDE              | 78B  | OSPK $1-2 \bar{p}p \rightarrow \pi^0 \pi^0$ |
| $\sim 2310$                                                                   | <sup>3</sup> CARTER | 77   | CNTR $0.7-2.4 \bar{p}p \rightarrow \pi\pi$  |

NODE=M041M1  
NODE=M041M1

<sup>1</sup>  $I(J^P) = 0(4^+)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^- \pi^+$  and  $\pi^0 \pi^0$ .

<sup>2</sup>  $I(J^P) = 0(4^+)$  from Barrelet-zero analysis.

<sup>3</sup>  $I(J^P) = 0(4^+)$  from amplitude analysis.

NODE=M041M1;LINKAGE=P  
NODE=M041M1;LINKAGE=K  
NODE=M041M1;LINKAGE=J**S-CHANNEL  $\bar{p}p$  or  $\bar{N}N$** 

| VALUE (MeV)                                                                   | DOCUMENT ID              | TECN | COMMENT                                      |
|-------------------------------------------------------------------------------|--------------------------|------|----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |                                              |
| $2283 \pm 17$                                                                 | <sup>4</sup> ANISOVICH   | 00J  | SPEC                                         |
| $\sim 2380$                                                                   | <sup>5</sup> CUTTS       | 78B  | CNTR $0.97-3 \bar{p}p \rightarrow \bar{N}N$  |
| $2345 \pm 15$                                                                 | <sup>5,6</sup> COUPLAND  | 77   | CNTR $0.7-2.4 \bar{p}p \rightarrow \bar{p}p$ |
| $2359 \pm 2$                                                                  | <sup>5,7</sup> ALSPECTOR | 73   | CNTR $\bar{p}p$ S channel                    |
| $2375 \pm 10$                                                                 | ABRAMS                   | 70   | CNTR S channel $\bar{N}N$                    |

<sup>4</sup> From the combined analysis of ANISOVICH 99C and ANISOVICH 99F on  $\bar{p}p \rightarrow \eta \pi^0 \pi^0$ ,  $\pi^0 \pi^0$ ,  $\eta \eta$ ,  $\eta \eta'$ ,  $\pi^+ \pi^-$ .

<sup>5</sup> Isospins 0 and 1 not separated.

<sup>6</sup> From a fit to the total elastic cross section.

<sup>7</sup> Referred to as  $U$  or  $U$  region by ALSPECTOR 73.

NODE=M041M2  
NODE=M041M2

NODE=M041M2;LINKAGE=AN

NODE=M041M2;LINKAGE=I  
NODE=M041M2;LINKAGE=E  
NODE=M041M2;LINKAGE=M **$\pi^- p \rightarrow \eta \pi \pi n$** 

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|-------------|------|-------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                                 |
| $2330 \pm 20 \pm 40$                                                          | AMELIN      | 00   | VES $37 \pi^- p \rightarrow \eta \pi^+ \pi^- n$ |

NODE=M041M3  
NODE=M041M3 **$pp$  CENTRAL PRODUCTION**

| VALUE (MeV)                                  | DOCUMENT ID | COMMENT |
|----------------------------------------------|-------------|---------|
| <b><math>2320 \pm 60</math> OUR ESTIMATE</b> |             |         |

NODE=M041M4  
NODE=M041M4

→ UNCHECKED ←

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |          |     |                                            |
|---------------|----------|-----|--------------------------------------------|
| $2332 \pm 15$ | BARBERIS | 00F | 450 $pp \rightarrow p_f \omega \omega p_S$ |
|---------------|----------|-----|--------------------------------------------|

 **$f_4(2300)$  WIDTH**

NODE=M041210

 **$\bar{p}p \rightarrow \pi\pi$  or  $\bar{K}K$** 

| VALUE (MeV)                                                                   | DOCUMENT ID          | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|----------------------|------|---------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |      |                                             |
| $\sim 278$                                                                    | HASAN                | 94   | RVUE $\bar{p}p \rightarrow \pi\pi$          |
| $\sim 200$                                                                    | <sup>8</sup> MARTIN  | 80C  | RVUE                                        |
| $\sim 150$                                                                    | <sup>9</sup> CARTER  | 78B  | CNTR $0.7-2.4 \bar{p}p \rightarrow K^- K^+$ |
| $\sim 210$                                                                    | <sup>10</sup> CARTER | 77   | CNTR $0.7-2.4 \bar{p}p \rightarrow \pi\pi$  |

NODE=M041W1  
NODE=M041W1

<sup>8</sup>  $I(J^P) = 0(4^+)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^- \pi^+$  and  $\pi^0 \pi^0$ .

<sup>9</sup>  $I(J^P) = 0(4^+)$  from Barrelet-zero analysis.

<sup>10</sup>  $I(J^P) = 0(4^+)$  from amplitude analysis.

NODE=M041W1;LINKAGE=P  
NODE=M041W1;LINKAGE=K  
NODE=M041W1;LINKAGE=J

**S-CHANNEL  $\bar{p}p$  or  $\bar{N}N$** 

| VALUE (MeV)                                                                                                                                                                     | DOCUMENT ID               | TECN | COMMENT                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                   |                           |      |                                                      |
| $310 \pm 25$                                                                                                                                                                    | <sup>11</sup> ANISOVICH   | 00J  | SPEC                                                 |
| $135^{+150}_{-65}$                                                                                                                                                              | <sup>12,13</sup> COUPLAND | 77   | CNTR $0.7\text{--}2.4 \bar{p}p \rightarrow \bar{p}p$ |
| $165^{+18}_{-8}$                                                                                                                                                                | <sup>13</sup> ALSPECTOR   | 73   | CNTR $\bar{p}p$ S channel                            |
| $\sim 190$                                                                                                                                                                      | ABRAMS                    | 70   | CNTR S channel $\bar{N}N$                            |
| <sup>11</sup> From the combined analysis of ANISOVICH 99C and ANISOVICH 99F on $\bar{p}p \rightarrow \eta\pi^0\pi^0$ , $\pi^0\pi^0$ , $\eta\eta$ , $\eta\eta'$ , $\pi^+\pi^-$ . |                           |      |                                                      |
| <sup>12</sup> From a fit to the total elastic cross section.                                                                                                                    |                           |      |                                                      |
| <sup>13</sup> Isospins 0 and 1 not separated.                                                                                                                                   |                           |      |                                                      |

NODE=M041W2  
 NODE=M041W2

NODE=M041W2;LINKAGE=AN

NODE=M041W2;LINKAGE=E  
 NODE=M041W2;LINKAGE=I

 **$\pi^-p \rightarrow \eta\pi\pi n$** 

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|-------------|------|---------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |      |                                             |
| $235 \pm 50 \pm 40$                                                           | AMELIN      | 00   | VES $37 \pi^-p \rightarrow \eta\pi^+\pi^-n$ |

NODE=M041W3  
 NODE=M041W3

 **$pp$  CENTRAL PRODUCTION**

| VALUE (MeV)                                                                   | DOCUMENT ID | COMMENT                                      |
|-------------------------------------------------------------------------------|-------------|----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |                                              |
| $260 \pm 57$                                                                  | BARBERIS    | 00F $450 pp \rightarrow p_f\omega\omega p_s$ |

NODE=M041W4  
 NODE=M041W4  
 → UNCHECKED ←

 **$f_4(2300)$  DECAY MODES**

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $\rho\rho$     | seen                           |
| $\Gamma_2$ $\omega\omega$ | seen                           |
| $\Gamma_3$ $\eta\pi\pi$   | seen                           |
| $\Gamma_4$ $\pi\pi$       | seen                           |
| $\Gamma_5$ $K\bar{K}$     | seen                           |
| $\Gamma_6$ $N\bar{N}$     | seen                           |

NODE=M041215;NODE=M041

DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=3;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=5;OUR EST;→ UNCHECKED ←  
 DESIG=6;OUR EST;→ UNCHECKED ←

 **$f_4(2300)$  BRANCHING RATIOS**

| $\Gamma(\rho\rho)/\Gamma(\omega\omega)$                                       |             |                                                 |  | $\Gamma_1/\Gamma_2$ |
|-------------------------------------------------------------------------------|-------------|-------------------------------------------------|--|---------------------|
| VALUE                                                                         | DOCUMENT ID | COMMENT                                         |  |                     |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |                                                 |  |                     |
| $2.8\pm 0.5$                                                                  | BARBERIS    | 00F 450 $p p \rightarrow p_f \omega \omega p_s$ |  |                     |

NODE=M041220

NODE=M041R1  
 NODE=M041R1

 **$f_4(2300)$  REFERENCES**

|           |     |             |                              |                      |
|-----------|-----|-------------|------------------------------|----------------------|
| AMELIN    | 00  | NP A668 83  | D. Amelin <i>et al.</i>      | (VES Collab.)        |
| ANISOVICH | 00J | PL B491 47  | A.V. Anisovich <i>et al.</i> | (RAL, LOQM, PNPI+)   |
| BARBERIS  | 00F | PL B484 198 | D. Barberis <i>et al.</i>    | (WA 102 Collab.)     |
| ANISOVICH | 99C | PL B452 173 | A.V. Anisovich <i>et al.</i> |                      |
| ANISOVICH | 99F | NP A651 253 | A.V. Anisovich <i>et al.</i> |                      |
| HASAN     | 94  | PL B334 215 | A. Hasan, D.V. Bugg          | (LOQM)               |
| MARTIN    | 80B | NP B176 355 | B.R. Martin, D. Morgan       | (LOUC, RHEL) JP      |
| MARTIN    | 80C | NP B169 216 | A.D. Martin, M.R. Pennington | (DURH) JP            |
| CARTER    | 78B | NP B141 467 | A.A. Carter                  | (LOQM)               |
| CUTTS     | 78B | PR D17 16   | D. Cutts <i>et al.</i>       | (STON, WISC)         |
| DULUDE    | 78B | PL 79B 335  | R.S. Dulude <i>et al.</i>    | (BROW, MIT, BARI) JP |
| CARTER    | 77  | PL 67B 117  | A.A. Carter <i>et al.</i>    | (LOQM, RHEL) JP      |
| COUPLAND  | 77  | PL 71B 460  | M. Coupland <i>et al.</i>    | (LOQM, RHEL)         |
| ALSPECTOR | 73  | PRL 30 511  | J. Alspector <i>et al.</i>   | (RUTG, UPNJ)         |
| ABRAMS    | 70  | PR D1 1917  | R.J. Abrams <i>et al.</i>    | (BNL)                |

NODE=M041

REFID=47432  
 REFID=47950  
 REFID=47962  
 REFID=46903  
 REFID=46926  
 REFID=44103  
 REFID=21838  
 REFID=21837  
 REFID=21964  
 REFID=21733  
 REFID=21850  
 REFID=21963  
 REFID=21830  
 REFID=21813  
 REFID=21807

$f_0(2330)$ 

$$I^G(J^{PC}) = 0^+(0^{++})$$

OMITTED FROM SUMMARY TABLE

 $f_0(2330)$  MASS

| VALUE (MeV)                                                                                                     | DOCUMENT ID       | TECN | COMMENT                                             |
|-----------------------------------------------------------------------------------------------------------------|-------------------|------|-----------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                   |                   |      |                                                     |
| $2314 \pm 25$                                                                                                   | <sup>1</sup> BUGG | 04A  | RVUE                                                |
| $2337 \pm 14$                                                                                                   | ANISOVICH         | 00J  | SPEC $2.0 \bar{p} p \rightarrow \pi \pi, \eta \eta$ |
| $\sim 2321$                                                                                                     | HASAN             | 94   | RVUE $\bar{p} p \rightarrow \pi \pi$                |
| <sup>1</sup> Partial wave analysis of the data on $p \bar{p} \rightarrow \bar{\Lambda} \Lambda$ from BARNES 00. |                   |      |                                                     |

NODE=M169M

NODE=M169M

NODE=M169M;LINKAGE=BU

 $f_0(2330)$  WIDTH

| VALUE (MeV)                                                                                                     | DOCUMENT ID       | TECN | COMMENT                                             |
|-----------------------------------------------------------------------------------------------------------------|-------------------|------|-----------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                   |                   |      |                                                     |
| $144 \pm 20$                                                                                                    | <sup>2</sup> BUGG | 04A  | RVUE                                                |
| $217 \pm 33$                                                                                                    | ANISOVICH         | 00J  | SPEC $2.0 \bar{p} p \rightarrow \pi \pi, \eta \eta$ |
| $\sim 223$                                                                                                      | HASAN             | 94   | RVUE $\bar{p} p \rightarrow \pi \pi$                |
| <sup>2</sup> Partial wave analysis of the data on $p \bar{p} \rightarrow \bar{\Lambda} \Lambda$ from BARNES 00. |                   |      |                                                     |

NODE=M169W

NODE=M169W

NODE=M169W;LINKAGE=BU

 $f_0(2330)$  REFERENCES

|           |     |               |                              |                    |
|-----------|-----|---------------|------------------------------|--------------------|
| BUGG      | 04A | EPJ C36 161   | D.V. Bugg                    |                    |
| ANISOVICH | 00J | PL B491 47    | A.V. Anisovich <i>et al.</i> | (RAL, LOQM, PNPI+) |
| BARNES    | 00  | PR C62 055203 | P.D. Barnes <i>et al.</i>    |                    |
| HASAN     | 94  | PL B334 215   | A. Hasan, D.V. Bugg          | (LOQM)             |

NODE=M169

REFID=50158  
REFID=47950  
REFID=47965  
REFID=44103

NODE=M108

 $f_2(2340)$ 

$$I^G(J^{PC}) = 0^+(2^{++})$$

 $f_2(2340)$  MASS

| VALUE (MeV)                                                                                                                                                                                          | EVTs | DOCUMENT ID          | TECN | COMMENT                                                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|------|----------------------------------------------------------------|
| <b><math>2345^{+50}_{-40}</math> OUR AVERAGE</b>                                                                                                                                                     |      |                      |      |                                                                |
| $2362^{+31+140}_{-30-63}$                                                                                                                                                                            | 5.5k | <sup>1</sup> ABLIKIM | 13N  | BES3 $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \eta \eta$ |
| $2339 \pm 55$                                                                                                                                                                                        |      | <sup>2</sup> ETKIN   | 88   | MPS $22 \pi^- p \rightarrow \phi \phi n$                       |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                        |      |                      |      |                                                                |
| $2350 \pm 7$                                                                                                                                                                                         | 80k  | <sup>3</sup> UMAN    | 06   | E835 $5.2 \bar{p} p \rightarrow \eta \eta \pi^0$               |
| $2392 \pm 10$                                                                                                                                                                                        |      | BOOTH                | 86   | OMEG $85 \pi^- \text{Be} \rightarrow 2 \phi \text{Be}$         |
| $2360 \pm 20$                                                                                                                                                                                        |      | LINDENBAUM           | 84   | RVUE                                                           |
| <sup>1</sup> From partial wave analysis including all possible combinations of $0^{++}$ , $2^{++}$ , and $4^{++}$ resonances.                                                                        |      |                      |      |                                                                |
| <sup>2</sup> Includes data of ETKIN 85. The percentage of the resonance going into $\phi \phi 2^{++} S_2$ , $D_2$ , and $D_0$ is $37 \pm 19$ , $4^{+12}_{-4}$ , and $59^{+21}_{-19}$ , respectively. |      |                      |      |                                                                |
| <sup>3</sup> Statistical error only.                                                                                                                                                                 |      |                      |      |                                                                |

NODE=M108M

NODE=M108M

NODE=M108M;LINKAGE=A

NODE=M108M;LINKAGE=C

NODE=M108M;LINKAGE=ST

 $f_2(2340)$  WIDTH

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID          | TECN | COMMENT                                                        |
|-------------------------------------------------------------------------------|------|----------------------|------|----------------------------------------------------------------|
| <b><math>322^{+70}_{-60}</math> OUR AVERAGE</b>                               |      |                      |      |                                                                |
| $334^{+62+165}_{-54-100}$                                                     | 5.5k | <sup>4</sup> ABLIKIM | 13N  | BES3 $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \eta \eta$ |
| $319^{+81}_{-69}$                                                             |      | <sup>5</sup> ETKIN   | 88   | MPS $22 \pi^- p \rightarrow \phi \phi n$                       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |      |                                                                |
| $218 \pm 16$                                                                  | 80k  | <sup>6</sup> UMAN    | 06   | E835 $5.2 \bar{p} p \rightarrow \eta \eta \pi^0$               |
| $198 \pm 50$                                                                  |      | BOOTH                | 86   | OMEG $85 \pi^- \text{Be} \rightarrow 2 \phi \text{Be}$         |
| $150^{+150}_{-50}$                                                            |      | LINDENBAUM           | 84   | RVUE                                                           |

NODE=M108W

NODE=M108W

<sup>4</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.  
<sup>5</sup> Includes data of ETKIN 85.  
<sup>6</sup> Statistical error only.

NODE=M108W;LINKAGE=A

NODE=M108W;LINKAGE=C  
NODE=M108W;LINKAGE=ST

NODE=M108215;NODE=M108

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=2

NODE=M108220

NODE=M108R01  
NODE=M108R01

NODE=M108

REFID=55387  
REFID=51063  
REFID=40285  
REFID=21870  
REFID=21871  
REFID=21869

NODE=M033

NODE=M033

NODE=M033205

NODE=M033M

NODE=M033M3  
NODE=M033M3

NODE=M033M1  
NODE=M033M1

NODE=M033M2  
NODE=M033M2

**$f_2(2340)$  DECAY MODES**

| Mode       |            | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------|------------|--------------------------------|
| $\Gamma_1$ | $\phi\phi$ | seen                           |
| $\Gamma_2$ | $\eta\eta$ | seen                           |

**$f_2(2340)$  BRANCHING RATIOS**

| $\Gamma(\eta\eta)/\Gamma_{\text{total}}$ |             |      |         | $\Gamma_2/\Gamma$                        |
|------------------------------------------|-------------|------|---------|------------------------------------------|
| VALUE                                    | DOCUMENT ID | TECN | COMMENT |                                          |
| seen                                     | UMAN        | 06   | E835    | $5.2 \bar{p}p \rightarrow \eta\eta\pi^0$ |

**$f_2(2340)$  REFERENCES**

|            |     |               |                            |                    |
|------------|-----|---------------|----------------------------|--------------------|
| ABLIKIM    | 13N | PR D87 092009 | Ablikim M. <i>et al.</i>   | (BESIII Collab.)   |
| UMAN       | 06  | PR D73 052009 | I. Uman <i>et al.</i>      | (FNAL E835)        |
| ETKIN      | 88  | PL B201 568   | A. Etkin <i>et al.</i>     | (BNL, CUNY)        |
| BOOTH      | 86  | NP B273 677   | P.S.L. Booth <i>et al.</i> | (LIVP, GLAS, CERN) |
| ETKIN      | 85  | PL 165B 217   | A. Etkin <i>et al.</i>     | (BNL, CUNY)        |
| LINDENBAUM | 84  | CNPP 13 285   | S.J. Lindenbaum            | (CUNY)             |

**$\rho_5(2350)$**

$$I^G(J^{PC}) = 1^+(5^--)$$

OMITTED FROM SUMMARY TABLE

This entry was previously called  $U_1(2400)$ . See also  $\rho(2150)$ ,  $f_2(2150)$ ,  $\rho_3(2250)$ ,  $f_4(2300)$ .

**$\rho_5(2350)$  MASS**

**$\pi^- p \rightarrow \omega\pi^0 n$**

| VALUE (MeV)                     | DOCUMENT ID | TECN | COMMENT                                     |
|---------------------------------|-------------|------|---------------------------------------------|
| <b><math>2330 \pm 35</math></b> | ALDE        | 95   | GAM2 $38 \pi^- p \rightarrow \omega\pi^0 n$ |

**$\bar{p}p \rightarrow \pi\pi$  or  $\bar{K}K$**

| VALUE (MeV)                                                                   | DOCUMENT ID         | TECN | CHG    | COMMENT                                        |
|-------------------------------------------------------------------------------|---------------------|------|--------|------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                     |      |        |                                                |
| ~ 2303                                                                        | HASAN               | 94   | RVUE   | $\bar{p}p \rightarrow \pi\pi$                  |
| ~ 2300                                                                        | <sup>1</sup> MARTIN | 80B  | RVUE   |                                                |
| ~ 2250                                                                        | <sup>1</sup> MARTIN | 80C  | RVUE   |                                                |
| ~ 2500                                                                        | <sup>2</sup> CARTER | 78B  | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow K^- K^+$ |
| ~ 2480                                                                        | <sup>3</sup> CARTER | 77   | CNTR 0 | $0.7\text{--}2.4 \bar{p}p \rightarrow \pi\pi$  |

**S-CHANNEL  $\bar{N}N$**

| VALUE (MeV)                                                                   | DOCUMENT ID              | TECN | CHG     | COMMENT                                                                               |
|-------------------------------------------------------------------------------|--------------------------|------|---------|---------------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |         |                                                                                       |
| $2300 \pm 45$                                                                 | <sup>4</sup> ANISOVICH   | 02   | SPEC    | $0.6\text{--}1.9 \bar{p}\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |
| $2295 \pm 30$                                                                 | ANISOVICH                | 00J  | SPEC    |                                                                                       |
| ~ 2380                                                                        | <sup>5</sup> CUTTS       | 78B  | CNTR    | $0.97\text{--}3 \bar{p}p \rightarrow \bar{N}N$                                        |
| $2345 \pm 15$                                                                 | <sup>5,6</sup> COUPLAND  | 77   | CNTR 0  | $0.7\text{--}2.4 \bar{p}p \rightarrow \bar{p}p$                                       |
| $2359 \pm 2$                                                                  | <sup>5,7</sup> ALSPECTOR | 73   | CNTR    | $\bar{p}p$ S channel                                                                  |
| $2350 \pm 10$                                                                 | <sup>8</sup> ABRAMS      | 70   | CNTR    | S channel $\bar{N}N$                                                                  |
| $2360 \pm 25$                                                                 | <sup>9</sup> OH          | 70B  | HDBC -0 | $\bar{p}(pn), K^*K2\pi$                                                               |

**$\pi^- p \rightarrow K^+ K^- n$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |       |    |      |   |                                    |
|----------|-------|----|------|---|------------------------------------|
| 2307 ± 6 | ALPER | 80 | CNTR | 0 | 62 $\pi^- p \rightarrow K^+ K^- n$ |
|----------|-------|----|------|---|------------------------------------|

<sup>1</sup>  $I(J^P) = 1(5^-)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^- \pi^+$  and  $\pi^0 \pi^0$ .

<sup>2</sup>  $I = 0(1); J^P = 5^-$  from Barrelet-zero analysis.

<sup>3</sup>  $I(J^P) = 1(5^-)$  from amplitude analysis.

<sup>4</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

<sup>5</sup> Isospins 0 and 1 not separated.

<sup>6</sup> From a fit to the total elastic cross section.

<sup>7</sup> Referred to as  $U$  or  $U$  region by ALSPECTOR 73.

<sup>8</sup> For  $I = 1 \bar{N}N$ .

<sup>9</sup> No evidence for this bump seen in the  $\bar{p}p$  data of CHAPMAN 71B. Narrow state not confirmed by OH 73 with more data.

NODE=M033M4  
NODE=M033M4

NODE=M033M1;LINKAGE=P  
NODE=M033M1;LINKAGE=K  
NODE=M033M1;LINKAGE=J  
NODE=M033M2;LINKAGE=AY

NODE=M033M2;LINKAGE=I  
NODE=M033M2;LINKAGE=E  
NODE=M033M2;LINKAGE=M  
NODE=M033M2;LINKAGE=A  
NODE=M033M2;LINKAGE=N

 **$\rho_5(2350)$  WIDTH**

NODE=M033210

 **$\pi^- p \rightarrow \omega \pi^0 n$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

|           |      |    |      |                                         |
|-----------|------|----|------|-----------------------------------------|
| 400 ± 100 | ALDE | 95 | GAM2 | 38 $\pi^- p \rightarrow \omega \pi^0 n$ |
|-----------|------|----|------|-----------------------------------------|

NODE=M033W3  
NODE=M033W3

 **$\bar{p}p \rightarrow \pi\pi$  or  $\bar{K}K$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |       |    |      |                               |
|-------|-------|----|------|-------------------------------|
| ~ 169 | HASAN | 94 | RVUE | $\bar{p}p \rightarrow \pi\pi$ |
|-------|-------|----|------|-------------------------------|

|       |           |     |      |  |
|-------|-----------|-----|------|--|
| ~ 250 | 10 MARTIN | 80B | RVUE |  |
|-------|-----------|-----|------|--|

|       |           |     |      |  |
|-------|-----------|-----|------|--|
| ~ 300 | 10 MARTIN | 80C | RVUE |  |
|-------|-----------|-----|------|--|

|       |           |     |      |   |                                        |
|-------|-----------|-----|------|---|----------------------------------------|
| ~ 150 | 11 CARTER | 78B | CNTR | 0 | 0.7-2.4 $\bar{p}p \rightarrow K^- K^+$ |
|-------|-----------|-----|------|---|----------------------------------------|

|       |           |    |      |   |                                       |
|-------|-----------|----|------|---|---------------------------------------|
| ~ 210 | 12 CARTER | 77 | CNTR | 0 | 0.7-2.4 $\bar{p}p \rightarrow \pi\pi$ |
|-------|-----------|----|------|---|---------------------------------------|

NODE=M033W1  
NODE=M033W1

**S-CHANNEL  $\bar{N}N$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |              |    |      |                                                                             |
|----------|--------------|----|------|-----------------------------------------------------------------------------|
| 260 ± 75 | 13 ANISOVICH | 02 | SPEC | 0.6-1.9 $p\bar{p} \rightarrow \omega \pi^0, \omega \eta \pi^0, \pi^+ \pi^-$ |
|----------|--------------|----|------|-----------------------------------------------------------------------------|

|                                              |           |     |      |  |
|----------------------------------------------|-----------|-----|------|--|
| 235 <sup>+</sup> <sub>40</sub> <sup>65</sup> | ANISOVICH | 00J | SPEC |  |
|----------------------------------------------|-----------|-----|------|--|

|                                               |                |    |      |   |                                         |
|-----------------------------------------------|----------------|----|------|---|-----------------------------------------|
| 135 <sup>+</sup> <sub>65</sub> <sup>150</sup> | 14,15 COUPLAND | 77 | CNTR | 0 | 0.7-2.4 $\bar{p}p \rightarrow \bar{p}p$ |
|-----------------------------------------------|----------------|----|------|---|-----------------------------------------|

|                                             |              |    |      |  |                      |
|---------------------------------------------|--------------|----|------|--|----------------------|
| 165 <sup>+</sup> <sub>8</sub> <sup>18</sup> | 15 ALSPECTOR | 73 | CNTR |  | $\bar{p}p$ S channel |
|---------------------------------------------|--------------|----|------|--|----------------------|

|      |       |     |      |    |                           |
|------|-------|-----|------|----|---------------------------|
| < 60 | 16 OH | 70B | HDBC | -0 | $\bar{p}(pn), K^* K 2\pi$ |
|------|-------|-----|------|----|---------------------------|

|       |        |     |      |  |                      |
|-------|--------|-----|------|--|----------------------|
| ~ 140 | ABRAMS | 67C | CNTR |  | S channel $\bar{p}N$ |
|-------|--------|-----|------|--|----------------------|

NODE=M033W2  
NODE=M033W2

 **$\pi^- p \rightarrow K^+ K^- n$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |       |    |      |   |                                    |
|----------|-------|----|------|---|------------------------------------|
| 245 ± 20 | ALPER | 80 | CNTR | 0 | 62 $\pi^- p \rightarrow K^+ K^- n$ |
|----------|-------|----|------|---|------------------------------------|

<sup>10</sup>  $I(J^P) = 1(5^-)$  from simultaneous analysis of  $p\bar{p} \rightarrow \pi^- \pi^+$  and  $\pi^0 \pi^0$ .

<sup>11</sup>  $I = 0(1); J^P = 5^-$  from Barrelet-zero analysis.

<sup>12</sup>  $I(J^P) = 1(5^-)$  from amplitude analysis.

<sup>13</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

<sup>14</sup> From a fit to the total elastic cross section.

<sup>15</sup> Isospins 0 and 1 not separated.

<sup>16</sup> No evidence for this bump seen in the  $\bar{p}p$  data of CHAPMAN 71B. Narrow state not confirmed by OH 73 with more data.

NODE=M033W4  
NODE=M033W4

OCCUR=2

NODE=M033W1;LINKAGE=P  
NODE=M033W1;LINKAGE=K  
NODE=M033W1;LINKAGE=J  
NODE=M033W2;LINKAGE=AY

NODE=M033W2;LINKAGE=E  
NODE=M033W2;LINKAGE=I  
NODE=M033W2;LINKAGE=N

$\rho_5(2350)$  REFERENCES

|           |     |              |                              |                           |
|-----------|-----|--------------|------------------------------|---------------------------|
| ANISOVICH | 02  | PL B542 8    | A.V. Anisovich <i>et al.</i> |                           |
| ANISOVICH | 01D | PL B508 6    | A.V. Anisovich <i>et al.</i> |                           |
| ANISOVICH | 01E | PL B513 281  | A.V. Anisovich <i>et al.</i> |                           |
| ANISOVICH | 00J | PL B491 47   | A.V. Anisovich <i>et al.</i> | (RAL, LOQM, PNPI+)        |
| ALDE      | 95  | ZPHY C66 379 | D.M. Alde <i>et al.</i>      | (GAMS Collab.) JP         |
| HASAN     | 94  | PL B334 215  | A. Hasan, D.V. Bugg          | (LOQM)                    |
| ALPER     | 80  | PL 94B 422   | B. Alper <i>et al.</i>       | (AMST, CERN, CRAC, MPIM+) |
| MARTIN    | 80B | NP B176 355  | B.R. Martin, D. Morgan       | (LOUC, RHEL) JP           |
| MARTIN    | 80C | NP B169 216  | A.D. Martin, M.R. Pennington | (DURH) JP                 |
| CARTER    | 78B | NP B141 467  | A.A. Carter                  | (LOQM)                    |
| CUTTS     | 78B | PR D17 16    | D. Cutts <i>et al.</i>       | (STON, WISC)              |
| CARTER    | 77  | PL 67B 117   | A.A. Carter <i>et al.</i>    | (LOQM, RHEL) JP           |
| COUPLAND  | 77  | PL 71B 460   | M. Coupland <i>et al.</i>    | (LOQM, RHEL)              |
| ALSPECTOR | 73  | PRL 30 511   | J. Alspector <i>et al.</i>   | (RUTG, UPNJ)              |
| OH        | 73  | NP B51 57    | B.Y. Oh <i>et al.</i>        | (MSU)                     |
| CHAPMAN   | 71B | PR D4 1275   | J.W. Chapman <i>et al.</i>   | (MICH)                    |
| ABRAMS    | 70  | PR D1 1917   | R.J. Abrams <i>et al.</i>    | (BNL)                     |
| OH        | 70B | PRL 24 1257  | B.Y. Oh <i>et al.</i>        | (MSU)                     |
| ABRAMS    | 67C | PRL 18 1209  | R.J. Abrams <i>et al.</i>    | (BNL)                     |

NODE=M033

REFID=48828  
REFID=48327  
REFID=48349  
REFID=47950  
REFID=44371  
REFID=44103  
REFID=21665  
REFID=21838  
REFID=21837  
REFID=21964  
REFID=21733  
REFID=21963  
REFID=21830  
REFID=21813  
REFID=21931  
REFID=21926  
REFID=21807  
REFID=21925  
REFID=21804

**X(2370)**

$$I^G(J^{PC}) = ?^?(??)$$

OMITTED FROM SUMMARY TABLE

NODE=M247

**X(2370) MASS**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID          | TECN     | COMMENT                                       |
|-------------------------------------------------------------------------------|------|----------------------|----------|-----------------------------------------------|
| <b>2341.6±6.5±5.7</b>                                                         |      | <sup>1</sup> ABLIKIM | 20Q BES3 | $J/\psi \rightarrow \gamma K \bar{K} \eta'$   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |          |                                               |
| 2376.3±8.7 <sup>+3.2</sup> <sub>-4.3</sub>                                    | 565  | ABLIKIM              | 11C BES3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |

<sup>1</sup> The state observed by ABLIKIM 11C at 2120 MeV is not observed with 90% CL upper limit of  $1.49 \times 10^{-5}$  for  $J/\psi \rightarrow \gamma X(2120) \rightarrow \gamma K^+ K^- \eta'$  and  $6.38 \times 10^{-6}$  for  $K_S^0 K_S^0 \eta'$ .

NODE=M247M

NODE=M247M

NODE=M247M;LINKAGE=A

**X(2370) WIDTH**

| VALUE (MeV)                                                                   | DOCUMENT ID          | TECN     | COMMENT                                       |
|-------------------------------------------------------------------------------|----------------------|----------|-----------------------------------------------|
| <b>117±10±8</b>                                                               | <sup>1</sup> ABLIKIM | 20Q BES3 | $J/\psi \rightarrow \gamma K \bar{K} \eta'$   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |          |                                               |
| 83±17 <sup>+44</sup> <sub>-6</sub>                                            | ABLIKIM              | 11C BES3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |

<sup>1</sup> The state observed by ABLIKIM 11C at 2120 MeV is not observed with 90% CL upper limit of  $1.49 \times 10^{-5}$  for  $J/\psi \rightarrow \gamma X(2120) \rightarrow \gamma K^+ K^- \eta'$  and  $6.38 \times 10^{-6}$  for  $K_S^0 K_S^0 \eta'$ .

NODE=M247W

NODE=M247W

NODE=M247W;LINKAGE=A

**X(2370) DECAY MODES**

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------|--------------------------------|
| $\Gamma_1$ $K^+ K^- \eta'$     | seen                           |
| $\Gamma_2$ $K_S^0 K_S^0 \eta'$ | seen                           |
| $\Gamma_3$ $\pi^+ \pi^- \eta'$ | seen                           |

NODE=M247215;NODE=M247

DESIG=1

DESIG=2

DESIG=3

**X(2370) BRANCHING RATIOS**

| $\Gamma(K^+ K^- \eta')/\Gamma_{\text{total}}$     |                    |             |                | $\Gamma_1/\Gamma$                             |
|---------------------------------------------------|--------------------|-------------|----------------|-----------------------------------------------|
| <u>VALUE</u>                                      | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                                               |
| seen                                              | ABLIKIM            | 20Q         | BES3           | $J/\psi \rightarrow \gamma K^+ K^- \eta'$     |
| $\Gamma(K_S^0 K_S^0 \eta')/\Gamma_{\text{total}}$ |                    |             |                | $\Gamma_2/\Gamma$                             |
| <u>VALUE</u>                                      | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                                               |
| seen                                              | ABLIKIM            | 20Q         | BES3           | $J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta'$ |
| $\Gamma(\pi^+ \pi^- \eta')/\Gamma_{\text{total}}$ |                    |             |                | $\Gamma_3/\Gamma$                             |
| <u>VALUE</u>                                      | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                                               |
| seen                                              | ABLIKIM            | 11C         | BES3           | $J/\psi \rightarrow \gamma \pi^+ \pi^- \eta'$ |

NODE=M247225

NODE=M247R01  
NODE=M247R01

NODE=M247R02  
NODE=M247R02

NODE=M247R00  
NODE=M247R00

**X(2370) REFERENCES**

|         |     |                |                          |                  |
|---------|-----|----------------|--------------------------|------------------|
| ABLIKIM | 20Q | EPJ C80 746    | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| ABLIKIM | 11C | PRL 106 072002 | M. Ablikim <i>et al.</i> | (BESIII Collab.) |

NODE=M247

REFID=60457  
REFID=53684

$f_6(2510)$

$$I^G(J^{PC}) = 0^+(6^{++})$$

OMITTED FROM SUMMARY TABLE  
Needs confirmation.

NODE=M089

NODE=M089

NODE=M089M

NODE=M089M

NODE=M089M;LINKAGE=AN

NODE=M089W

NODE=M089W

NODE=M089W;LINKAGE=AN

NODE=M089215;NODE=M089

DESIG=1

NODE=M089220

NODE=M089R1  
NODE=M089R1

NODE=M089R1;LINKAGE=A

NODE=M089

REFID=47942  
REFID=47950  
REFID=46903  
REFID=46926  
REFID=47416  
REFID=47472  
REFID=46605  
REFID=46914  
  
REFID=21780  
REFID=40288  
  
REFID=44705

**$f_6(2510)$  MASS**

| VALUE (MeV)                                                                                                               | DOCUMENT ID                         | TECN     | COMMENT                                 |
|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------|----------|-----------------------------------------|
| <b>2465±50 OUR AVERAGE</b>                                                                                                | Error includes scale factor of 2.1. |          |                                         |
| 2420±30                                                                                                                   | ALDE                                | 98 GAM4  | 100 $\pi^- p \rightarrow \pi^0 \pi^0 n$ |
| 2510±30                                                                                                                   | BINON                               | 84B GAM2 | 38 $\pi^- p \rightarrow n 2\pi^0$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                             |                                     |          |                                         |
| 2485±40                                                                                                                   | <sup>1</sup> ANISOVICH              | 00J SPEC | 1.92–2.41 $p\bar{p}$                    |
| <sup>1</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99F, ANISOVICH 99J, ANISOVICH 99K, and ANISOVICH 00B. |                                     |          |                                         |

**$f_6(2510)$  WIDTH**

| VALUE (MeV)                                                                                                               | DOCUMENT ID            | TECN     | COMMENT                                 |
|---------------------------------------------------------------------------------------------------------------------------|------------------------|----------|-----------------------------------------|
| <b>255±40 OUR AVERAGE</b>                                                                                                 |                        |          |                                         |
| 270±60                                                                                                                    | ALDE                   | 98 GAM4  | 100 $\pi^- p \rightarrow \pi^0 \pi^0 n$ |
| 240±60                                                                                                                    | BINON                  | 84B GAM2 | 38 $\pi^- p \rightarrow n 2\pi^0$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                             |                        |          |                                         |
| 410±90                                                                                                                    | <sup>2</sup> ANISOVICH | 00J SPEC | 1.92–2.41 $p\bar{p}$                    |
| <sup>2</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99F, ANISOVICH 99J, ANISOVICH 99K, and ANISOVICH 00B. |                        |          |                                         |

**$f_6(2510)$  DECAY MODES**

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1 \quad \pi \pi$ | (6.0±1.0) %                    |

**$f_6(2510)$  BRANCHING RATIOS**

| $\Gamma(\pi\pi)/\Gamma_{\text{total}}$                                | DOCUMENT ID        | TECN     | COMMENT                            | $\Gamma_1/\Gamma$ |
|-----------------------------------------------------------------------|--------------------|----------|------------------------------------|-------------------|
| <b>0.06±0.01</b>                                                      | <sup>3</sup> BINON | 83C GAM2 | 38 $\pi^- p \rightarrow n 4\gamma$ |                   |
| <sup>3</sup> Assuming one pion exchange and using data of BOLOTOV 74. |                    |          |                                    |                   |

**$f_6(2510)$  REFERENCES**

|               |                              |                              |                       |
|---------------|------------------------------|------------------------------|-----------------------|
| ANISOVICH 00B | NP A662 319                  | A.V. Anisovich <i>et al.</i> |                       |
| ANISOVICH 00J | PL B491 47                   | A.V. Anisovich <i>et al.</i> | (RAL, LOQM, PNPI+)    |
| ANISOVICH 99C | PL B452 173                  | A.V. Anisovich <i>et al.</i> |                       |
| ANISOVICH 99F | NP A651 253                  | A.V. Anisovich <i>et al.</i> |                       |
| ANISOVICH 99J | PL B471 271                  | A.V. Anisovich <i>et al.</i> |                       |
| ANISOVICH 99K | PL B468 309                  | A.V. Anisovich <i>et al.</i> |                       |
| ALDE 98       | EPJ A3 361                   | D. Alde <i>et al.</i>        | (GAM4 Collab.)        |
| Also          | PAN 62 405                   | D. Alde <i>et al.</i>        | (GAMS Collab.)        |
|               | Translated from YAF 62 446.  |                              |                       |
| BINON 84B     | LNC 39 41                    | F.G. Binon <i>et al.</i>     | (SERP, BELG, LAPP) JP |
| BINON 83C     | SJNP 38 723                  | F.G. Binon <i>et al.</i>     | (SERP, BRUX+)         |
|               | Translated from YAF 38 1199. |                              |                       |
| BOLOTOV 74    | PL 52B 489                   | V.N. Bolotov <i>et al.</i>   | (SERP)                |



# OTHER LIGHT MESONS

## Further States

### OMITTED FROM SUMMARY TABLE

This section contains states observed by a single group or states poorly established that thus need confirmation.

### QUANTUM NUMBERS, MASSES, WIDTHS, AND BRANCHING RATIOS

| <b>X(360)</b> $I^G(J^{PC}) = ?^?(?^{++})$ |             |      |                           |      |                                       |
|-------------------------------------------|-------------|------|---------------------------|------|---------------------------------------|
| MASS (MeV)                                | WIDTH (MeV) | EVTs | DOCUMENT ID               | TECN | COMMENT                               |
| $360 \pm 7 \pm 9$                         | $64 \pm 18$ | 2.3k | <sup>1</sup> ABRAAMYAN 09 | CNTR | $2.75 d C \rightarrow \gamma\gamma X$ |

<sup>1</sup> Not seen in  $p C \rightarrow \gamma\gamma X$  at 5.5 GeV/c.

NODE=MXXX015

NODE=M300

NODE=M300

NODE=M300K08  
NODE=M300K08

NODE=M300K08;LINKAGE=AB

| <b>X(1070)</b> $I^G(J^{PC}) = ?^?(0^{++})$ |               |  |                              |  |                                                 |
|--------------------------------------------|---------------|--|------------------------------|--|-------------------------------------------------|
| MASS (MeV)                                 | WIDTH (MeV)   |  | DOCUMENT ID                  |  | COMMENT                                         |
| $1072 \pm 1$                               | $3.5 \pm 0.5$ |  | <sup>1</sup> VLADIMIRSK...08 |  | $40 \pi^- p \rightarrow K_S^0 K_S^0 n + m\pi^0$ |

<sup>1</sup> Supersedes GRIGOR'EV 05.

NODE=M300J07  
NODE=M300J07

NODE=M300J07;LINKAGE=VL

| <b>X(1110)</b> $I^G(J^{PC}) = 0^+(\text{even}^{++})$ |                    |  |             |      |         |
|------------------------------------------------------|--------------------|--|-------------|------|---------|
| MASS (MeV)                                           | WIDTH (MeV)        |  | DOCUMENT ID | TECN | COMMENT |
| $1107 \pm 4$                                         | $111 \pm 8 \pm 15$ |  | DAFTARI     | 87   | DBC     |

0.  $\bar{p} n \rightarrow \rho^- \pi^+ \pi^-$

NODE=M300J30  
NODE=M300J30

| <b>f<sub>0</sub>(1200–1600)</b> $I^G(J^{PC}) = 0^+(0^{++})$ |                     |              |                 |      |                                        |
|-------------------------------------------------------------|---------------------|--------------|-----------------|------|----------------------------------------|
| MASS (MeV)                                                  | WIDTH (MeV)         |              | DOCUMENT ID     | TECN | COMMENT                                |
| $1323 \pm 8$                                                | $237 \pm 20$        |              | VLADIMIRSK...06 | SPEC | $40 \pi^- p \rightarrow K_S^0 K_S^0 n$ |
| $1480^{+100}_{-150}$                                        | $1030^{+80}_{-170}$ | <sup>1</sup> | ANISOVICH 03    | SPEC |                                        |
| $1530^{+90}_{-250}$                                         | $560 \pm 40$        | <sup>2</sup> | ANISOVICH 03    | SPEC |                                        |

NODE=M300J98  
NODE=M300J98

OCCUR=2

<sup>1</sup> K-matrix pole from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K \bar{K} n$ ,  $\pi^+ \pi^- \rightarrow \pi^+ \pi^-$ ,  $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^+ \pi^- \pi^0$ ,  $K^+ K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^0$ ,  $K^+ K_S^0 \pi^-$  at rest,  $\bar{p} n \rightarrow \pi^- \pi^- \pi^+$ ,  $K_S^0 K^- \pi^0$ ,  $K_S^0 K_S^0 \pi^-$  at rest.

NODE=M300;LINKAGE=KM

<sup>2</sup> K-matrix pole from combined analysis of  $\pi^- p \rightarrow \pi^0 \pi^0 n$ ,  $\pi^- p \rightarrow K \bar{K} n$ ,  $\bar{p} p \rightarrow \pi^0 \pi^0 \pi^0$ ,  $\pi^0 \pi^0 \eta$ ,  $\pi^0 \pi^0 \eta$  at rest.

NODE=M300;LINKAGE=MK

| <b>X(1420)</b> $I^G(J^{PC}) = 2^+(0^{++})$ |              |  |             |      |         |
|--------------------------------------------|--------------|--|-------------|------|---------|
| MASS (MeV)                                 | WIDTH (MeV)  |  | DOCUMENT ID | TECN | COMMENT |
| $1420 \pm 20$                              | $160 \pm 10$ |  | FILIPPI     | 00   | OBLX    |

0  $\bar{n} p \rightarrow \pi^+ \pi^+ \pi^-$

NODE=M300J61  
NODE=M300J61

| <b>X(1545)</b> $I^G(J^{PC}) = ?^?(?^{++})$ |               |              |                 |  |                                                 |
|--------------------------------------------|---------------|--------------|-----------------|--|-------------------------------------------------|
| MASS (MeV)                                 | WIDTH (MeV)   |              | DOCUMENT ID     |  | COMMENT                                         |
| $1545 \pm 3$                               | $6.0 \pm 2.5$ | <sup>1</sup> | VLADIMIRSK...08 |  | $40 \pi^- p \rightarrow K_S^0 K_S^0 n + m\pi^0$ |

<sup>1</sup> Supersedes VLADIMIRSKII 00.

NODE=M300K07  
NODE=M300K07

NODE=M300K07;LINKAGE=VL

| <b>X(1575)</b> $I^G(J^{PC}) = ?^?(1^{--})$ |                          |              |             |      |         |
|--------------------------------------------|--------------------------|--------------|-------------|------|---------|
| MASS (MeV)                                 | WIDTH (MeV)              |              | DOCUMENT ID | TECN | COMMENT |
| $1576^{+49+98}_{-55-91}$                   | $818^{+22+64}_{-23-133}$ | <sup>1</sup> | ABLIKIM     | 06S  | BES     |

$J/\psi \rightarrow K^+ K^- \pi^0$

NODE=M300J08  
NODE=M300J08

<sup>1</sup> A broad peak observed at  $K^+ K^-$  invariant mass. Mass and width above are its pole position. The observed branching ratio is  $B(J/\psi \rightarrow X \pi^0) B(X \rightarrow K^+ K^-) = (8.5 \pm 0.6^{+2.7}_{-3.6}) \times 10^{-4}$ .

NODE=M300J08;LINKAGE=AB

| <b>X(1600)</b> $J^{PC} = 2^+(2^{++})$ |                    |                               |             |                                              |  |
|---------------------------------------|--------------------|-------------------------------|-------------|----------------------------------------------|--|
| <u>MASS (MeV)</u>                     | <u>WIDTH (MeV)</u> | <u>DOCUMENT ID</u>            | <u>TECN</u> | <u>COMMENT</u>                               |  |
| 1600±100                              | 400 ± 200          | <sup>1</sup> ALBRECHT 91F ARG | 10.2        | $e^+ e^- \rightarrow e^+ e^- 2(\pi^+ \pi^-)$ |  |
| <sup>1</sup> Our estimate.            |                    |                               |             |                                              |  |

NODE=M300J99  
NODE=M300J99

NODE=M300J99;LINKAGE=A

| <b>X(1650)</b> $J^{PC} = 0^-(?^{-})$ |             |      |               |      |                                         |
|--------------------------------------|-------------|------|---------------|------|-----------------------------------------|
| MASS (MeV)                           | WIDTH (MeV) | EVTS | DOCUMENT ID   | TECN | COMMENT                                 |
| 1652±7                               | <50         | 100  | PROKOSHKIN 96 | GAM2 | 32,38 $\pi p \rightarrow \omega \eta n$ |

NODE=M300J62  
NODE=M300J62

| <b>X(1730)</b> $J^{PC} = ?^?(?^{?+})$ |                 |      |                 |      |                                        |
|---------------------------------------|-----------------|------|-----------------|------|----------------------------------------|
| MASS (MeV)                            | WIDTH (MeV)     | EVTS | DOCUMENT ID     | TECN | COMMENT                                |
| 1731.0±1.2±2.0                        | 3.2 ± 0.8 ± 1.3 | 58   | VLADIMIRSK...07 | SPEC | 40 $\pi^- p \rightarrow K_S^0 K_S^0 X$ |

NODE=M300K06  
NODE=M300K06

| <b>X(1750)</b> $J^{PC} = ?^?(1^{- -})$                                                                                                                     |           |                     |             |                                        |                      |     |      |                                         |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------------|-------------|----------------------------------------|----------------------|-----|------|-----------------------------------------|--|
| MASS (MeV)                                                                                                                                                 |           |                     | WIDTH (MeV) |                                        | DOCUMENT ID          |     | TECN | COMMENT                                 |  |
| 1784                                                                                                                                                       | $\pm 12$  | $\pm \frac{0}{-27}$ | $106$       | $\pm \frac{22}{-19} \pm \frac{8}{-36}$ | <sup>1</sup> ABLIKIM | 20F | BES3 | $\psi(2S) \rightarrow K^+ K^- \eta$     |  |
| 1753.5                                                                                                                                                     | $\pm 1.5$ | $\pm 2.3$           | 122.2       | $\pm 6.2 \pm 8.0$                      | LINK                 | 02K | FOCS | 20–160 $\gamma p \rightarrow K^+ K^- p$ |  |
| <sup>1</sup> Seen in $\psi(2S)$ decay with branching ratio $\psi(2S) \rightarrow X \eta \rightarrow K^+ K^- \eta = (4.8 \pm 1.0 \pm 2.6) \times 10^{-6}$ . |           |                     |             |                                        |                      |     |      |                                         |  |

NODE=M300J94  
NODE=M300J94

NODE=M300J94;LINKAGE=A

| <b>B(X(1750) → <math>\bar{K}^*(892)^0 K^0 \rightarrow K^\pm \pi^\mp K_S^0</math>)/B(X(1750) → <math>K^+ K^-</math>)</b> |            |                    |             |      |
|-------------------------------------------------------------------------------------------------------------------------|------------|--------------------|-------------|------|
| <u>VALUE</u>                                                                                                            | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> |      |
| <0.065                                                                                                                  | 90         | LINK               | 02k         | FOCS |

| <b>B(X(1750) → <math>K^*(892)^\pm K^\mp \rightarrow K_S^0 \pi^\pm K^\mp</math>)/B(X(1750) → <math>K^+ K^-</math>)</b> |            |                    |             |      |
|-----------------------------------------------------------------------------------------------------------------------|------------|--------------------|-------------|------|
| <u>VALUE</u>                                                                                                          | <u>CL%</u> | <u>DOCUMENT ID</u> | <u>TECN</u> |      |
| <0.183                                                                                                                | 90         | LINK               | 02k         | FOCS |

NODE=M300B5  
NODE=M300B5

NODE=M300B6  
NODE=M300B6

| <b>f<sub>2</sub>(1750)</b> $J^{PC} = 0^+(2^{++})$ |             |      |                             |      |                                        |
|---------------------------------------------------|-------------|------|-----------------------------|------|----------------------------------------|
| MASS (MeV)                                        | WIDTH (MeV) | EVTS | DOCUMENT ID                 | TECN | COMMENT                                |
| 1755±10                                           | 67 ± 12     | 870  | <sup>1</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

NODE=M300JAM  
NODE=M300JAM

| <b>Γ(K<math>\bar{K}</math>)</b> |      |                             |      |                                        |  |
|---------------------------------|------|-----------------------------|------|----------------------------------------|--|
| VALUE (MeV)                     | EVTS | DOCUMENT ID                 | TECN | COMMENT                                |  |
| 17±5                            | 870  | <sup>2</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |  |

NODE=M300JA1  
NODE=M300JA1

| <b>Γ(γγ)</b> |      |                             |      |                                        |  |
|--------------|------|-----------------------------|------|----------------------------------------|--|
| VALUE (keV)  | EVTS | DOCUMENT ID                 | TECN | COMMENT                                |  |
| 0.13±0.04    | 870  | <sup>2</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |  |

NODE=M300JA2  
NODE=M300JA2

| <b>Γ(ππ)</b> |      |                             |      |                                        |  |
|--------------|------|-----------------------------|------|----------------------------------------|--|
| VALUE (MeV)  | EVTS | DOCUMENT ID                 | TECN | COMMENT                                |  |
| 1.3±1.0      | 870  | <sup>2</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |  |

NODE=M300JA3  
NODE=M300JA3

| <b>Γ(ηη)</b> |      |                             |      |                                        |  |
|--------------|------|-----------------------------|------|----------------------------------------|--|
| VALUE (MeV)  | EVTS | DOCUMENT ID                 | TECN | COMMENT                                |  |
| 2.0±0.5      | 870  | <sup>2</sup> SCHEGELSKY 06A | RVUE | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |  |

NODE=M300JA4  
NODE=M300JA4

<sup>1</sup> From analysis of L3 data at 91 and 183–209 GeV.

<sup>2</sup> From analysis of L3 data at 91 and 183–209 GeV and using SU(3) relations.

NODE=M300JAM;LINKAGE=SC  
NODE=M300JA;LINKAGE=SC

| <b>X(1775)</b> $J^{PC} = 1^-(?^{- +})$ |             |             |      |                                                     |  |
|----------------------------------------|-------------|-------------|------|-----------------------------------------------------|--|
| MASS (MeV)                             | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT                                             |  |
| 1763±20                                | 192 ± 60    | CONDO 91    | SHF  | $\gamma p \rightarrow (p \pi^+)(\pi^+ \pi^- \pi^-)$ |  |

NODE=M300J60  
NODE=M300J60

1787±18 118 ± 60 CONDO 91 SHF  $\gamma p \rightarrow n\pi^+\pi^+\pi^-$ 

OCCUR=2

| <b>X(1850 - 3100)</b> $I^G(J^{PC}) = ?^?(1^-)$                                               |     |                      |      |         |                                     |
|----------------------------------------------------------------------------------------------|-----|----------------------|------|---------|-------------------------------------|
| $\Gamma(e^+e^-) \cdot B(X \rightarrow \text{hadrons})$ (eV)                                  | CL% | DOCUMENT ID          | TECN | COMMENT |                                     |
| <120                                                                                         | 90  | <sup>1</sup> ANASHIN | 11   | KEDR    | $e^+e^- \rightarrow \text{hadrons}$ |
| <sup>1</sup> This limit is center-of-mass energy dependent. We quote the most stringent one. |     |                      |      |         |                                     |

NODE=M300K28  
NODE=M300K28

NODE=M300K28;LINKAGE=AN

| <b>X(1855)</b> $I^G(J^{PC}) = ?^?(???)$ |             |             |      |         |                                    |
|-----------------------------------------|-------------|-------------|------|---------|------------------------------------|
| MASS (MeV)                              | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                                    |
| 1856.6±5                                | 20 ± 5      | BRIDGES     | 86D  | SPEC    | 0. $\bar{p}d \rightarrow \pi\pi N$ |

NODE=M300J31  
NODE=M300J31

| <b>X(1870)</b> $I^G(J^{PC}) = ?^?(2^{??})$ |             |             |      |         |                                   |
|--------------------------------------------|-------------|-------------|------|---------|-----------------------------------|
| MASS (MeV)                                 | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                                   |
| 1870±40                                    | 250 ± 30    | ALDE        | 86D  | GAM4    | 100 $\pi^- p \rightarrow 2\eta X$ |

NODE=M300J45  
NODE=M300J45

| <b>a<sub>3</sub>(1875)</b> $I^G(J^{PC}) = 1^-(3^{++})$ |                 |             |      |         |                                              |
|--------------------------------------------------------|-----------------|-------------|------|---------|----------------------------------------------|
| MASS (MeV)                                             | WIDTH (MeV)     | DOCUMENT ID | TECN | COMMENT |                                              |
| 1874±43±96                                             | 385 ± 121 ± 114 | CHUNG       | 02   | B852    | 18.3 $\pi^- p \rightarrow \pi^+\pi^-\pi^- p$ |

NODE=M300J95  
NODE=M300J95

| <b>B(a<sub>3</sub>(1875) → f<sub>2</sub>(1270)π)/B(a<sub>3</sub>(1875) → ρπ)</b>                             |                    |             |                |                                                                        |
|--------------------------------------------------------------------------------------------------------------|--------------------|-------------|----------------|------------------------------------------------------------------------|
| <u>VALUE</u>                                                                                                 | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                                                                        |
| 0.8±0.2                                                                                                      | <sup>1</sup> CHUNG | 02          | B852           | 18.3 π <sup>-</sup> p → π <sup>+</sup> π <sup>-</sup> π <sup>-</sup> p |
| <sup>1</sup> Using the observable fractions of 50.0% ρπ, 56.5% f <sub>2</sub> π, and 11.8% ρ <sub>3</sub> π. |                    |             |                |                                                                        |

NODE=M300B7  
NODE=M300B7

NODE=M300B;LINKAGE=C1

| <b>B(a<sub>3</sub>(1875) → ρ<sub>3</sub>(1690)π)/B(a<sub>3</sub>(1875) → ρπ)</b>                             |                    |             |                |                                                                        |
|--------------------------------------------------------------------------------------------------------------|--------------------|-------------|----------------|------------------------------------------------------------------------|
| <u>VALUE</u>                                                                                                 | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                                                                        |
| 0.9±0.3                                                                                                      | <sup>1</sup> CHUNG | 02          | B852           | 18.3 π <sup>-</sup> p → π <sup>+</sup> π <sup>-</sup> π <sup>-</sup> p |
| <sup>1</sup> Using the observable fractions of 50.0% ρπ, 56.5% f <sub>2</sub> π, and 11.8% ρ <sub>3</sub> π. |                    |             |                |                                                                        |

NODE=M300B8  
NODE=M300B8

NODE=M300B8;LINKAGE=C1

| <b>a<sub>1</sub>(1930)</b> $I^G(J^{PC}) = 1^-(1^{++})$ |             |             |      |         |                                                          |
|--------------------------------------------------------|-------------|-------------|------|---------|----------------------------------------------------------|
| MASS (MeV)                                             | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                                                          |
| 1930 <sup>+30</sup> <sub>-70</sub>                     | 155 ± 45    | ANISOVICH   | 01F  | SPEC    | 2.0 $\bar{p}p \rightarrow 3\pi^0, \pi^0\eta, \pi^0\eta'$ |

NODE=M300J92  
NODE=M300J92

| <b>X(1935)</b> $I^G(J^{PC}) = 1^+(1^{-?})$ |             |              |      |         |                                       |
|--------------------------------------------|-------------|--------------|------|---------|---------------------------------------|
| MASS (MeV)                                 | WIDTH (MeV) | DOCUMENT ID  | TECN | COMMENT |                                       |
| 1935±20                                    | 215 ± 30    | EVANGELIS... | 79   | OMEG    | 10,16 $\pi^- p \rightarrow \bar{p}pn$ |

NODE=M300J33  
NODE=M300J33

| <b>ρ<sub>2</sub>(1940)</b> $I^G(J^{PC}) = 1^+(2^{--})$ |             |                        |      |         |                                                                         |
|--------------------------------------------------------|-------------|------------------------|------|---------|-------------------------------------------------------------------------|
| MASS (MeV)                                             | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                                                                         |
| 1940±40                                                | 155 ± 40    | <sup>1</sup> ANISOVICH | 02   | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |

NODE=M300J85  
NODE=M300J85<sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300J85;LINKAGE=AY

| <b>ω<sub>3</sub>(1945)</b> $I^G(J^{PC}) = 0^-(3^{--})$ |             |                        |      |         |                                                             |
|--------------------------------------------------------|-------------|------------------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                                             | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                                                             |
| 1945±20                                                | 115 ± 22    | <sup>1</sup> ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

NODE=M300J65  
NODE=M300J65<sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J65;LINKAGE=AZ

| <b>a<sub>2</sub>(1950)</b> $I^G(J^{PC}) = 1^-(2^{++})$ |                                   |                        |      |         |                      |
|--------------------------------------------------------|-----------------------------------|------------------------|------|---------|----------------------|
| MASS (MeV)                                             | WIDTH (MeV)                       | DOCUMENT ID            | TECN | COMMENT |                      |
| 1950 <sup>+30</sup> <sub>-70</sub>                     | 180 <sup>+30</sup> <sub>-70</sub> | <sup>1</sup> ANISOVICH | 01F  | SPEC    | 1.96–2.41 $\bar{p}p$ |

NODE=M300K24  
NODE=M300K24

<sup>1</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99E, and ANISOVICH 01F.

NODE=M300K24;LINKAGE=AN

| <b><math>\omega(1960)</math> <math>I^G(J^{PC}) = 0^-(1^--)</math></b> |             |                        |      |         |                                                             |
|-----------------------------------------------------------------------|-------------|------------------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                                                            | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                                                             |
| 1960 ± 25                                                             | 195 ± 60    | <sup>1</sup> ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

NODE=M300J79  
NODE=M300J79

<sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J79;LINKAGE=AZ

| <b><math>b_1(1960)</math> <math>I^G(J^{PC}) = 1^+(1^{+-})</math></b> |             |                        |      |         |                                                                         |
|----------------------------------------------------------------------|-------------|------------------------|------|---------|-------------------------------------------------------------------------|
| MASS (MeV)                                                           | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                                                                         |
| 1960 ± 35                                                            | 230 ± 50    | <sup>1</sup> ANISOVICH | 02   | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |

NODE=M300J67  
NODE=M300J67

<sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300J67;LINKAGE=AY

| <b><math>h_1(1965)</math> <math>I^G(J^{PC}) = 0^-(1^{+-})</math></b> |             |                        |      |         |                                                             |
|----------------------------------------------------------------------|-------------|------------------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                                                           | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                                                             |
| 1965 ± 45                                                            | 345 ± 75    | <sup>1</sup> ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

NODE=M300J64  
NODE=M300J64

<sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J64;LINKAGE=AZ

| <b><math>f_1(1970)</math> <math>I^G(J^{PC}) = 0^+(1^{++})</math></b> |             |             |      |         |  |
|----------------------------------------------------------------------|-------------|-------------|------|---------|--|
| MASS (MeV)                                                           | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |  |
| 1971 ± 15                                                            | 240 ± 45    | ANISOVICH   | 00J  | SPEC    |  |

NODE=M300J1  
NODE=M300J1

| <b><math>X(1970)</math> <math>I^G(J^{PC}) = ?^?(??)</math></b> |             |              |      |         |                                     |
|----------------------------------------------------------------|-------------|--------------|------|---------|-------------------------------------|
| MASS (MeV)                                                     | WIDTH (MeV) | DOCUMENT ID  | TECN | COMMENT |                                     |
| 1970 ± 10                                                      | 40 ± 20     | CHLIAPNIK... | 80   | HBC     | 32 $K^+p \rightarrow 2K_S^0 2\pi X$ |

NODE=M300J46  
NODE=M300J46

| <b><math>X(1975)</math> <math>I^G(J^{PC}) = ?^?(??)</math></b> |             |      |             |      |                                         |
|----------------------------------------------------------------|-------------|------|-------------|------|-----------------------------------------|
| MASS (MeV)                                                     | WIDTH (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT                                 |
| 1973 ± 15                                                      | 80          | 30   | CASO        | 70   | HBC 11.2 $\pi^-p \rightarrow \rho 2\pi$ |

NODE=M300J47  
NODE=M300J47

| <b><math>\omega_2(1975)</math> <math>I^G(J^{PC}) = 0^-(2^{--})</math></b> |             |                        |      |         |                                                             |
|---------------------------------------------------------------------------|-------------|------------------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                                                                | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                                                             |
| 1975 ± 20                                                                 | 175 ± 25    | <sup>1</sup> ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

<sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J81  
NODE=M300J81

NODE=M300J81;LINKAGE=AZ

| <b><math>a_2(1990)</math> <math>I^G(J^{PC}) = 1^-(2^{++})</math></b> |                |      |                         |      |                                                 |
|----------------------------------------------------------------------|----------------|------|-------------------------|------|-------------------------------------------------|
| MASS (MeV)                                                           | WIDTH (MeV)    | EVTs | DOCUMENT ID             | TECN | COMMENT                                         |
| 2050 ± 10 ± 40                                                       | 190 ± 22 ± 100 | 18k  | <sup>1</sup> SCHEGELSKY | 06   | RVUE $\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$ |
| 2003 ± 10 ± 19                                                       | 249 ± 23 ± 32  |      | LU                      | 05   | B852 18 $\pi^-p \rightarrow \omega\pi^-\pi^0p$  |

<sup>1</sup> From analysis of L3 data at 183–209 GeV.

NODE=M300J2  
NODE=M300J2

NODE=M300J2;LINKAGE=SC

| <b><math>\Gamma(\gamma\gamma) \Gamma(\pi^+\pi^-\pi^0) / \Gamma(\text{total})</math></b> |      |                         |      |         |                                            |
|-----------------------------------------------------------------------------------------|------|-------------------------|------|---------|--------------------------------------------|
| VALUE (keV)                                                                             | EVTs | DOCUMENT ID             | TECN | COMMENT |                                            |
| 0.11 ± 0.04 ± 0.05                                                                      | 18k  | <sup>1</sup> SCHEGELSKY | 06   | RVUE    | $\gamma\gamma \rightarrow \pi^+\pi^-\pi^0$ |

<sup>1</sup> From analysis of L3 data at 183–209 GeV.

NODE=M300J2G  
NODE=M300J2G

NODE=M300J2G;LINKAGE=SC

| <b><math>\rho(2000)</math> <math>I^G(J^{PC}) = 1^+(1^{--})</math></b> |             |                   |      |         |                               |
|-----------------------------------------------------------------------|-------------|-------------------|------|---------|-------------------------------|
| MASS (MeV)                                                            | WIDTH (MeV) | DOCUMENT ID       | TECN | COMMENT |                               |
| 2000 ± 30                                                             | 260 ± 45    | <sup>1</sup> BUGG | 04C  | RVUE    | Compilation                   |
| ~ 1988                                                                | ~ 244       | HASAN             | 94   | RVUE    | $\bar{p}p \rightarrow \pi\pi$ |

NODE=M300J77  
NODE=M300J77

<sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300;LINKAGE=AY

| <b><math>f_2(2000)</math></b> |             | $I^G(J^{PC}) = 0^+(2^{++})$ |      |         |                               |
|-------------------------------|-------------|-----------------------------|------|---------|-------------------------------|
| MASS (MeV)                    | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT |                               |
| 2001 ± 10                     | 312 ± 32    | ANISOVICH                   | 00J  | SPEC    |                               |
| ~ 1996                        | ~ 134       | HASAN                       | 94   | RVUE    | $\bar{p}p \rightarrow \pi\pi$ |

NODE=M300J25  
NODE=M300J25

| <b><math>X(2000)</math></b> |             | $I^G(J^{PC}) = 1^-(\gamma^+)$ |      |      |                                                   |
|-----------------------------|-------------|-------------------------------|------|------|---------------------------------------------------|
| MASS (MeV)                  | WIDTH (MeV) | DOCUMENT ID                   | TECN | CHG  | COMMENT                                           |
| 1964 ± 35                   | 225 ± 50    | <sup>1</sup> ARMSTRONG        | 93D  | E760 | $\bar{p}p \rightarrow 3\pi^0 \rightarrow 6\gamma$ |
| ~ 2100                      | ~ 500       | <sup>1</sup> ANTIPOV          | 77   | CIBS | – 25 $\pi^- p \rightarrow p\pi^- \rho_3$          |
| 2214 ± 15                   | 355 ± 21    | <sup>2</sup> BALTAY           | 77   | HBC  | 0 15 $\pi^- p \rightarrow \Delta^{++} 3\pi$       |
| 2080 ± 40                   | 340 ± 80    | KALELKAR                      | 75   | HBC  | + 15 $\pi^+ p \rightarrow p\pi^+ \rho_3$          |

NODE=M300K01  
NODE=M300K01

<sup>1</sup> Cannot determine spin to be 3.

<sup>2</sup> BALTAY 77 favors  $J^P = ,3^+$ .

NODE=M300K01;LINKAGE=AA  
NODE=M300K01;LINKAGE=B

| <b><math>X(2000)</math></b> |             | $I^G(J^{PC}) = ?^?(4^{++})$ |      |                                       |  |
|-----------------------------|-------------|-----------------------------|------|---------------------------------------|--|
| MASS (MeV)                  | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT                               |  |
| 1998 ± 3 ± 5                | <15         | VLADIMIRSK...03             | SPEC | $\pi^- p \rightarrow K_S^0 K_S^0 M M$ |  |

NODE=M300J97  
NODE=M300J97

| <b><math>\eta(2010)</math></b>     |             | $I^G(J^{PC}) = 0^+(0^{-+})$ |      |         |  |
|------------------------------------|-------------|-----------------------------|------|---------|--|
| MASS (MeV)                         | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT |  |
| 2010 <sup>+35</sup> <sub>-60</sub> | 270 ± 60    | ANISOVICH                   | 00J  | SPEC    |  |

NODE=M300J5  
NODE=M300J5

| <b><math>\pi_1(2015)</math></b> |               | $I^G(J^{PC}) = 1^-(1^{-+})$ |             |      |                                                       |
|---------------------------------|---------------|-----------------------------|-------------|------|-------------------------------------------------------|
| MASS (MeV)                      | WIDTH (MeV)   | EVTS                        | DOCUMENT ID | TECN | COMMENT                                               |
| 2014 ± 20 ± 16                  | 230 ± 32 ± 73 | 145k                        | LU          | 05   | B852 18 $\pi^- p \rightarrow \omega\pi^- \pi^0 p$     |
| 2001 ± 30 ± 92                  | 333 ± 52 ± 49 | 69k                         | KUHN        | 04   | B852 18 $\pi^- p \rightarrow \eta\pi^+ \pi^- \pi^- p$ |

NODE=M300J05  
NODE=M300J05

| <b><math>a_0(2020)</math></b> |             | $I^G(J^{PC}) = 1^-(0^{++})$ |      |         |  |
|-------------------------------|-------------|-----------------------------|------|---------|--|
| MASS (MeV)                    | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT |  |
| 2025 ± 30                     | 330 ± 75    | ANISOVICH                   | 99C  | SPEC    |  |

NODE=M300J6  
NODE=M300J6

| <b><math>X(2020)</math></b> |             | $I^G(J^{PC}) = ?^?(??)$ |      |         |                                          |
|-----------------------------|-------------|-------------------------|------|---------|------------------------------------------|
| MASS (MeV)                  | WIDTH (MeV) | DOCUMENT ID             | TECN | COMMENT |                                          |
| 2015 ± 3                    | 10 ± 4      | FERRER                  | 99   | RVUE    | $\pi p \rightarrow p p \bar{p} \pi(\pi)$ |

NODE=M300J34  
NODE=M300J34

| <b><math>h_3(2025)</math></b> |             | $I^G(J^{PC}) = 0^-(3^{+-})$ |      |         |                                                             |
|-------------------------------|-------------|-----------------------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                    | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT |                                                             |
| 2025 ± 20                     | 145 ± 30    | <sup>1</sup> ANISOVICH      | 02B  | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

<sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J78  
NODE=M300J78

NODE=M300J78;LINKAGE=AZ

| <b><math>b_3(2030)</math></b> |             | $I^G(J^{PC}) = 1^+(3^{+-})$ |      |         |                                                                         |
|-------------------------------|-------------|-----------------------------|------|---------|-------------------------------------------------------------------------|
| MASS (MeV)                    | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT |                                                                         |
| 2032 ± 12                     | 117 ± 11    | <sup>1</sup> ANISOVICH      | 02   | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |

<sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300J69  
NODE=M300J69

NODE=M300J69;LINKAGE=AY

| <b><math>a_2(2030)</math></b> |             | $I^G(J^{PC}) = 1^-(2^{++})$ |      |         |                      |
|-------------------------------|-------------|-----------------------------|------|---------|----------------------|
| MASS (MeV)                    | WIDTH (MeV) | DOCUMENT ID                 | TECN | COMMENT |                      |
| 2030 ± 20                     | 205 ± 30    | <sup>1</sup> ANISOVICH      | 01F  | SPEC    | 1.96–2.41 $\bar{p}p$ |

NODE=M300K23  
NODE=M300K23

<sup>1</sup> From the combined analysis of ANISOVICH 99c, ANISOVICH 99E, and ANISOVICH 01F.

NODE=M300K23;LINKAGE=AN

| <b><math>a_3(2030)</math> <math>I^G(J^{PC}) = 1^-(3^{++})</math></b> |             |                        |      |         |                      |
|----------------------------------------------------------------------|-------------|------------------------|------|---------|----------------------|
| MASS (MeV)                                                           | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                      |
| 2031 ± 12                                                            | 150 ± 18    | <sup>1</sup> ANISOVICH | 01F  | SPEC    | 1.96–2.41 $\bar{p}p$ |

NODE=M300K20  
NODE=M300K20

<sup>1</sup> From the combined analysis of ANISOVICH 99c, ANISOVICH 99E, and ANISOVICH 01F.

NODE=M300K20;LINKAGE=AN

| <b><math>\eta_2(2030)</math> <math>I^G(J^{PC}) = 0^+(2^{-+})</math></b> |               |             |      |         |  |
|-------------------------------------------------------------------------|---------------|-------------|------|---------|--|
| MASS (MeV)                                                              | WIDTH (MeV)   | DOCUMENT ID | TECN | COMMENT |  |
| 2030 ± 5 ± 15                                                           | 205 ± 10 ± 15 | ANISOVICH   | 00E  | SPEC    |  |

NODE=M300J8  
NODE=M300J8

| <b><math>B(a_2\pi)_{L=0}/B(a_2\pi)_{L=2}</math></b> |                        |      |         |                     |  |
|-----------------------------------------------------|------------------------|------|---------|---------------------|--|
| VALUE                                               | DOCUMENT ID            | TECN | COMMENT |                     |  |
| 0.05 ± 0.03                                         | <sup>1</sup> ANISOVICH | 11   | SPEC    | 0.9–1.94 $p\bar{p}$ |  |

NODE=M300B1  
NODE=M300B1

<sup>1</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M300B1;LINKAGE=AN

| <b><math>B(a_0\pi)/B(a_2\pi)_{L=2}</math></b> |                        |      |         |                     |  |
|-----------------------------------------------|------------------------|------|---------|---------------------|--|
| VALUE                                         | DOCUMENT ID            | TECN | COMMENT |                     |  |
| 0.10 ± 0.08                                   | <sup>1</sup> ANISOVICH | 11   | SPEC    | 0.9–1.94 $p\bar{p}$ |  |

NODE=M300B2  
NODE=M300B2

<sup>1</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M300B2;LINKAGE=AN

| <b><math>B(f_2\eta)/B(a_2\pi)_{L=2}</math></b> |                        |      |         |                     |  |
|------------------------------------------------|------------------------|------|---------|---------------------|--|
| VALUE                                          | DOCUMENT ID            | TECN | COMMENT |                     |  |
| 0.13 ± 0.06                                    | <sup>1</sup> ANISOVICH | 11   | SPEC    | 0.9–1.94 $p\bar{p}$ |  |

NODE=M300B3  
NODE=M300B3

<sup>1</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M300B3;LINKAGE=AN

| <b><math>f_3(2050)</math> <math>I^G(J^{PC}) = 0^+(3^{++})</math></b> |             |             |      |         |                                           |
|----------------------------------------------------------------------|-------------|-------------|------|---------|-------------------------------------------|
| MASS (MeV)                                                           | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                                           |
| 2048 ± 8                                                             | 213 ± 34    | ANISOVICH   | 00J  | SPEC    | 2.0 $p\bar{p} \rightarrow \eta\pi^0\pi^0$ |

NODE=M300J7  
NODE=M300J7

| <b><math>f_0(2060)</math> <math>I^G(J^{PC}) = 0^+(0^{++})</math></b> |             |                     |      |         |                                         |
|----------------------------------------------------------------------|-------------|---------------------|------|---------|-----------------------------------------|
| MASS (MeV)                                                           | WIDTH (MeV) | DOCUMENT ID         | TECN | COMMENT |                                         |
| ~ 2050                                                               | ~ 120       | <sup>1</sup> OAKDEN | 94   | RVUE    | 0.36–1.55 $\bar{p}p \rightarrow \pi\pi$ |
| ~ 2060                                                               | ~ 50        | <sup>1</sup> OAKDEN | 94   | RVUE    | 0.36–1.55 $\bar{p}p \rightarrow \pi\pi$ |

NODE=M300J59  
NODE=M300J59

<sup>1</sup> See SEMENOV 99 and KLOET 96.

OCCUR=2

NODE=M300J;LINKAGE=A

| <b><math>\pi(2070)</math> <math>I^G(J^{PC}) = 1^-(0^{-+})</math></b> |                                    |             |      |         |                                                          |
|----------------------------------------------------------------------|------------------------------------|-------------|------|---------|----------------------------------------------------------|
| MASS (MeV)                                                           | WIDTH (MeV)                        | DOCUMENT ID | TECN | COMMENT |                                                          |
| 2070 ± 35                                                            | 310 <sup>+100</sup> <sub>-50</sub> | ANISOVICH   | 01F  | SPEC    | 2.0 $\bar{p}p \rightarrow 3\pi^0, \pi^0\eta, \pi^0\eta'$ |

NODE=M300J91  
NODE=M300J91

| <b><math>X(2075)</math> <math>I^G(J^{PC}) = ?^?(??)</math></b> |             |                      |      |         |                                          |
|----------------------------------------------------------------|-------------|----------------------|------|---------|------------------------------------------|
| MASS (MeV)                                                     | WIDTH (MeV) | DOCUMENT ID          | TECN | COMMENT |                                          |
| 2075 ± 12 ± 5                                                  | 90 ± 35 ± 9 | <sup>1</sup> ABLIKIM | 04J  | BES2    | $J/\psi \rightarrow K^- p \bar{\Lambda}$ |

NODE=M300J01  
NODE=M300J01

<sup>1</sup> From a fit in the region  $M_{p\bar{\Lambda}} - M_p - M_{\Lambda} < 150$  MeV. *S*-wave in the  $p\bar{\Lambda}$  system preferred.  
A similar near-threshold enhancement in the  $p\bar{\Lambda}$  system is observed in  $B^+ \rightarrow p\bar{\Lambda}\bar{D}^0$  by CHEN 11F.

NODE=M300J01;LINKAGE=AB

| <b><math>X(2080)</math> <math>I^G(J^{PC}) = ?^?(??)</math></b> |             |             |      |         |                                         |
|----------------------------------------------------------------|-------------|-------------|------|---------|-----------------------------------------|
| MASS (MeV)                                                     | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                                         |
| 2080 ± 10                                                      | 110 ± 20    | KREYMER     | 80   | STRC    | 13 $\pi^- d \rightarrow p\bar{p}n(n_s)$ |

NODE=M300J35  
NODE=M300J35

| <b><math>X(2080)</math> <math>I^G(J^{PC}) = ?^?(3^{-?})</math></b> |             |             |      |         |                                    |
|--------------------------------------------------------------------|-------------|-------------|------|---------|------------------------------------|
| MASS (MeV)                                                         | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                                    |
| 2080 ± 10                                                          | 190 ± 15    | ROZANSKA    | 80   | SPRK    | 18 $\pi^- p \rightarrow p\bar{p}n$ |

NODE=M300J37  
NODE=M300J37

| <b><math>a_1(2095)</math> <math>I^G(J^{PC}) = 1^-(1^{++})</math></b> |               |      |             |      |                                                    |
|----------------------------------------------------------------------|---------------|------|-------------|------|----------------------------------------------------|
| MASS (MeV)                                                           | WIDTH (MeV)   | EVTS | DOCUMENT ID | TECN | COMMENT                                            |
| 2096 ± 17 ± 121                                                      | 451 ± 41 ± 81 | 69k  | KUHN        | 04   | B852 18 $\pi^- p \rightarrow \eta\pi^+\pi^-\pi^-p$ |

NODE=M300J04  
NODE=M300J04

**$B(a_1(2095) \rightarrow f_1(1285)\pi) / B(a_1(2095) \rightarrow a_1(1260))$** 

| VALUE           | EVTs | DOCUMENT ID | TECN    | COMMENT                                           |
|-----------------|------|-------------|---------|---------------------------------------------------|
| $3.18 \pm 0.64$ | 69k  | KUHN        | 04 B852 | $18 \pi^- p \rightarrow \eta \pi^+ \pi^- \pi^- p$ |

NODE=M300B03  
NODE=M300B03

| $\eta(2100) \quad I^G(J^{PC}) = 0^+(0^-+)$ |                           |             |                      |             |                                             |
|--------------------------------------------|---------------------------|-------------|----------------------|-------------|---------------------------------------------|
| <u>MASS (MeV)</u>                          | <u>WIDTH (MeV)</u>        | <u>EVTs</u> | <u>DOCUMENT ID</u>   | <u>TECN</u> | <u>COMMENT</u>                              |
| $2050^{+30+75}_{-24-26}$                   | $250^{+36+181}_{-30-164}$ |             | <sup>1</sup> ABLIKIM | 16N BES3    | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$ |
| $2103 \pm 50$                              | $187 \pm 75$              | 586         | <sup>2</sup> BISELLO | 89B DM2     | $J/\psi \rightarrow 4\pi\gamma$             |

NODE=M300J48  
NODE=M300J48

<sup>1</sup> From a partial wave analysis of  $J/\psi \rightarrow \gamma \phi \phi$ , for which the primary signal is  $\eta(2225) \rightarrow \phi \phi$ , and that also finds significant signals for for  $0^-+$  phase space,  $f_0(2100)$ ,  $f_2(2010)$ ,  $f_2(2300)$ ,  $f_2(2340)$ , and a previously unseen  $0^-+$  state  $X(2500)$  ( $M = 2470^{+15+101}_{-19-23}$  MeV,  $\Gamma = 230^{+64+56}_{-35-33}$  MeV).

NODE=M300J48;LINKAGE=A

<sup>2</sup> ASTON 81B sees no peak, has 850 events in Ajinenko+Barth bins. ARESTOV 80 sees no peak.

NODE=M300J;LINKAGE=A1

| <b><math>X(2100) \quad I^G(J^{PC}) = ?^?(0^{??})</math></b> |              |             |          |                                   |
|-------------------------------------------------------------|--------------|-------------|----------|-----------------------------------|
| MASS (MeV)                                                  | WIDTH (MeV)  | DOCUMENT ID | TECN     | COMMENT                           |
| $2100 \pm 40$                                               | $250 \pm 40$ | ALDE        | 86D GAM4 | $100 \pi^- p \rightarrow 2\eta X$ |

NODE=M300J49  
NODE=M300J49

| <b><math>X(2110) \quad I^G(J^{PC}) = 1^+(3^{-?})</math></b> |              |              |         |                                         |
|-------------------------------------------------------------|--------------|--------------|---------|-----------------------------------------|
| MASS (MeV)                                                  | WIDTH (MeV)  | DOCUMENT ID  | TECN    | COMMENT                                 |
| $2110 \pm 10$                                               | $330 \pm 20$ | EVANGELIS... | 79 OMEG | $10,16 \pi^- p \rightarrow \bar{p} p n$ |

NODE=M300J36  
NODE=M300J36

| <b><math>f_2(2140)</math></b> $I^G(J^{PC}) = 0^+(2^{++})$ |                    |             |                    |             |                |
|-----------------------------------------------------------|--------------------|-------------|--------------------|-------------|----------------|
| <u>MASS (MeV)</u>                                         | <u>WIDTH (MeV)</u> | <u>EVTs</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
| 2141±12                                                   | 49 ± 28            | 389         | GREEN              | 86 MPSF     | 400 pA → 4KX   |

NODE=M300J50  
NODE=M300J50

| <b><math>X(2150) \quad I^G(J^{PC}) = ?^?(2^{+?})</math></b> |              |             |         |                                      |
|-------------------------------------------------------------|--------------|-------------|---------|--------------------------------------|
| MASS (MeV)                                                  | WIDTH (MeV)  | DOCUMENT ID | TECN    | COMMENT                              |
| $2150 \pm 10$                                               | $260 \pm 10$ | ROZANSKA    | 80 SPRK | $18 \pi^- p \rightarrow p \bar{p} n$ |

NODE=M300J38  
NODE=M300J38

| <b><math>a_2(2175) \quad I^G(J^{PC}) = 1^-(2^{++})</math></b> |                   |             |          |                                                             |
|---------------------------------------------------------------|-------------------|-------------|----------|-------------------------------------------------------------|
| MASS (MeV)                                                    | WIDTH (MeV)       | DOCUMENT ID | TECN     | COMMENT                                                     |
| $2175 \pm 40$                                                 | $310^{+90}_{-45}$ | ANISOVICH   | 01F SPEC | $2.0 \bar{p} p \rightarrow 3\pi^0, \pi^0 \eta, \pi^0 \eta'$ |

NODE=M300J88  
NODE=M300J88

| <b><math>\eta(2190) \quad I^G(J^{PC}) = 0^+(0^-+)</math></b> |               |             |        |         |
|--------------------------------------------------------------|---------------|-------------|--------|---------|
| MASS (MeV)                                                   | WIDTH (MeV)   | DOCUMENT ID | TECN   | COMMENT |
| $2190 \pm 50$                                                | $850 \pm 100$ | BUGG        | 99 BES |         |

NODE=M300J13  
NODE=M300J13

| <b><math>\omega_2(2195) \quad I^G(J^{PC}) = 0^-(2^{--})</math></b> |              |             |          |                                                                 |
|--------------------------------------------------------------------|--------------|-------------|----------|-----------------------------------------------------------------|
| MASS (MeV)                                                         | WIDTH (MeV)  | DOCUMENT ID | TECN     | COMMENT                                                         |
| $2195 \pm 30$                                                      | $225 \pm 40$ | 1 ANISOVICH | 02B SPEC | $0.6-1.9 p \bar{p} \rightarrow \omega \eta, \omega \pi^0 \pi^0$ |

NODE=M300J82  
NODE=M300J82

<sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J82;LINKAGE=AZ

| <b><math>\omega(2205) \quad I^G(J^{PC}) = 0^-(1^{--})</math></b> |              |             |          |                                                                 |
|------------------------------------------------------------------|--------------|-------------|----------|-----------------------------------------------------------------|
| MASS (MeV)                                                       | WIDTH (MeV)  | DOCUMENT ID | TECN     | COMMENT                                                         |
| $2205 \pm 30$                                                    | $350 \pm 90$ | 1 ANISOVICH | 02B SPEC | $0.6-1.9 p \bar{p} \rightarrow \omega \eta, \omega \pi^0 \pi^0$ |

NODE=M300J80  
NODE=M300J80

<sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J80;LINKAGE=AZ

| <b>X(2210)</b> $I^G(J^{PC}) = ?^?(???)$ |                                    |              |      |         |                                    |
|-----------------------------------------|------------------------------------|--------------|------|---------|------------------------------------|
| MASS (MeV)                              | WIDTH (MeV)                        | DOCUMENT ID  | TECN | COMMENT |                                    |
| 2210 <sup>+79</sup> <sub>-21</sub>      | 203 <sup>+437</sup> <sub>-87</sub> | EVANGELIS... | 79B  | OMEG    | 10 $\pi^- p \rightarrow K^+ K^- n$ |

NODE=M300J39  
NODE=M300J39

| <b>X(2210)</b> $I^G(J^{PC}) = ?^?(???)$ |             |             |      |         |                |
|-----------------------------------------|-------------|-------------|------|---------|----------------|
| MASS (MeV)                              | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                |
| 2207 ± 22                               | 130         | CASO        | 70   | HBC     | 11.2 $\pi^- p$ |

NODE=M300J51  
NODE=M300J51

| <b>h<sub>1</sub>(2215)</b> $I^G(J^{PC}) = 0^-(1^+ -)$ |             |                        |      |         |                                                             |
|-------------------------------------------------------|-------------|------------------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                                            | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                                                             |
| 2215 ± 40                                             | 325 ± 55    | <sup>1</sup> ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

NODE=M300J27  
NODE=M300J27<sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J27;LINKAGE=AZ

| <b>ρ<sub>2</sub>(2225)</b> $I^G(J^{PC}) = 1^+(2^- -)$ |                                    |                        |      |         |                                                                         |
|-------------------------------------------------------|------------------------------------|------------------------|------|---------|-------------------------------------------------------------------------|
| MASS (MeV)                                            | WIDTH (MeV)                        | DOCUMENT ID            | TECN | COMMENT |                                                                         |
| 2225 ± 35                                             | 335 <sup>+100</sup> <sub>-50</sub> | <sup>1</sup> ANISOVICH | 02   | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |

NODE=M300J70  
NODE=M300J70<sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300J70;LINKAGE=AY

| <b>ρ<sub>4</sub>(2230)</b> $I^G(J^{PC}) = 1^+(4^- -)$ |             |                        |      |         |                                                                         |
|-------------------------------------------------------|-------------|------------------------|------|---------|-------------------------------------------------------------------------|
| MASS (MeV)                                            | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                                                                         |
| 2230 ± 25                                             | 210 ± 30    | <sup>1</sup> ANISOVICH | 02   | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |

NODE=M300J74  
NODE=M300J74<sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300J74;LINKAGE=AY

| <b>b<sub>1</sub>(2240)</b> $I^G(J^{PC}) = 1^+(1^+ -)$ |             |                        |      |         |                                                                         |
|-------------------------------------------------------|-------------|------------------------|------|---------|-------------------------------------------------------------------------|
| MASS (MeV)                                            | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                                                                         |
| 2240 ± 35                                             | 320 ± 85    | <sup>1</sup> ANISOVICH | 02   | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\pi^0, \omega\eta\pi^0, \pi^+\pi^-$ |

NODE=M300J87  
NODE=M300J87<sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300J87;LINKAGE=AY

| <b>f<sub>2</sub>(2240)</b> $I^G(J^{PC}) = 0^+(2^+ +)$                         |             |                        |      |         |                               |
|-------------------------------------------------------------------------------|-------------|------------------------|------|---------|-------------------------------|
| MASS (MeV)                                                                    | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                               |
| 2240 ± 15                                                                     | 241 ± 30    | <sup>1</sup> ANISOVICH | 00J  | SPEC    | 1.92–2.41 $p\bar{p}$          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |                        |      |         |                               |
| ~ 2226                                                                        | ~ 226       | HASAN                  | 94   | RVUE    | $p\bar{p} \rightarrow \pi\pi$ |

NODE=M300K26  
NODE=M300K26<sup>1</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99F, ANISOVICH 99J, ANISOVICH 99K, and ANISOVICH 00B. See also ANISOVICH 12.

NODE=M300K26;LINKAGE=AN

| <b>b<sub>3</sub>(2245)</b> $I^G(J^{PC}) = 1^+(3^+ -)$ |             |                   |      |         |  |
|-------------------------------------------------------|-------------|-------------------|------|---------|--|
| MASS (MeV)                                            | WIDTH (MeV) | DOCUMENT ID       | TECN | COMMENT |  |
| 2245 ± 50                                             | 320 ± 70    | <sup>1</sup> BUGG | 04C  | RVUE    |  |

NODE=M300K10  
NODE=M300K10<sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E, and ANISOVICH 02.

NODE=M300K10;LINKAGE=AY

| <b>η<sub>2</sub>(2250)</b> $I^G(J^{PC}) = 0^+(2^- +)$ |             |             |      |         |  |
|-------------------------------------------------------|-------------|-------------|------|---------|--|
| MASS (MeV)                                            | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |  |
| 2248 ± 20                                             | 280 ± 20    | ANISOVICH   | 00I  | SPEC    |  |
| 2267 ± 14                                             | 290 ± 50    | ANISOVICH   | 00J  | SPEC    |  |

NODE=M300J17  
NODE=M300J17



| $\pi_4(2250) \quad I^G(J^{PC}) = 1^-(4^-+)$ |             |             |          |                                                          |  |
|---------------------------------------------|-------------|-------------|----------|----------------------------------------------------------|--|
| MASS (MeV)                                  | WIDTH (MeV) | DOCUMENT ID | TECN     | COMMENT                                                  |  |
| 2250 ± 15                                   | 215 ± 25    | ANISOVICH   | 01F SPEC | 2.0 $\bar{p}p \rightarrow 3\pi^0, \pi^0\eta, \pi^0\eta'$ |  |

NODE=M300J73  
NODE=M300J73

| $\omega_4(2250) \quad I^G(J^{PC}) = 0^-(4^{--})$                                            |                    |                        |             |                                                                       |  |
|---------------------------------------------------------------------------------------------|--------------------|------------------------|-------------|-----------------------------------------------------------------------|--|
| <u>MASS (MeV)</u>                                                                           | <u>WIDTH (MeV)</u> | <u>DOCUMENT ID</u>     | <u>TECN</u> | <u>COMMENT</u>                                                        |  |
| $2250 \pm 30$                                                                               | $150 \pm 50$       | <sup>1</sup> ANISOVICH | 02B SPEC    | $0.6\text{--}1.9 \ p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |  |
| <sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B. |                    |                        |             |                                                                       |  |

NODE=M300J84  
NODE=M300J84

NODE=M300J84;LINKAGE=AZ

| $\omega_5(2250) \quad I^G(J^{PC}) = 0^-(5^{--})$                                            |                    |                    |             |      |
|---------------------------------------------------------------------------------------------|--------------------|--------------------|-------------|------|
| <u>MASS (MeV)</u>                                                                           | <u>WIDTH (MeV)</u> | <u>DOCUMENT ID</u> | <u>TECN</u> |      |
| 2250 ± 70                                                                                   | 320 ± 95           | <sup>1</sup> BUGG  | 04          | RVUE |
| <sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B. |                    |                    |             |      |

NODE=M300K11  
NODE=M300K11

NODE=M300;LINKAGE=AZ

| $\omega_3(2255) \quad I^G(J^{PC}) = 0^-(3^{--})$                                            |                    |                        |             |                                                             |  |
|---------------------------------------------------------------------------------------------|--------------------|------------------------|-------------|-------------------------------------------------------------|--|
| <u>MASS (MeV)</u>                                                                           | <u>WIDTH (MeV)</u> | <u>DOCUMENT ID</u>     | <u>TECN</u> | <u>COMMENT</u>                                              |  |
| $2255 \pm 15$                                                                               | $175 \pm 30$       | <sup>1</sup> ANISOVICH | 02B SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |  |
| <sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B. |                    |                        |             |                                                             |  |

NODE=M300J66  
NODE=M300J66

NODE=M300J66;LINKAGE=AZ

| $a_4(2255) \quad I^G(J^{PC}) = 1^-(4^{++})$                                                |                                    |                        |             |                                          |  |
|--------------------------------------------------------------------------------------------|------------------------------------|------------------------|-------------|------------------------------------------|--|
| <u>MASS (MeV)</u>                                                                          | <u>WIDTH (MeV)</u>                 | <u>DOCUMENT ID</u>     | <u>TECN</u> | <u>COMMENT</u>                           |  |
| 2237± 5                                                                                    | 291 ± 12                           | UMAN                   | 06 E835     | 5.2 $\bar{p}p \rightarrow \eta\eta\pi^0$ |  |
| 2255±40                                                                                    | 330 <sup>+110</sup> <sub>-50</sub> | <sup>1</sup> ANISOVICH | 01F SPEC    | 1.96–2.41 $\bar{p}p$                     |  |
| <sup>1</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99E, and ANISOVICH 01F |                                    |                        |             |                                          |  |

NODE=M300K21  
NODE=M300K21

NODE=M300K21;LINKAGE=AN

| $a_2(2255) \quad I^G(J^{PC}) = 1^-(2^{++})$                                                               |                    |                        |             |                      |  |
|-----------------------------------------------------------------------------------------------------------|--------------------|------------------------|-------------|----------------------|--|
| <u>MASS (MeV)</u>                                                                                         | <u>WIDTH (MeV)</u> | <u>DOCUMENT ID</u>     | <u>TECN</u> | <u>COMMENT</u>       |  |
| $2255 \pm 20$                                                                                             | $230 \pm 15$       | <sup>1</sup> ANISOVICH | 01G SPEC    | 1.96–2.41 $\bar{p}p$ |  |
| <sup>1</sup> From the combined analysis of ANISOVICH 99c, ANISOVICH 99E, ANISOVICH 01F and ANISOVICH 01G. |                    |                        |             |                      |  |

NODE=M300K22  
NODE=M300K22

NODE=M300K22;LINKAGE=AN

| $X(2260) \quad I^G(J^{PC}) = 0^+(4^{+?})$ |             |              |         |                                       |  |
|-------------------------------------------|-------------|--------------|---------|---------------------------------------|--|
| MASS (MeV)                                | WIDTH (MeV) | DOCUMENT ID  | TECN    | COMMENT                               |  |
| 2260 ± 20                                 | 400 ± 100   | EVANGELIS... | 79 OMEG | 10,16 $\pi^- p \rightarrow \bar{p}pn$ |  |

NODE=M300J40  
NODE=M300J40

| $\rho(2270) \quad I^G(J^{PC}) = 1^+(1^{--})$                                                             |                    |                        |             |                |                                                                              |
|----------------------------------------------------------------------------------------------------------|--------------------|------------------------|-------------|----------------|------------------------------------------------------------------------------|
| <u>MASS (MeV)</u>                                                                                        | <u>WIDTH (MeV)</u> | <u>DOCUMENT ID</u>     | <u>TECN</u> | <u>COMMENT</u> |                                                                              |
| 2265±40                                                                                                  | 325 ± 80           | <sup>1</sup> ANISOVICH | 02          | SPEC           | 0.6–1.9 $p\bar{p} \rightarrow \omega\pi^0,$<br>$\omega\eta\pi^0, \pi^+\pi^-$ |
| 2280±50                                                                                                  | 440 ± 110          | ATKINSON               | 85          | OMEG           | 20–70 $\gamma p \rightarrow p\omega\pi^+\pi^-\pi^0$                          |
| <sup>1</sup> From the combined analysis of ANISOVICH 00J, ANISOVICH 01D, ANISOVICH 01E and ANISOVICH 02. |                    |                        |             |                |                                                                              |

NODE=M300J86  
NODE=M300J86

NODE=M300J86;LINKAGE=AY

| $a_1(2270) \quad I^G(J^{PC}) = 1^-(1^{++})$ |                                   |             |          |                                                          |  |
|---------------------------------------------|-----------------------------------|-------------|----------|----------------------------------------------------------|--|
| MASS (MeV)                                  | WIDTH (MeV)                       | DOCUMENT ID | TECN     | COMMENT                                                  |  |
| 2270 <sup>+55</sup> <sub>-40</sub>          | 305 <sup>+70</sup> <sub>-40</sub> | ANISOVICH   | 01F SPEC | 2.0 $\bar{p}p \rightarrow 3\pi^0, \pi^0\eta, \pi^0\eta'$ |  |

NODE=M300J72  
NODE=M300J72

| $h_3(2275) \quad I^G(J^{PC}) = 0^-(3^{+-})$                                                 |                    |                        |             |                                                             |  |
|---------------------------------------------------------------------------------------------|--------------------|------------------------|-------------|-------------------------------------------------------------|--|
| <u>MASS (MeV)</u>                                                                           | <u>WIDTH (MeV)</u> | <u>DOCUMENT ID</u>     | <u>TECN</u> | <u>COMMENT</u>                                              |  |
| $2275 \pm 25$                                                                               | $190 \pm 45$       | <sup>1</sup> ANISOVICH | 02B SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |  |
| <sup>1</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B. |                    |                        |             |                                                             |  |

NODE=M300J28  
NODE=M300J28

NODE=M300J28;LINKAGE=AZ

| $a_3(2275) \quad I^G(J^{PC}) = 1^-(3^{++})$ |                                    |                        |          |                      |  |
|---------------------------------------------|------------------------------------|------------------------|----------|----------------------|--|
| MASS (MeV)                                  | WIDTH (MeV)                        | DOCUMENT ID            | TECN     | COMMENT              |  |
| 2275 ± 35                                   | 350 <sup>+100</sup> <sub>-50</sub> | <sup>1</sup> ANISOVICH | 01G SPEC | 1.96–2.41 $\bar{p}p$ |  |

NODE=M300K19  
NODE=M300K19

<sup>1</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99E, ANISOVICH 01F, and ANISOVICH 01G.

NODE=M300K19;LINKAGE=AN

| $\pi_2(2285) \quad I^G(J^{PC}) = 1^-(2^-+)$ |               |                        |      |         |                     |
|---------------------------------------------|---------------|------------------------|------|---------|---------------------|
| MASS (MeV)                                  | WIDTH (MeV)   | DOCUMENT ID            | TECN | COMMENT |                     |
| 2285 ± 20 ± 25                              | 250 ± 20 ± 25 | <sup>1</sup> ANISOVICH | 11   | SPEC    | 0.9–1.94 $p\bar{p}$ |

NODE=M300K25  
NODE=M300K25

<sup>1</sup> Reanalysis of ADOMEIT 96 and ANISOVICH 00E.

NODE=M300K25;LINKAGE=AN

| $\omega_3(2285) \quad I^G(J^{PC}) = 0^-(3^{--})$ |             |                        |      |         |                                                             |
|--------------------------------------------------|-------------|------------------------|------|---------|-------------------------------------------------------------|
| MASS (MeV)                                       | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                                                             |
| 2278 ± 28                                        | 224 ± 50    | <sup>1</sup> BUGG      | 04A  | RVUE    |                                                             |
| 2285 ± 60                                        | 230 ± 40    | <sup>2</sup> ANISOVICH | 02B  | SPEC    | 0.6–1.9 $p\bar{p} \rightarrow \omega\eta, \omega\pi^0\pi^0$ |

NODE=M300J83  
NODE=M300J83

<sup>1</sup> Partial wave analysis of the data on  $p\bar{p} \rightarrow \bar{\Lambda}\Lambda$  from BARNES 00.

<sup>2</sup> From the combined analysis of ANISOVICH 00D, ANISOVICH 01C, and ANISOVICH 02B.

NODE=M300J83;LINKAGE=BU  
NODE=M300J83;LINKAGE=AZ

| $\omega(2290) \quad I^G(J^{PC}) = 0^-(1^{--})$ |             |                   |      |         |
|------------------------------------------------|-------------|-------------------|------|---------|
| MASS (MeV)                                     | WIDTH (MeV) | DOCUMENT ID       | TECN | COMMENT |
| 2290 ± 20                                      | 275 ± 35    | <sup>1</sup> BUGG | 04A  | RVUE    |

NODE=M300J02  
NODE=M300J02

<sup>1</sup> Partial wave analysis of the data on  $p\bar{p} \rightarrow \bar{\Lambda}\Lambda$  from BARNES 00.

NODE=M300J02;LINKAGE=BU

| $f_2(2295) \quad I^G(J^{PC}) = 0^+(2^{++})$ |             |                        |      |         |                      |
|---------------------------------------------|-------------|------------------------|------|---------|----------------------|
| MASS (MeV)                                  | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |                      |
| 2293 ± 13                                   | 216 ± 37    | <sup>1</sup> ANISOVICH | 00J  | SPEC    | 1.92–2.41 $p\bar{p}$ |

NODE=M300K27  
NODE=M300K27

<sup>1</sup> From the combined analysis of ANISOVICH 99C, ANISOVICH 99F, ANISOVICH 99J, ANISOVICH 99K, and ANISOVICH 00B. See also ANISOVICH 12.

NODE=M300K27;LINKAGE=AN

| $f_3(2300) \quad I^G(J^{PC}) = 0^+(3^{++})$ |             |                   |      |         |
|---------------------------------------------|-------------|-------------------|------|---------|
| MASS (MeV)                                  | WIDTH (MeV) | DOCUMENT ID       | TECN | COMMENT |
| 2334 ± 25                                   | 200 ± 20    | <sup>1</sup> BUGG | 04A  | RVUE    |

NODE=M300J19  
NODE=M300J19

<sup>1</sup> Partial wave analysis of the data on  $p\bar{p} \rightarrow \bar{\Lambda}\Lambda$  from BARNES 00.

NODE=M300J19;LINKAGE=BU

| $f_1(2310) \quad I^G(J^{PC}) = 0^+(1^{++})$ |             |             |      |         |
|---------------------------------------------|-------------|-------------|------|---------|
| MASS (MeV)                                  | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |
| 2310 ± 60                                   | 255 ± 70    | ANISOVICH   | 00J  | SPEC    |

NODE=M300J23  
NODE=M300J23

| $\eta(2320) \quad I^G(J^{PC}) = 0^+(0^{-+})$ |             |                        |      |         |
|----------------------------------------------|-------------|------------------------|------|---------|
| MASS (MeV)                                   | WIDTH (MeV) | DOCUMENT ID            | TECN | COMMENT |
| 2320 ± 15                                    | 230 ± 35    | <sup>1</sup> ANISOVICH | 00M  | SPEC    |

NODE=M300J18  
NODE=M300J18

<sup>1</sup> From the combined analysis of  $\bar{p}p \rightarrow \eta\eta\eta$  from ANISOVICH 00M and  $\bar{p}p \rightarrow \eta\pi^0\pi^0$  from ANISOVICH 00J.

NODE=M300;LINKAGE=B

| $\eta_4(2330) \quad I^G(J^{PC}) = 0^+(4^{-+})$ |             |             |      |         |                                           |
|------------------------------------------------|-------------|-------------|------|---------|-------------------------------------------|
| MASS (MeV)                                     | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT |                                           |
| 2328 ± 38                                      | 240 ± 90    | ANISOVICH   | 00J  | SPEC    | 2.0 $p\bar{p} \rightarrow \eta\pi^0\pi^0$ |

NODE=M300J22  
NODE=M300J22

| $\omega(2330) \quad I^G(J^{PC}) = 0^-(1^{--})$ |             |             |      |                                                           |
|------------------------------------------------|-------------|-------------|------|-----------------------------------------------------------|
| MASS (MeV)                                     | WIDTH (MeV) | DOCUMENT ID | TECN | COMMENT                                                   |
| 2330 ± 30                                      | 435 ± 75    | ATKINSON    | 88   | OMEG 25–50 $\gamma p \rightarrow \rho^\pm \rho^0 \pi^\mp$ |

NODE=M300J53  
NODE=M300J53

| $X(2340) \quad I^G(J^{PC}) = ??(???)$ |             |      |                     |      |                                    |
|---------------------------------------|-------------|------|---------------------|------|------------------------------------|
| MASS (MeV)                            | WIDTH (MeV) | EVTS | DOCUMENT ID         | TECN | COMMENT                            |
| 2340 ± 20                             | 180 ± 60    | 126  | <sup>1</sup> BALTAY | 75   | HBC 15 $\pi^+ p \rightarrow p5\pi$ |

NODE=M300J54  
NODE=M300J54

<sup>1</sup> Dominant decay into  $\rho^0 \rho^0 \pi^+$ . BALTAY 78 finds confirmation in  $2\pi^+ \pi^- 2\pi^0$  events which contain  $\rho^+ \rho^0 \pi^0$  and  $2\rho^+ \pi^-$ .

NODE=M300J;LINKAGE=B1

| <b><math>\pi(2360)</math> <math>I^G(J^{PC}) = 1^-(0^-+)</math></b> |                     |             |          |                                                          |  |
|--------------------------------------------------------------------|---------------------|-------------|----------|----------------------------------------------------------|--|
| MASS (MeV)                                                         | WIDTH (MeV)         | DOCUMENT ID | TECN     | COMMENT                                                  |  |
| 2360 ± 25                                                          | 300 $^{+100}_{-50}$ | ANISOVICH   | 01F SPEC | 2.0 $\bar{p}p \rightarrow 3\pi^0, \pi^0\eta, \pi^0\eta'$ |  |

NODE=M300J90  
NODE=M300J90

| <b><math>X(2360)</math> <math>I^G(J^{PC}) = ?^?(4^{+?})</math></b> |             |             |         |                                    |  |
|--------------------------------------------------------------------|-------------|-------------|---------|------------------------------------|--|
| MASS (MeV)                                                         | WIDTH (MeV) | DOCUMENT ID | TECN    | COMMENT                            |  |
| 2360 ± 10                                                          | 430 ± 30    | ROZANSKA    | 80 SPRK | 18 $\pi^- p \rightarrow p\bar{p}n$ |  |

NODE=M300J42  
NODE=M300J42

| <b><math>X(2440)</math> <math>I^G(J^{PC}) = ?^?(5^{-?})</math></b> |             |             |         |                                    |  |
|--------------------------------------------------------------------|-------------|-------------|---------|------------------------------------|--|
| MASS (MeV)                                                         | WIDTH (MeV) | DOCUMENT ID | TECN    | COMMENT                            |  |
| 2440 ± 10                                                          | 310 ± 20    | ROZANSKA    | 80 SPRK | 18 $\pi^- p \rightarrow p\bar{p}n$ |  |

NODE=M300J43  
NODE=M300J43

| <b><math>a_6(2450)</math> <math>I^G(J^{PC}) = 1^-(6^{++})</math></b> |             |             |          |                                      |  |
|----------------------------------------------------------------------|-------------|-------------|----------|--------------------------------------|--|
| MASS (MeV)                                                           | WIDTH (MeV) | DOCUMENT ID | TECN     | COMMENT                              |  |
| 2450 ± 130                                                           | 400 ± 250   | CLELAND     | 82B SPEC | 50 $\pi p \rightarrow K_S^0 K^\pm p$ |  |

NODE=M300K12  
NODE=M300K12

| <b><math>X(2540)</math> <math>I^G(J^{PC}) = 0^+(0^{++})</math></b> |                            |             |         |                                        |  |
|--------------------------------------------------------------------|----------------------------|-------------|---------|----------------------------------------|--|
| MASS (MeV)                                                         | WIDTH (MeV)                | DOCUMENT ID | TECN    | COMMENT                                |  |
| 2539 ± 14 $^{+38}_{-14}$                                           | 274 $^{+77+126}_{-61-163}$ | UEHARA      | 13 BELL | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |  |

NODE=M300K30  
NODE=M300K30

| <b><math>\Gamma(\gamma\gamma) \times B(K\bar{K})</math></b> |             |         |                                        |  |  |
|-------------------------------------------------------------|-------------|---------|----------------------------------------|--|--|
| VALUE (eV)                                                  | DOCUMENT ID | TECN    | COMMENT                                |  |  |
| 40 $^{+9+17}_{-7-40}$                                       | UEHARA      | 13 BELL | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |  |  |

NODE=M300K3G  
NODE=M300K3G

| <b><math>X(2632)</math> <math>I^G(J^{PC}) = ?^?(??)</math></b> |             |                           |      |                                  |  |
|----------------------------------------------------------------|-------------|---------------------------|------|----------------------------------|--|
| MASS (MeV)                                                     | WIDTH (MeV) | DOCUMENT ID               | TECN | COMMENT                          |  |
| 2635.2 ± 3.3                                                   |             | <sup>1</sup> EVDOKIMOV 04 | SELX | $X(2632) \rightarrow D_s^+ \eta$ |  |
| 2631.6 ± 2.1                                                   | < 17        | <sup>2</sup> EVDOKIMOV 04 | SELX | $X(2632) \rightarrow D_s^0 K^+$  |  |

NODE=M300J03  
NODE=M300J03

OCCUR=2

<sup>1</sup> From a mass difference to  $D_s^+$  of  $666.9 \pm 3.3$  MeV.

<sup>2</sup> From a mass difference to  $D_s^0$  of  $767.0 \pm 2.0$  MeV.

NODE=M300J03;LINKAGE=EV  
NODE=M300J03;LINKAGE=ED

**$B(X(2632) \rightarrow D_s^0 K^+)/B(X(2632) \rightarrow D_s^+ \eta)$**

| VALUE       | DOCUMENT ID               | TECN |
|-------------|---------------------------|------|
| 0.14 ± 0.06 | <sup>1</sup> EVDOKIMOV 04 | SELX |

NODE=M300B01  
NODE=M300B01

<sup>1</sup> Possible interpretation of this decay pattern is discussed by YASUI 07.

NODE=M300B01;LINKAGE=YA

| <b><math>X(2680)</math> <math>I^G(J^{PC}) = ?^?(??)</math></b> |             |             |        |                                                 |  |
|----------------------------------------------------------------|-------------|-------------|--------|-------------------------------------------------|--|
| MASS (MeV)                                                     | WIDTH (MeV) | DOCUMENT ID | TECN   | COMMENT                                         |  |
| 2676 ± 27                                                      | 150         | CASO        | 70 HBC | 11.2 $\pi^- p \rightarrow \rho^- \pi^+ \pi^- p$ |  |

NODE=M300J55  
NODE=M300J55

| <b><math>X(2710)</math> <math>I^G(J^{PC}) = ?^?(6^{+?})</math></b> |             |             |         |                                    |  |
|--------------------------------------------------------------------|-------------|-------------|---------|------------------------------------|--|
| MASS (MeV)                                                         | WIDTH (MeV) | DOCUMENT ID | TECN    | COMMENT                            |  |
| 2710 ± 20                                                          | 170 ± 40    | ROZANSKA    | 80 SPRK | 18 $\pi^- p \rightarrow p\bar{p}n$ |  |

NODE=M300J44  
NODE=M300J44

| <b><math>X(2750)</math> <math>I^G(J^{PC}) = ?^?(7^{-?})</math></b> |             |             |         |                                          |  |
|--------------------------------------------------------------------|-------------|-------------|---------|------------------------------------------|--|
| MASS (MeV)                                                         | WIDTH (MeV) | DOCUMENT ID | TECN    | COMMENT                                  |  |
| 2747 ± 32                                                          | 195 ± 75    | DENNEY      | 83 LASS | 10 $\pi^+ p \rightarrow K^+ K^- \pi^+ p$ |  |

NODE=M300J56  
NODE=M300J56

| $f_6(3100)$ | $I^G(J^{PC}) = 0^+(6^{++})$ |             |      |         |                                      |
|-------------|-----------------------------|-------------|------|---------|--------------------------------------|
| MASS (MeV)  | WIDTH (MeV)                 | DOCUMENT ID | TECN | COMMENT |                                      |
| 3100 ± 100  | 700 ± 130                   | BINON       | 05   | GAMS    | 33 $\pi^- p \rightarrow \eta \eta n$ |

NODE=M300J06  
NODE=M300J06

| $X(3250)$     | $I^G(J^{PC}) = ?^?(?^{??})$ | 3-Body Decays |      |         |                                           |
|---------------|-----------------------------|---------------|------|---------|-------------------------------------------|
| MASS (MeV)    | WIDTH (MeV)                 | DOCUMENT ID   | TECN | COMMENT |                                           |
| 3250 ± 8 ± 20 | 45 ± 18                     | ALEEV         | 93   | BIS2    | $X(3250) \rightarrow \Lambda \bar{p} K^+$ |
| 3265 ± 7 ± 20 | 40 ± 18                     | ALEEV         | 93   | BIS2    | $X(3250) \rightarrow \bar{\Lambda} p K^-$ |

NODE=M300J57  
NODE=M300J57

OCCUR=2

| $X(3250)$     | $I^G(J^{PC}) = ?^?(?^{??})$ | 4-Body Decays |      |         |                                                   |
|---------------|-----------------------------|---------------|------|---------|---------------------------------------------------|
| MASS (MeV)    | WIDTH (MeV)                 | DOCUMENT ID   | TECN | COMMENT |                                                   |
| 3245 ± 8 ± 20 | 25 ± 11                     | ALEEV         | 93   | BIS2    | $X(3250) \rightarrow \Lambda \bar{p} K^+ \pi^\pm$ |
| 3250 ± 9 ± 20 | 50 ± 20                     | ALEEV         | 93   | BIS2    | $X(3250) \rightarrow \bar{\Lambda} p K^- \pi^\mp$ |
| 3270 ± 8 ± 20 | 25 ± 11                     | ALEEV         | 93   | BIS2    | $X(3250) \rightarrow K_S^0 p \bar{p} K^\pm$       |

NODE=M300J58  
NODE=M300J58

OCCUR=2

OCCUR=3

| $X(3350)$                | $I^G(J^{PC}) = ?^?(?^{??})$ |         |                       |      |                                                  |
|--------------------------|-----------------------------|---------|-----------------------|------|--------------------------------------------------|
| MASS (MeV)               | WIDTH (MeV)                 | EVTS    | DOCUMENT ID           | TECN | COMMENT                                          |
| 3350 $^{+10}_{-20}$ ± 20 | 70 $^{+40}_{-30}$ ± 40      | 50 ± 10 | <sup>1</sup> GABYSHEV | 06A  | BELL $B^- \rightarrow \Lambda_c^+ \bar{p} \pi^-$ |

NODE=M300J09  
NODE=M300J09

<sup>1</sup> A similar enhancement in the  $\Lambda_c^+ \bar{p}$  final state is also reported by BABAR collaboration in AUBERT 10H.

NODE=M300J09;LINKAGE=AU

## REFERENCES for Further States

NODE=M300

|               |     |                               |                                   |                      |
|---------------|-----|-------------------------------|-----------------------------------|----------------------|
| ABLIKIM       | 20F | PR D101 032008                | M. Ablikim <i>et al.</i>          | (BESIII Collab.)     |
| ABLIKIM       | 16N | PR D93 112011                 | M. Ablikim                        | (BESIII Collab.)     |
| UEHARA        | 13  | PTEP 2013 123C01              | S. Uehara <i>et al.</i>           | (BELLE Collab.)      |
| ANISOVICH     | 12  | PR D85 014001                 | A.V. Anisovich <i>et al.</i>      |                      |
| ANASHIN       | 11  | PL B703 543                   | V.V. Anashin <i>et al.</i>        | (KEDR Collab.)       |
| ANISOVICH     | 11  | EPJ C71 1511                  | A.V. Anisovich <i>et al.</i>      | (LOQM, RAL, PNPI)    |
| CHEN          | 11F | PR D84 071501                 | P. Chen <i>et al.</i>             | (BELLE Collab.)      |
| AUBERT        | 10H | PR D82 031102                 | B. Aubert <i>et al.</i>           | (BABAR Collab.)      |
| ABRAAMYAN     | 09  | PR C80 034001                 | Kh.U. Abraamyan <i>et al.</i>     |                      |
| VLADIMIRSK... | 08  | PAN 71 2129                   | V.V. Vladimirovsky <i>et al.</i>  | (ITEP)               |
| VLADIMIRSK... | 07  | Translated from YAF 71 2166.  |                                   |                      |
|               |     | PAN 70 1706                   | V. Vladimirovsky <i>et al.</i>    |                      |
|               |     | Translated from YAF 70 1751.  |                                   |                      |
| YASUI         | 07  | PR D76 034009                 | S. Yasui, M. Oka                  |                      |
| ABLIKIM       | 06S | PRL 97 142002                 | M. Ablikim <i>et al.</i>          | (BES Collab.)        |
| GABYSHEV      | 06A | PRL 97 242001                 | N. Gabyshev <i>et al.</i>         | (BELLE Collab.)      |
| SCHEGELSKY    | 06  | EPJ A27 199                   | V.A. Schegelsky <i>et al.</i>     |                      |
| SCHEGELSKY    | 06A | EPJ A27 207                   | V.A. Schegelsky <i>et al.</i>     |                      |
| UMAN          | 06  | PR D73 052009                 | I. Uman <i>et al.</i>             | (FNAL E835)          |
| VLADIMIRSK... | 06  | PAN 69 493                    | V.V. Vladimirovsky <i>et al.</i>  | (ITEP, Moscow)       |
|               |     | Translated from YAF 69 515.   |                                   |                      |
| BINON         | 05  | PAN 68 960                    | F. Binon <i>et al.</i>            |                      |
|               |     | Translated from YAF 68 998.   |                                   |                      |
| GRIGOR'EV     | 05  | PAN 68 1271                   | V.K. Grigor'ev <i>et al.</i>      | (ITEP)               |
|               |     | Translated from YAF 68 1324.  |                                   |                      |
| LU            | 05  | PRL 94 032002                 | M. Lu <i>et al.</i>               | (BNL E852 Collab.)   |
| ABLIKIM       | 04J | PRL 93 112002                 | M. Ablikim <i>et al.</i>          | (BES Collab.)        |
| BUGG          | 04  | PL B595 556 (errata.)         | D.V. Bugg                         |                      |
| BUGG          | 04A | EPJ C36 161                   | D.V. Bugg                         |                      |
| BUGG          | 04C | PRPL 397 257                  | D.V. Bugg                         |                      |
| EVDOKIMOV     | 04  | PRL 93 242001                 | A.V. Evdokimov <i>et al.</i>      | (SELEX Collab.)      |
| KUHN          | 04  | PL B595 109                   | J. Kuhn <i>et al.</i>             | (BNL E852 Collab.)   |
| ANISOVICH     | 03  | EPJ A16 229                   | V.V. Anisovich <i>et al.</i>      |                      |
| VLADIMIRSK... | 03  | PAN 66 700                    | V.V. Vladimirovsky <i>et al.</i>  |                      |
|               |     | Translated from YAF 66 729.   |                                   |                      |
| ANISOVICH     | 02  | PL B542 8                     | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 02B | PL B542 19                    | A.V. Anisovich <i>et al.</i>      |                      |
| CHUNG         | 02  | PR D65 072001                 | S.U. Chung <i>et al.</i>          | (BNL E852 Collab.)   |
| LINK          | 02K | PL B545 50                    | J.M. Link <i>et al.</i>           | (FNAL FOCUS Collab.) |
| ANISOVICH     | 01C | PL B507 23                    | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 01D | PL B508 6                     | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 01E | PL B513 281                   | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 01F | PL B517 261                   | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 01G | PL B517 273                   | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 00B | NP A662 319                   | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 00D | PL B476 15                    | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 00E | PL B477 19                    | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 00I | PL B491 40                    | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 00J | PL B491 47                    | A.V. Anisovich <i>et al.</i>      | (RAL, LOQM, PNPI+)   |
| ANISOVICH     | 00M | PL B496 145                   | A.V. Anisovich <i>et al.</i>      |                      |
| BARNES        | 00  | PR C62 055203                 | P.D. Barnes <i>et al.</i>         |                      |
| FILIPPI       | 00  | PL B495 284                   | A. Filippi <i>et al.</i>          | (OBELIX Experiment)  |
| VLADIMIRSKII  | 00  | JETPL 72 486                  | V.V. Vladimirovskii <i>et al.</i> |                      |
|               |     | Translated from ZETFP 72 698. |                                   |                      |
| ANISOVICH     | 99C | PL B452 173                   | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 99E | PL B452 187                   | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 99F | NP A651 253                   | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 99J | PL B471 271                   | A.V. Anisovich <i>et al.</i>      |                      |
| ANISOVICH     | 99K | PL B468 309                   | A.V. Anisovich <i>et al.</i>      |                      |
| BUGG          | 99  | PL B458 511                   | D.V. Bugg <i>et al.</i>           |                      |
| FERRER        | 99  | EPJ C10 249                   | A. Ferrer <i>et al.</i>           |                      |
| SEMEVNOV      | 99  | SPU 42 847                    | S.V. Semenov                      |                      |
|               |     | Translated from UFN 42 937.   |                                   |                      |

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|--------------|-----|-------------------------------|-------------------------------------|---------------------------|
| ADOMEIT      | 96  | ZPHY C71 227                  | J. Adomeit <i>et al.</i>            | (Crystal Barrel Collab.)  |
| KLOET        | 96  | PR D53 6120                   | W.M. Kloet, F. Myhrer               | (RUTG, NORD)              |
| PROKOSHKIN   | 96  | PD 41 247                     | Y.D. Prokoshkin, V.D. Samoilenko    | (SERP)                    |
|              |     | Translated from DANS 348 481. |                                     |                           |
| HASAN        | 94  | PL B334 215                   | A. Hasan, D.V. Bugg                 | (LOQM)                    |
| OAKDEN       | 94  | NP A574 731                   | M.N. Oakden, M.R. Pennington        | (DURH)                    |
| ALEEV        | 93  | PAN 56 1358                   | A.N. Aleev <i>et al.</i>            | (BIS-2 Collab.)           |
|              |     | Translated from YAF 56 100.   |                                     |                           |
| ARMSTRONG    | 93D | PL B307 399                   | T.A. Armstrong <i>et al.</i>        | (FNAL, FERR, GENO+)       |
| ALBRECHT     | 91F | ZPHY C50 1                    | H. Albrecht <i>et al.</i>           | (ARGUS Collab.)           |
| CONDO        | 91  | PR D43 2787                   | G.T. Condo <i>et al.</i>            | (SLAC Hybrid Collab.)     |
| BISELLO      | 89B | PR D39 701                    | G. Busetto <i>et al.</i>            | (DM2 Collab.)             |
| ATKINSON     | 88  | ZPHY C38 535                  | M. Atkinson <i>et al.</i>           | (BONN, CERN, GLAS+)       |
| DAFTARI      | 87  | PRL 58 859                    | I.K. Daftari <i>et al.</i>          | (SYRA)                    |
| ALDE         | 86D | NP B269 485                   | D.M. Alde <i>et al.</i>             | (BELG, LAPP, SERP, CERN+) |
| BRIDGES      | 86D | PL B180 313                   | D.L. Bridges <i>et al.</i>          | (SYRA, BNL, CASE+)        |
| GREEN        | 86  | PRL 56 1639                   | D.R. Green <i>et al.</i>            | (FNAL, ARIZ, FSU+)        |
| ATKINSON     | 85  | ZPHY C29 333                  | M. Atkinson <i>et al.</i>           | (BONN, CERN, GLAS+)       |
| DENNEY       | 83  | PR D28 2726                   | D.L. Denney <i>et al.</i>           | (IOWA, MICH)              |
| CLELAND      | 82B | NP B208 228                   | W.E. Cleland <i>et al.</i>          | (DURH, GEVA, LAUS+)       |
| ASTON        | 81B | NP B189 205                   | D. Aston <i>et al.</i>              | (BONN, CERN, EPOL, GLAS+) |
| ARESTOV      | 80  | IHEP 80-165                   | Y.I. Arestov <i>et al.</i>          | (SERP)                    |
| CHLIAPNIK... | 80  | ZPHY C3 285                   | P.V. Chliapnikov <i>et al.</i>      | (SERP, BRUX, MONS)        |
| KREYMER      | 80  | PR D22 36                     | A.E. Kreymer <i>et al.</i>          | (IND, PURD, SLAC+)        |
| ROZANSKA     | 80  | NP B162 505                   | M. Rozanska <i>et al.</i>           | (MPIM, CERN)              |
| EVANGELIS... | 79  | NP B153 253                   | C. Evangelista <i>et al.</i>        | (BARI, BONN, CERN+)       |
| EVANGELIS... | 79B | NP B154 381                   | C. Evangelista <i>et al.</i>        | (BARI, BONN, CERN+)       |
| BALTAY       | 78  | PR D17 52                     | C. Baltay <i>et al.</i>             | (COLU, BING)              |
| ANTIPOV      | 77  | NP B119 45                    | Y.M. Antipov <i>et al.</i>          | (SERP, GEVA)              |
| BALTAY       | 77  | PRL 39 591                    | C. Baltay, C.V. Cautis, M. Kalelkar | (COLU)                    |
| BALTAY       | 75  | PRL 35 891                    | C. Baltay <i>et al.</i>             | (COLU, BING)              |
| KALELKAR     | 75  | Thesis Nevis 207              | M.S. Kalelkar                       | (COLU)                    |
| CASO         | 70  | LNC 3 707                     | C. Caso <i>et al.</i>               | (GENO, HAMB, MILA, SACL)  |

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## STRANGE MESONS

$$(S = \pm 1, C = B = 0)$$

$$K^+ = u\bar{s}, K^0 = d\bar{s}, \bar{K}^0 = \bar{d}s, K^- = \bar{u}s, \text{ similarly for } K^{*'}s$$

NODE=MXXX020

NODE=MXXX020

NODE=M174

$$K_0^{*}(700)$$

$$I(J^P) = \frac{1}{2}(0^+)$$

also known as  $\kappa$ ; was  $K_0^{*}(800)$

See the review on "Scalar Mesons below 2 GeV."

NODE=M174

### $K_0^{*}(700)$ T-Matrix Pole $\sqrt{s}$

NODE=M174TMP

NODE=M174TMP

→ UNCHECKED ←

| VALUE (MeV)                                                                   | DOCUMENT ID              | TECN | COMMENT                                                    |
|-------------------------------------------------------------------------------|--------------------------|------|------------------------------------------------------------|
| <b>(630-730) – <math>i</math> (260-340) OUR EVALUATION</b>                    |                          |      |                                                            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |                                                            |
| $(648 \pm 7) - i(280 \pm 16)$                                                 | <sup>1</sup> PELAEZ      | 20   | RVUE $\pi K \rightarrow \pi K$                             |
| $(670 \pm 18) - i(295 \pm 28)$                                                | <sup>2</sup> PELAEZ      | 17   | RVUE $\pi K \rightarrow \pi K$                             |
| $(764 \pm 63^{+71}_{-54}) - i(306 \pm 149^{+143}_{-85})$                      | <sup>3</sup> ABLIKIM     | 11B  | BES2 $1.3k J/\psi \rightarrow K_S^0 K_S^0 \pi^+ \pi^-$     |
| $(665 \pm 9) - i(268^{+21}_{-6})$                                             | <sup>4</sup> GUO         | 11B  | RVUE                                                       |
| $(849 \pm 77^{+18}_{-14}) - i(256 \pm 40^{+46}_{-22})$                        | <sup>3</sup> ABLIKIM     | 10E  | BES2 $1.4k J/\psi \rightarrow K^\pm K_S^0 \pi^\mp \pi^0$   |
| $(663 \pm 8 \pm 34) - i(329 \pm 5 \pm 22)$                                    | <sup>5</sup> BUGG        | 10   | RVUE S-matrix pole                                         |
| $(706.0 \pm 1.8 \pm 22.8) - i(319.4 \pm 2.2 \pm 20.2)$                        | <sup>6</sup> BONVICINI   | 08A  | CLEO $141k D^+ \rightarrow K^- \pi^+ \pi^+$                |
| $(841 \pm 30^{+81}_{-73}) - i(309 \pm 45^{+48}_{-72})$                        | <sup>3</sup> ABLIKIM     | 06C  | BES2 $25k J/\psi \rightarrow \bar{K}^{*}(892)^0 K^+ \pi^-$ |
| $(750^{+30}_{-55}) - i(342 \pm 60)$                                           | <sup>7</sup> BUGG        | 06   | RVUE                                                       |
| $(658 \pm 13) - i(279 \pm 12)$                                                | <sup>8</sup> DESCOTES-G. | 06   | RVUE $\pi K \rightarrow \pi K$                             |
| $(757 \pm 33) - i(279 \pm 41)$                                                | <sup>9</sup> GUO         | 06   | RVUE                                                       |
| $(694 \pm 53) - i(303 \pm 30)$                                                | <sup>10</sup> ZHOU       | 06   | RVUE $K p \rightarrow K^- \pi^+ n$                         |
| $(594 \pm 79) - i(362 \pm 166)$                                               | <sup>10</sup> ZHENG      | 04   | RVUE $K^- p \rightarrow K^- \pi^+ n$                       |
| $(722 \pm 60) - i(386 \pm 50)$                                                | <sup>10</sup> BUGG       | 03   | RVUE $11 K^- p \rightarrow K^- \pi^+ n$                    |
| $(875 \pm 75) - i(335 \pm 110)$                                               | <sup>11</sup> ISHIDA     | 97B  | RVUE $11 K^- p \rightarrow K^- \pi^+ n$                    |
| $727 - i 263$                                                                 | <sup>12</sup> VANBEVEREN | 86   | RVUE                                                       |

- <sup>1</sup> Extracted employing  $\pi K$  partial wave analysis from ESTABROOKS 78 and ASTON 88, Roy-Steiner equations and once subtracted forward dispersion relations.
- <sup>2</sup> Reanalysis of ESTABROOKS 78 and ASTON 88 satisfying Forward Dispersion Relations and using sequences of Pade approximants.
- <sup>3</sup> Extracted from Breit-Wigner parameters.
- <sup>4</sup> Fit to scattering phase shifts using UChPT amplitudes with explicit resonances.
- <sup>5</sup> Supersedes BUGG 06. Combined analysis of ASTON 88, ABLIKIM 06C, AITALA 06, and LINK 09 using an  $s$ -dependent width with couplings to  $K\pi$  and  $K\eta'$ , and the Adler zero near thresholds.
- <sup>6</sup> From a complex pole included in the fit. Using parameters from the model that fits data best.
- <sup>7</sup> Reanalysis of ASTON 88, AITALA 02, and ABLIKIM 06C using for the  $\kappa$  an  $s$ -dependent width with an Adler zero near threshold.
- <sup>8</sup> Using Roy-Steiner equations (ROY 71) consistent with unitarity, analyticity and crossing symmetry constraints.
- <sup>9</sup> From UChPT fitted to MERCER 71, BINGHAM 72 and ESTABROOKS 78. Amplitude shown to be consistent with data of ABLIKIM 06C.
- <sup>10</sup> Reanalysis of ASTON 88 data.
- <sup>11</sup> Reanalysis of ASTON 88 using interfering Breit-Wigner amplitudes. Extracted from Breit-Wigner parameters.
- <sup>12</sup> Unitarized Quark Model.

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NODE=M174TMP;LINKAGE=O

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NODE=M174TMP;LINKAGE=E

### $K_0^*(700)$ Breit-Wigner Mass

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN     | COMMENT                                         |
|-------------------------------------------------------------------------------|------|------------------------|----------|-------------------------------------------------|
| <b>824 <math>\pm</math> 30 OUR AVERAGE</b>                                    |      |                        |          |                                                 |
| 826 $\pm$ 49 $^{+49}_{-34}$                                                   | 1.3k | <sup>1</sup> ABLIKIM   | 11B BES2 | $J/\psi \rightarrow K_S^0 K_S^0 \pi^+ \pi^-$    |
| 810 $\pm$ 68 $^{+15}_{-24}$                                                   | 1.4k | <sup>2</sup> ABLIKIM   | 10E BES2 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp \pi^0$  |
| 878 $\pm$ 23 $^{+64}_{-55}$                                                   | 25k  | <sup>3</sup> ABLIKIM   | 06C BES2 | $J/\psi \rightarrow \bar{K}^*(892)^0 K^+ \pi^-$ |
| 797 $\pm$ 19 $\pm$ 43                                                         | 15k  | <sup>4,5</sup> AITALA  | 02 E791  | $D^+ \rightarrow K^- \pi^+ \pi^+$               |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |          |                                                 |
| 888.0 $\pm$ 1.9                                                               | 141k | <sup>6</sup> BONVICINI | 08A CLEO | $D^+ \rightarrow K^- \pi^+ \pi^+$               |
| 856 $\pm$ 17 $\pm$ 13                                                         | 54k  | <sup>7</sup> LINK      | 07B FOCS | $D^+ \rightarrow K^- \pi^+ \pi^+$               |
| 855 $\pm$ 15                                                                  | 0.6k | <sup>8</sup> CAWLFIELD | 06A CLEO | $D^0 \rightarrow K^+ K^- \pi^0$                 |
| 905 $^{+65}_{-30}$                                                            |      | <sup>9</sup> ISHIDA    | 97B RVUE | $11 K^- p \rightarrow K^- \pi^+ n$              |

NODE=M174M  
 NODE=M174M

OCCUR=2

OCCUR=2

OCCUR=2

- <sup>1</sup> The Breit-Wigner parameters from a fit with seven intermediate resonances. The  $S$ -matrix pole position is  $(764 \pm 63^{+71}_{-54}) - i (306 \pm 149^{+143}_{-85})$  MeV.
- <sup>2</sup> From a fit including ten additional resonances and energy-independent Breit-Wigner width.
- <sup>3</sup> A fit in the  $K_0^*(700) + K^*(892) + K^*(1410)$  model with mass and width of the  $K_0^*(700)$  from ABLIKIM 06C well describes the left slope of the  $K_S^0 \pi^-$  invariant mass spectrum in  $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$  decay studied by EPIFANOV 07. Averaged value from different parameterizations.
- <sup>4</sup> Not seen by KOPP 01 using 7070 events of  $D^0 \rightarrow K^- \pi^+ \pi^0$ . LINK 02E and LINK 05I show clear evidence for a constant non-resonant scalar amplitude rather than  $K_0^*(700)$  in their high statistics analysis of  $D^+ \rightarrow K^- \pi^+ \mu^+ \nu_\mu$ .
- <sup>5</sup> AUBERT 07T does not find evidence for the charged  $K_0^*(700)$  using 11k events of  $D^0 \rightarrow K^- K^+ \pi^0$ .
- <sup>6</sup> Using parameters from the model that fits data best.
- <sup>7</sup> A Breit-Wigner mass and width.
- <sup>8</sup> Breit-Wigner parameters. A significant  $S$ -wave can be also modeled as a non-resonant contribution.
- <sup>9</sup> Reanalysis of ASTON 88 using interfering Breit-Wigner amplitudes.

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NODE=M174M;LINKAGE=EP

NODE=M174M;LINKAGE=A

NODE=M174M;LINKAGE=AU

NODE=M174M;LINKAGE=C  
 NODE=M174M;LINKAGE=BW  
 NODE=M174M;LINKAGE=CA

NODE=M174M;LINKAGE=IS

### $K_0^*(700)$ Breit-Wigner Width

| VALUE (MeV)                                | EVTS | DOCUMENT ID           | TECN     | COMMENT                                         |
|--------------------------------------------|------|-----------------------|----------|-------------------------------------------------|
| <b>478 <math>\pm</math> 50 OUR AVERAGE</b> |      |                       |          |                                                 |
| 449 $\pm$ 156 $^{+144}_{-81}$              | 1.3k | <sup>1</sup> ABLIKIM  | 11B BES2 | $J/\psi \rightarrow K_S^0 K_S^0 \pi^+ \pi^-$    |
| 536 $\pm$ 87 $^{+106}_{-47}$               | 1.4k | <sup>2</sup> ABLIKIM  | 10E BES2 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp \pi^0$  |
| 499 $\pm$ 52 $^{+55}_{-87}$                | 25k  | <sup>3</sup> ABLIKIM  | 06C BES2 | $J/\psi \rightarrow \bar{K}^*(892)^0 K^+ \pi^-$ |
| 410 $\pm$ 43 $\pm$ 87                      | 15k  | <sup>4,5</sup> AITALA | 02 E791  | $D^+ \rightarrow K^- \pi^+ \pi^+$               |

NODE=M174W

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OCCUR=2

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• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                          |      |                        |          |                                    |
|----------------------------------------------------------|------|------------------------|----------|------------------------------------|
| 550.4 ± 11.8                                             | 141k | <sup>6</sup> BONVICINI | 08A CLEO | $D^+ \rightarrow K^- \pi^+ \pi^+$  |
| 464 ± 28 ± 22                                            | 54k  | <sup>7</sup> LINK      | 07B FOCS | $D^+ \rightarrow K^- \pi^+ \pi^+$  |
| 251 ± 48                                                 | 0.6k | <sup>8</sup> CAWLFIELD | 06A CLEO | $D^0 \rightarrow K^+ K^- \pi^0$    |
| 545 $\begin{smallmatrix} +235 \\ -110 \end{smallmatrix}$ |      | <sup>9</sup> ISHIDA    | 97B RVUE | $11 K^- p \rightarrow K^- \pi^+ n$ |

<sup>1</sup> The Breit-Wigner parameters from a fit with seven intermediate resonances. The S-matrix pole position is  $(764 \pm 63^{+71}_{-54}) - i(306 \pm 149^{+143}_{-85})$  MeV.

<sup>2</sup> From a fit including ten additional resonances and energy-independent Breit-Wigner width.

<sup>3</sup> A fit in the  $K_0^*(700) + K^*(892) + K^*(1410)$  model with mass and width of the  $K_0^*(700)$  from ABLIKIM 06C well describes the left slope of the  $K_S^0 \pi^-$  invariant mass spectrum in  $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$  decay studied by EPIFANOV 07. Averaged value from different parameterizations.

<sup>4</sup> Not seen by KOPP 01 using 7070 events of  $D^0 \rightarrow K^- \pi^+ \pi^0$ . LINK 02E and LINK 05I show clear evidence for a constant non-resonant scalar amplitude rather than  $K_0^*(700)$  in their high statistics analysis of  $D^+ \rightarrow K^- \pi^+ \mu^+ \nu_\mu$ .

<sup>5</sup> AUBERT 07T does not find evidence for the charged  $K_0^*(700)$  using 11k events of  $D^0 \rightarrow K^- K^+ \pi^0$ .

<sup>6</sup> Using parameters from the model that fits data best.

<sup>7</sup> A Breit-Wigner mass and width.

<sup>8</sup> Statistical error only. A fit to the Dalitz plot including the  $K_0^*(700)^\pm$ ,  $K^*(892)^\pm$ , and  $\phi$  resonances modeled as Breit-Wigners. A significant S-wave can be also modeled as a non-resonant contribution.

<sup>9</sup> Reanalysis of ASTON 88 using interfering Breit-Wigner amplitudes.

OCCUR=2

NODE=M174W;LINKAGE=LI

NODE=M174W;LINKAGE=BL

NODE=M174W;LINKAGE=EP

NODE=M174W;LINKAGE=A

NODE=M174W;LINKAGE=AU

NODE=M174W;LINKAGE=C

NODE=M174W;LINKAGE=BW

NODE=M174W;LINKAGE=CA

NODE=M174W;LINKAGE=IS

NODE=M174215;NODE=M174

DESIG=1;OUR EVAL;→ UNCHECKED ←

### $K_0^*(700)$ DECAY MODES

| Mode                   | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------|--------------------------------|
| $\Gamma_1 \quad K \pi$ | 100 %                          |

### $K_0^*(700)$ REFERENCES

|               |     |                      |                                      |
|---------------|-----|----------------------|--------------------------------------|
| PELAEZ        | 20  | PRL 124 172001       | J.R. Pelaez <i>et al.</i>            |
| PELAEZ        | 17  | EPJ C77 91           | J.R. Pelaez, A.Rodas, J.R. de Elvira |
| ABLIKIM       | 11B | PL B698 183          | M. Ablikim <i>et al.</i>             |
| GUO           | 11B | PR D84 034005        | Z.-H. Guo, J.A. Oller                |
| ABLIKIM       | 10E | PL B693 88           | M. Ablikim <i>et al.</i>             |
| BUGG          | 10  | PR D81 014002        | D.V. Bugg                            |
| LINK          | 09  | PL B681 14           | J.M. Link <i>et al.</i>              |
| BONVICINI     | 08A | PR D78 052001        | G. Bonvicini <i>et al.</i>           |
| AUBERT        | 07T | PR D76 011102        | B. Aubert <i>et al.</i>              |
| EPIFANOV      | 07  | PL B654 65           | D. Epifanov <i>et al.</i>            |
| LINK          | 07B | PL B653 1            | J.M. Link <i>et al.</i>              |
| ABLIKIM       | 06C | PL B633 681          | M. Ablikim <i>et al.</i>             |
| AITALA        | 06  | PR D73 032004        | E.M. Aitala <i>et al.</i>            |
| Also          |     | PR D74 059901 (err.) | E.M. Aitala <i>et al.</i>            |
| BUGG          | 06  | PL B632 471          | D.V. Bugg                            |
| CAWLFIELD     | 06A | PR D74 031108        | C. Cawfield <i>et al.</i>            |
| DESCOTES-G... | 06  | EPJ C48 553          | S. Descotes-Genon, B. Moussallam     |
| GUO           | 06  | NP A773 78           | F.K. Guo <i>et al.</i>               |
| ZHOU          | 06  | NP A775 212          | Z.Y. Zhou, H.Q. Zheng                |
| LINK          | 05I | PL B621 72           | J.M. Link <i>et al.</i>              |
| ZHENG         | 04  | NP A733 235          | H.Q. Zheng <i>et al.</i>             |
| BUGG          | 03  | PL B572 1            | D.V. Bugg                            |
| AITALA        | 02  | PRL 89 121801        | E.M. Aitala <i>et al.</i>            |
| LINK          | 02E | PL B535 43           | J.M. Link <i>et al.</i>              |
| KOPP          | 01  | PR D63 092001        | S. Kopp <i>et al.</i>                |
| ISHIDA        | 97B | PTP 98 621           | S. Ishida <i>et al.</i>              |
| ASTON         | 88  | NP B296 493          | D. Aston <i>et al.</i>               |
| VANBEVEREN    | 86  | ZPHY C30 615         | E. van Beveren <i>et al.</i>         |
| ESTABROOKS    | 78  | NP B133 490          | P.G. Estabrooks <i>et al.</i>        |
| BINGHAM       | 72  | NP B41 1             | H.H. Bingham <i>et al.</i>           |
| MERCER        | 71  | NP B32 381           | R. Mercer <i>et al.</i>              |
| ROY           | 71  | PL 36B 353           | S.M. Roy                             |

NODE=M174

REFID=60559  
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 REFID=22415  
 REFID=22412  
 REFID=51107

**$K^*(892)$** 

$$I(J^P) = \frac{1}{2}(1^-)$$

NODE=M018

 **$K^*(892)$  T-Matrix Pole  $\sqrt{s}$** 

NODE=M018TMP

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

NODE=M018TMP

**(890 ± 14) – i (26 ± 6) OUR ESTIMATE**

→ UNCHECKED ←

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                            |                     |     |      |                           |
|----------------------------|---------------------|-----|------|---------------------------|
| (890 ± 2) – i (25.6 ± 1.2) | <sup>1</sup> PELAEZ | 20  | RVUE | $\pi K \rightarrow \pi K$ |
| (892 ± 1) – i (29 ± 1)     | <sup>2</sup> PELAEZ | 17  | RVUE | $\pi K \rightarrow \pi K$ |
| (889 ± 13) – i (24 ± 4)    | <sup>3</sup> PELAEZ | 04A | RVUE | $\pi K \rightarrow \pi K$ |

OCCUR=2

<sup>1</sup> Extracted employing  $\pi K$  partial wave analysis from ESTABROOKS 78 and ASTON 88, Roy-Steiner equations and once subtracted forward dispersion relations.

NODE=M018TMP;LINKAGE=A

<sup>2</sup> Reanalysis of ESTABROOKS 78 and ASTON 88 satisfying Forward Dispersion Relations and using sequences of Pade approximants.

NODE=M018TMP;LINKAGE=E

<sup>3</sup> Reanalysis of data from ESTABROOKS 78 and ASTON 88 in the unitarized ChPT model.

NODE=M018TMP;LINKAGE=B

 **$K^*(892)$  MASS**

NODE=M018205

**CHARGED ONLY, HADROPRODUCED**

NODE=M018M1

NODE=M018M1

NEW

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

**891.67 ± 0.26 OUR AVERAGE**

[891.66 ± 0.26 MeV OUR 2020 AVERAGE]

|                   |      |                       |     |      |                                                   |
|-------------------|------|-----------------------|-----|------|---------------------------------------------------|
| 892.2 ± 0.5 ± 1.7 |      | ALBRECHT              | 20  | CBAR | 0.9 $\bar{p}p \rightarrow K^+ K^- \pi^0$          |
| 892.6 ± 0.5       | 5840 | BAUBILLIER            | 84B | HBC  | 8.25 $K^- p \rightarrow \bar{K}^0 \pi^- p$        |
| 888 ± 3           |      | NAPIER                | 84  | SPEC | + 200 $\pi^- p \rightarrow 2K_S^0 X$              |
| 891 ± 1           |      | NAPIER                | 84  | SPEC | – 200 $\pi^- p \rightarrow 2K_S^0 X$              |
| 891.7 ± 2.1       | 3700 | BARTH                 | 83  | HBC  | + 70 $K^+ p \rightarrow K^0 \pi^+ X$              |
| 891 ± 1           | 4100 | TOAFF                 | 81  | HBC  | – 6.5 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |
| 892.8 ± 1.6       |      | AJINENKO              | 80  | HBC  | + 32 $K^+ p \rightarrow K^0 \pi^+ X$              |
| 890.7 ± 0.9       | 1800 | AGUILAR-...           | 78B | HBC  | ± 0.76 $\bar{p}p \rightarrow K^\mp K_S^0 \pi^\pm$ |
| 886.6 ± 2.4       | 1225 | BALAND                | 78  | HBC  | ± 12 $\bar{p}p \rightarrow (K\pi)^\pm X$          |
| 891.7 ± 0.6       | 6706 | COOPER                | 78  | HBC  | ± 0.76 $\bar{p}p \rightarrow (K\pi)^\pm X$        |
| 891.9 ± 0.7       | 9000 | <sup>1</sup> PALER    | 75  | HBC  | – 14.3 $K^- p \rightarrow (K\pi)^- X$             |
| 892.2 ± 1.5       | 4404 | AGUILAR-...           | 71B | HBC  | – 3.9, 4.6 $K^- p \rightarrow (K\pi)^- p$         |
| 891 ± 2           | 1000 | CRENNELL              | 69D | DBC  | – 3.9 $K^- N \rightarrow K^0 \pi^- X$             |
| 890 ± 3.0         | 720  | BARLOW                | 67  | HBC  | ± 1.2 $\bar{p}p \rightarrow (K^0 \pi)^\pm K^\mp$  |
| 889 ± 3.0         | 600  | BARLOW                | 67  | HBC  | ± 1.2 $\bar{p}p \rightarrow (K^0 \pi)^\pm K\pi$   |
| 891 ± 2.3         | 620  | <sup>2</sup> DEBAERE  | 67B | HBC  | + 3.5 $K^+ p \rightarrow K^0 \pi^+ p$             |
| 891.0 ± 1.2       | 1700 | <sup>3</sup> WOJCICKI | 64  | HBC  | – 1.7 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |

OCCUR=2

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                              |      |                          |      |      |                                              |
|------------------------------|------|--------------------------|------|------|----------------------------------------------|
| 893.6 ± 0.1 $^{+0.2}_{-0.3}$ | 183k | ABLIKIM                  | 19AQ | BES  | ± $J/\psi \rightarrow K^+ K^- \pi^0$         |
| 895.6 ± 0.8                  | 4k   | <sup>4</sup> LEES        | 17C  | BABR | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$     |
| 893.2 ± 0.1 ± 1.0            | 190k | <sup>5</sup> AAIJ        | 16N  | LHCB | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$        |
| 893.5 ± 1.1                  | 27k  | <sup>6</sup> ABELE       | 99D  | CBAR | ± 0.0 $\bar{p}p \rightarrow K^+ K^- \pi^0$   |
| 890.4 ± 0.2 ± 0.5            | 80k  | <sup>7</sup> BIRD        | 89   | LASS | – 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$   |
| 890.0 ± 2.3                  | 800  | <sup>2,3</sup> CLELAND   | 82   | SPEC | + 30 $K^+ p \rightarrow K_S^0 \pi^+ p$       |
| 896.0 ± 1.1                  | 3200 | <sup>2,3</sup> CLELAND   | 82   | SPEC | + 50 $K^+ p \rightarrow K_S^0 \pi^+ p$       |
| 893 ± 1                      | 3600 | <sup>2,3</sup> CLELAND   | 82   | SPEC | – 50 $K^+ p \rightarrow K_S^0 \pi^- p$       |
| 896.0 ± 1.9                  | 380  | DELFOSE                  | 81   | SPEC | + 50 $K^\pm p \rightarrow K^\pm \pi^0 p$     |
| 886.0 ± 2.3                  | 187  | DELFOSE                  | 81   | SPEC | – 50 $K^\pm p \rightarrow K^\pm \pi^0 p$     |
| 894.2 ± 2.0                  | 765  | <sup>2</sup> CLARK       | 73   | HBC  | – 3.13 $K^- p \rightarrow \bar{K}^0 \pi^- p$ |
| 894.3 ± 1.5                  | 1150 | <sup>2,3</sup> CLARK     | 73   | HBC  | – 3.3 $K^- p \rightarrow \bar{K}^0 \pi^- p$  |
| 892.0 ± 2.6                  | 341  | <sup>2</sup> SCHWEING... | 68   | HBC  | – 5.5 $K^- p \rightarrow \bar{K}^0 \pi^- p$  |

OCCUR=2

OCCUR=3

OCCUR=2

OCCUR=2

OCCUR=2

<sup>1</sup> Inclusive reaction. Complicated background and phase-space effects.

NODE=M018M;LINKAGE=I

<sup>2</sup> Mass errors enlarged by us to  $\Gamma/\sqrt{N}$ . See note.

NODE=M018M;LINKAGE=D

<sup>3</sup> Number of events in peak reevaluated by us.

NODE=M018M;LINKAGE=W

<sup>4</sup> From a Dalitz plot analysis in an isobar model with charged and neutral  $K^*(892)$  masses and widths floating.

NODE=M018M1;LINKAGE=B

<sup>5</sup> Average of fit results with different parametrizations for the  $K\pi$  S-wave.

NODE=M018M1;LINKAGE=A

<sup>6</sup> K-matrix pole.

NODE=M018M1;LINKAGE=AN

<sup>7</sup> From a partial wave amplitude analysis.

NODE=M018M1;LINKAGE=F



**CHARGED ONLY, PRODUCED IN  $\tau$  LEPTON DECAYS**

| VALUE (MeV)                                                                   | EVS | DOCUMENT ID            | TECN     | COMMENT                                   |
|-------------------------------------------------------------------------------|-----|------------------------|----------|-------------------------------------------|
| <b>895.47<math>\pm</math>0.20<math>\pm</math>0.74</b>                         | 53k | <sup>1</sup> EPIFANOV  | 07 BELL  | $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                        |          |                                           |
| 892.0 $\pm$ 0.5                                                               |     | <sup>2</sup> BOITO     | 10 RVUE  | $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| 892.0 $\pm$ 0.9                                                               |     | <sup>3,4</sup> BOITO   | 09 RVUE  | $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| 895.3 $\pm$ 0.2                                                               |     | <sup>4,5</sup> JAMIN   | 08 RVUE  | $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| 896.4 $\pm$ 0.9                                                               | 12k | <sup>6</sup> BONVICINI | 02 CLEO  | $\tau^- \rightarrow K^- \pi^0 \nu_\tau$   |
| 895 $\pm$ 2                                                                   |     | <sup>7</sup> BARATE    | 99R ALEP | $\tau^- \rightarrow K^- \pi^0 \nu_\tau$   |

<sup>1</sup> From a fit in the  $K_0^*(700) + K^*(892) + K^*(1410)$  model.

<sup>2</sup> From the pole position of the  $K\pi$  vector form factor using EPIFANOV 07 and constraints from  $K_{J3}$  decays in ANTONELLI 10.

<sup>3</sup> From the pole position of the  $K\pi$  vector form factor in the complex  $s$ -plane and using EPIFANOV 07 data.

<sup>4</sup> Systematic uncertainties not estimated.

<sup>5</sup> Reanalysis of EPIFANOV 07 using resonance chiral theory.

<sup>6</sup> Calculated by us from the shift by  $4.7 \pm 0.9$  MeV (statistical uncertainty only) reported in BONVICINI 02 with respect to the world average value from PDG 00.

<sup>7</sup> With mass and width of the  $K^*(1410)$  fixed at 1412 MeV and 227 MeV, respectively.

NODE=M018MCT  
NODE=M018MCT

NODE=M018MCT;LINKAGE=EF  
NODE=M018MCT;LINKAGE=BT

NODE=M018MCT;LINKAGE=BI

NODE=M018MCT;LINKAGE=NS  
NODE=M018MCT;LINKAGE=JA  
NODE=M018MCT;LINKAGE=BO

NODE=M018MCT;LINKAGE=BA

**NEUTRAL ONLY**

| VALUE (MeV)                                                                   | EVS   | DOCUMENT ID                                                 | TECN      | COMMENT                                                |
|-------------------------------------------------------------------------------|-------|-------------------------------------------------------------|-----------|--------------------------------------------------------|
| <b>895.55<math>\pm</math>0.20 OUR AVERAGE</b>                                 |       | Error includes scale factor of 1.7. See the ideogram below. |           |                                                        |
| 894.68 $\pm$ 0.25 $\pm$ 0.05                                                  |       | <sup>1</sup> ABLIKIM                                        | 16F BES3  | $D^+ \rightarrow K^- \pi^+ e^+ \nu_e$                  |
| 895.4 $\pm$ 0.2 $\pm$ 0.2                                                     | 243k  | <sup>2</sup> DEL-AMO-SA..11I                                | BABR      | $D^+ \rightarrow K^- \pi^+ e^+ \nu_e$                  |
| 895.7 $\pm$ 0.2 $\pm$ 0.3                                                     | 141k  | <sup>3</sup> BONVICINI                                      | 08A CLEO  | $D^+ \rightarrow K^- \pi^+ \pi^+$                      |
| 895.41 $\pm$ 0.32 $^{+0.35}_{-0.43}$                                          | 18k   | <sup>4</sup> LINK                                           | 05I FOCS  | $D^+ \rightarrow K^- \pi^+ \mu^+ \nu_\mu$              |
| 896 $\pm$ 2                                                                   |       | BARBERIS                                                    | 98E OMEG  | 450 $pp \rightarrow p_f p_s K^* \bar{K}^*$             |
| 895.9 $\pm$ 0.5 $\pm$ 0.2                                                     |       | ASTON                                                       | 88 LASS   | 11 $K^- p \rightarrow K^- \pi^+ n$                     |
| 894.52 $\pm$ 0.63                                                             | 25k   | <sup>5</sup> ATKINSON                                       | 86 OMEG   | 20-70 $\gamma p$                                       |
| 894.63 $\pm$ 0.76                                                             | 20k   | <sup>5</sup> ATKINSON                                       | 86 OMEG   | 20-70 $\gamma p$                                       |
| 897 $\pm$ 1                                                                   | 28k   | EVANGELIS...                                                | 80 OMEG   | 10 $\pi^- p \rightarrow K^+ \pi^- (\Lambda, \Sigma)$   |
| 898.4 $\pm$ 1.4                                                               | 1180  | AGUILAR-...                                                 | 78B HBC   | 0.76 $\bar{p} p \rightarrow K^\mp K_S^0 \pi^\pm$       |
| 894.9 $\pm$ 1.6                                                               |       | WICKLUND                                                    | 78 ASPK   | 3,4,6 $K^\pm N \rightarrow (K\pi)^0 N$                 |
| 897.6 $\pm$ 0.9                                                               |       | BOWLER                                                      | 77 DBC    | 5.4 $K^+ d \rightarrow K^+ \pi^- p p$                  |
| 895.5 $\pm$ 1.0                                                               | 3600  | MCCUBBIN                                                    | 75 HBC    | 3.6 $K^- p \rightarrow K^- \pi^+ n$                    |
| 897.1 $\pm$ 0.7                                                               | 22k   | <sup>5</sup> PALER                                          | 75 HBC    | 14.3 $K^- p \rightarrow (K\pi)^0 X$                    |
| 896.0 $\pm$ 0.6                                                               | 10k   | FOX                                                         | 74 RVUE   | 2 $K^- p \rightarrow K^- \pi^+ n$                      |
| 896.0 $\pm$ 0.6                                                               |       | FOX                                                         | 74 RVUE   | 2 $K^+ n \rightarrow K^+ \pi^- p$                      |
| 896 $\pm$ 2                                                                   |       | <sup>6</sup> MATISON                                        | 74 HBC    | 12 $K^+ p \rightarrow K^+ \pi^- \Delta$                |
| 896 $\pm$ 1                                                                   | 3186  | LEWIS                                                       | 73 HBC    | 2.1-2.7 $K^+ p \rightarrow K\pi\pi p$                  |
| 894.0 $\pm$ 1.3                                                               |       | <sup>6</sup> LINGLIN                                        | 73 HBC    | 2-13 $K^+ p \rightarrow K^+ \pi^- \pi^+ p$             |
| 898.4 $\pm$ 1.3                                                               | 1700  | <sup>7</sup> BUCHNER                                        | 72 DBC    | 4.6 $K^+ n \rightarrow K^+ \pi^- p$                    |
| 897.9 $\pm$ 1.1                                                               | 2934  | <sup>7</sup> AGUILAR-...                                    | 71B HBC   | 3,9,4,6 $K^- p \rightarrow K^- \pi^+ n$                |
| 898.0 $\pm$ 0.7                                                               | 5362  | <sup>7</sup> AGUILAR-...                                    | 71B HBC   | 3,9,4,6 $K^- p \rightarrow K^- \pi^+ \pi^- p$          |
| 895 $\pm$ 1                                                                   | 4300  | <sup>8</sup> HABER                                          | 70 DBC    | 3 $K^- N \rightarrow K^- \pi^+ X$                      |
| 893.7 $\pm$ 2.0                                                               | 10k   | DAVIS                                                       | 69 HBC    | 12 $K^+ p \rightarrow K^+ \pi^- \pi^+ p$               |
| 894.7 $\pm$ 1.4                                                               | 1040  | <sup>7</sup> DAUBER                                         | 67B HBC   | 2.0 $K^- p \rightarrow K^- \pi^+ \pi^- p$              |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                                                             |           |                                                        |
| 895.50 $\pm$ 0.92 $\pm$ 2.6                                                   |       | <sup>9</sup> ADUSZKIEW...20A                                | NA61      | 158 $pp$                                               |
| 898.1 $\pm$ 1.0                                                               | 4k    | <sup>10</sup> LEES                                          | 17C BABR  | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$               |
| 895.53 $\pm$ 0.17                                                             |       | LEES                                                        | 13F BABR  | $D^+ \rightarrow K^+ K^- \pi^+$                        |
| 894.9 $\pm$ 0.5 $\pm$ 0.7                                                     | 14.4k | <sup>11</sup> MITCHELL                                      | 09A CLEO  | $D_s^+ \rightarrow K^+ K^- \pi^+$                      |
| 896.2 $\pm$ 0.3                                                               | 20k   | <sup>12</sup> AUBERT                                        | 07AK BABR | 10.6 $e^+ e^- \rightarrow K^{*0} K^\pm \pi^\mp \gamma$ |
| 900.7 $\pm$ 1.1                                                               | 5900  | BARTH                                                       | 83 HBC    | 70 $K^+ p \rightarrow K^+ \pi^- X$                     |

<sup>1</sup> Taking also into account the  $K_0^*(1430)^0$  and  $K_2^*(1430)^0$ .

<sup>2</sup> Taking into account the  $K^*(892)^0$ ,  $S$ -wave and  $P$ -wave ( $K^*(1410)^0$ ).

<sup>3</sup> From the isobar model with a complex pole for the  $\kappa$ .

<sup>4</sup> Fit to  $K\pi$  mass spectrum includes a non-resonant scalar component.

<sup>5</sup> Inclusive reaction. Complicated background and phase-space effects.

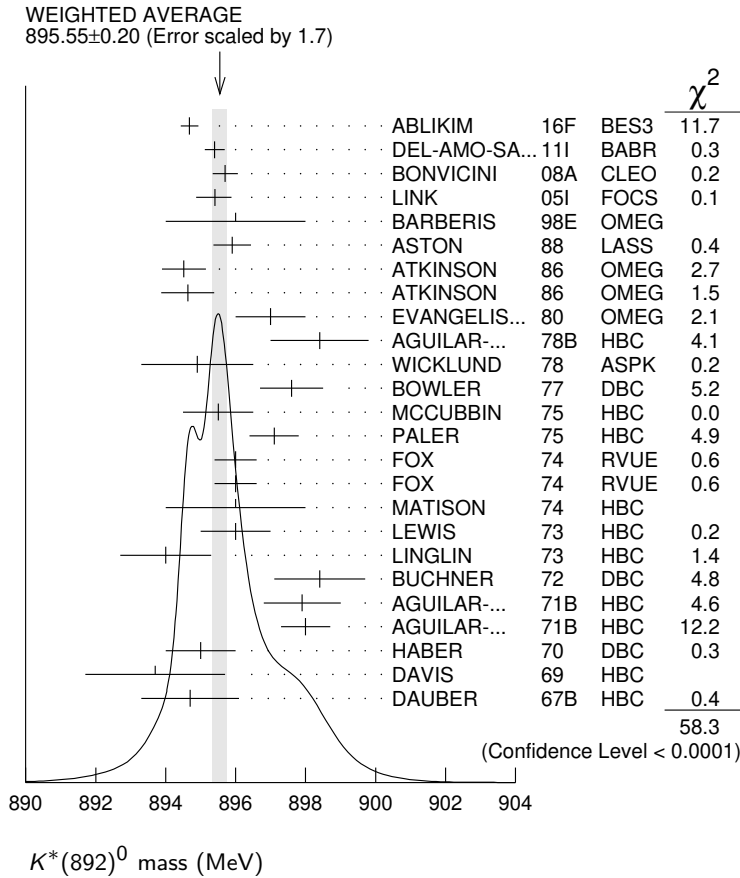
<sup>6</sup> From pole extrapolation.

<sup>7</sup> Mass errors enlarged by us to  $\Gamma/\sqrt{N}$ . See note.

NODE=M018M2;LINKAGE=B  
NODE=M018M2;LINKAGE=DE  
NODE=M018M2;LINKAGE=BO  
NODE=M018M2;LINKAGE=LI  
NODE=M018M2;LINKAGE=I  
NODE=M018M2;LINKAGE=C  
NODE=M018M2;LINKAGE=D

- <sup>8</sup>Number of events in peak reevaluated by us.
- <sup>9</sup>For transverse momenta between 0.6 and 0.8 GeV/c and rapidity  $0 < y < 0.5$ .
- <sup>10</sup>From a Dalitz plot analysis in an isobar model with charged and neutral  $K^*(892)$  masses and widths floating.
- <sup>11</sup>This value comes from a fit with  $\chi^2$  of 178/117.
- <sup>12</sup>Systematic uncertainties not estimated.

NODE=M018M2;LINKAGE=W  
NODE=M018M2;LINKAGE=C  
NODE=M018M2;LINKAGE=A  
  
NODE=M018M2;LINKAGE=MI  
NODE=M018M2;LINKAGE=NS



**$K^*(892)$  MASSES AND MASS DIFFERENCES**

NODE=M018209

Unrealistically small errors have been reported by some experiments. We use simple “realistic” tests for the minimum errors on the determination of a mass and width from a sample of  $N$  events:

$$\delta_{\min}(m) = \frac{\Gamma}{\sqrt{N}}, \quad \delta_{\min}(\Gamma) = 4 \frac{\Gamma}{\sqrt{N}} . \tag{1}$$

We consistently increase unrealistic errors before averaging. For a detailed discussion, see the 1971 edition of this Note.

| $m_{K^*(892)^0} - m_{K^*(892)^\pm}$ |      |                     |      |     |         |                                                 |
|-------------------------------------|------|---------------------|------|-----|---------|-------------------------------------------------|
| VALUE (MeV)                         | EVTS | DOCUMENT ID         | TECN | CHG | COMMENT |                                                 |
| <b>6.7±1.2 OUR AVERAGE</b>          |      |                     |      |     |         |                                                 |
| 7.7±1.7                             | 2980 | AGUILAR-...         | 78B  | HBC | ±0      | 0.76 $\bar{p}p \rightarrow K^\mp K_S^0 \pi^\pm$ |
| 5.7±1.7                             | 7338 | AGUILAR-...         | 71B  | HBC | -0      | 3.9,4.6 $K^- p$                                 |
| 6.3±4.1                             | 283  | <sup>1</sup> BARASH | 67B  | HBC |         | 0.0 $\bar{p}p$                                  |

NODE=M018D

NODE=M018D

<sup>1</sup> Number of events in peak reevaluated by us. **$K^*(892)$  RANGE PARAMETER**

All from partial wave amplitude analyses.

| VALUE (GeV <sup>-1</sup> )                   | EVTS | DOCUMENT ID                 | TECN | CHG  | COMMENT                                     |
|----------------------------------------------|------|-----------------------------|------|------|---------------------------------------------|
| 2.1 ±0.5 ±0.5                                | 243k | <sup>1</sup> DEL-AMO-SA.11i | BABR | 0    | $D^+ \rightarrow K^- \pi^+ e^+ \nu_e$       |
| 3.96 ±0.54 <sup>+1.31</sup> <sub>-0.90</sub> | 18k  | <sup>2</sup> LINK           | 05i  | FOCS | 0 $D^+ \rightarrow K^- \pi^+ \mu^+ \nu_\mu$ |
| 3.4 ±0.7                                     |      | ASTON                       | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$        |
| 12.1 ±3.2 ±3.0                               |      | BIRD                        | 89   | LASS | - 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$  |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<sup>1</sup> Taking into account the  $K^*(892)^0$ ,  $S$ -wave and  $P$ -wave ( $K^*(1410)^0$ ).<sup>2</sup> Fit to  $K\pi$  mass spectrum includes a non-resonant scalar component. **$K^*(892)$  WIDTH****CHARGED ONLY, HADROPRODUCED**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID              | TECN | CHG  | COMMENT                                            |
|-------------------------------------------------------------------------------|------|--------------------------|------|------|----------------------------------------------------|
| <b>51.4 ±0.8 OUR FIT</b>                                                      |      |                          |      |      |                                                    |
| [50.8 ± 0.9 MeV OUR 2020 FIT]                                                 |      |                          |      |      |                                                    |
| <b>51.4 ±0.8 OUR AVERAGE</b>                                                  |      |                          |      |      |                                                    |
| [50.8 ± 0.9 MeV OUR 2020 AVERAGE]                                             |      |                          |      |      |                                                    |
| 54.4 ±0.9 ±1.7                                                                |      | ALBRECHT                 | 20   | CBAR | 0.9 $\bar{p} p \rightarrow K^+ K^- \pi^0$          |
| 49 ±2                                                                         | 5840 | BAUBILLIER               | 84B  | HBC  | - 8.25 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |
| 56 ±4                                                                         |      | NAPIER                   | 84   | SPEC | - 200 $\pi^- p \rightarrow 2K_S^0 X$               |
| 51 ±2                                                                         | 4100 | TOAFF                    | 81   | HBC  | - 6.5 $K^- p \rightarrow \bar{K}^0 \pi^- p$        |
| 50.5 ±5.6                                                                     |      | AJINENKO                 | 80   | HBC  | + 32 $K^+ p \rightarrow K^0 \pi^+ X$               |
| 45.8 ±3.6                                                                     | 1800 | AGUILAR-...              | 78B  | HBC  | ± 0.76 $\bar{p} p \rightarrow K^\mp K_S^0 \pi^\pm$ |
| 52.0 ±2.5                                                                     | 6706 | <sup>1</sup> COOPER      | 78   | HBC  | ± 0.76 $\bar{p} p \rightarrow (K\pi)^\pm X$        |
| 52.1 ±2.2                                                                     | 9000 | <sup>2</sup> PALER       | 75   | HBC  | - 14.3 $K^- p \rightarrow (K\pi)^- X$              |
| 46.3 ±6.7                                                                     | 765  | <sup>1</sup> CLARK       | 73   | HBC  | - 3.13 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |
| 48.2 ±5.7                                                                     | 1150 | <sup>1,3</sup> CLARK     | 73   | HBC  | - 3.3 $K^- p \rightarrow \bar{K}^0 \pi^- p$        |
| 54.3 ±3.3                                                                     | 4404 | <sup>1</sup> AGUILAR-... | 71B  | HBC  | - 3.9,4.6 $K^- p \rightarrow (K\pi)^- p$           |
| 46 ±5                                                                         | 1700 | <sup>1,3</sup> WOJCICKI  | 64   | HBC  | - 1.7 $K^- p \rightarrow \bar{K}^0 \pi^- p$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                          |      |      |                                                    |
| 46.7 ±0.2 <sup>+0.1</sup> <sub>-0.2</sub>                                     | 183k | ABLIKIM                  | 19AQ | BES  | ± $J/\psi \rightarrow K^+ K^- \pi^0$               |
| 43.6 ±1.3                                                                     | 4k   | <sup>4</sup> LEES        | 17C  | BABR | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$           |
| 47.2 ±0.3 ±2.3                                                                | 190k | <sup>5</sup> AAIJ        | 16N  | LHCB | $D^0 \rightarrow K_S^0 K^\pm \pi^\mp$              |
| 54.8 ±1.7                                                                     | 27k  | <sup>6</sup> ABELE       | 99D  | CBAR | ± 0.0 $\bar{p} p \rightarrow K^+ K^- \pi^0$        |
| 45.2 ±1 ±2                                                                    | 80k  | <sup>7</sup> BIRD        | 89   | LASS | - 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$         |
| 42.8 ±7.1                                                                     | 3700 | BARTH                    | 83   | HBC  | + 70 $K^+ p \rightarrow K^0 \pi^+ X$               |
| 64.0 ±9.2                                                                     | 800  | <sup>1,3</sup> CLELAND   | 82   | SPEC | + 30 $K^+ p \rightarrow K_S^0 \pi^+ p$             |
| 62.0 ±4.4                                                                     | 3200 | <sup>1,3</sup> CLELAND   | 82   | SPEC | + 50 $K^+ p \rightarrow K_S^0 \pi^+ p$             |
| 55 ±4                                                                         | 3600 | <sup>1,3</sup> CLELAND   | 82   | SPEC | - 50 $K^+ p \rightarrow K_S^0 \pi^- p$             |
| 62.6 ±3.8                                                                     | 380  | DELFOSE                  | 81   | SPEC | + 50 $K^\pm p \rightarrow K^\pm \pi^0 p$           |
| 50.5 ±3.9                                                                     | 187  | DELFOSE                  | 81   | SPEC | - 50 $K^\pm p \rightarrow K^\pm \pi^0 p$           |

<sup>1</sup> Width errors enlarged by us to  $4 \times \Gamma/\sqrt{N}$ ; see note.<sup>2</sup> Inclusive reaction. Complicated background and phase-space effects.<sup>3</sup> Number of events in peak reevaluated by us.<sup>4</sup> From a Dalitz plot analysis in an isobar model with charged and neutral  $K^*(892)$  masses and widths floating.<sup>5</sup> Average of fit results with different parametrizations for the  $K\pi$   $S$ -wave.<sup>6</sup>  $K$ -matrix pole.<sup>7</sup> From a partial wave amplitude analysis.

NODE=M018D;LINKAGE=W

NODE=M018R

NODE=M018R

NODE=M018R

NODE=M018R;LINKAGE=DE

NODE=M018R;LINKAGE=LI

NODE=M018215

NODE=M018W1

NODE=M018W1

NEW

NEW

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=3

OCCUR=2

NODE=M018W;LINKAGE=D

NODE=M018W;LINKAGE=I

NODE=M018W;LINKAGE=W

NODE=M018W1;LINKAGE=B

NODE=M018W1;LINKAGE=A

NODE=M018W1;LINKAGE=AN

NODE=M018W1;LINKAGE=F

**CHARGED ONLY, PRODUCED IN  $\tau$  LEPTON DECAYS**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN     | COMMENT                                   |
|-------------------------------------------------------------------------------|------|-----------------------|----------|-------------------------------------------|
| <b>46.2<math>\pm</math>0.6<math>\pm</math>1.2</b>                             | 53k  | <sup>1</sup> EPIFANOV | 07 BELL  | $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |          |                                           |
| 46.5 $\pm$ 1.1                                                                |      | <sup>2</sup> BOITO    | 10 RVUE  | $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| 46.2 $\pm$ 0.4                                                                |      | <sup>3,4</sup> BOITO  | 09 RVUE  | $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| 47.5 $\pm$ 0.4                                                                |      | <sup>4,5</sup> JAMIN  | 08 RVUE  | $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ |
| 55 $\pm$ 8                                                                    |      | <sup>6</sup> BARATE   | 99R ALEP | $\tau^- \rightarrow K^- \pi^0 \nu_\tau$   |

<sup>1</sup> From a fit in the  $K_0^*(700) + K^*(892) + K^*(1410)$  model.

<sup>2</sup> From the pole position of the  $K\pi$  vector form factor using EPIFANOV 07 and constraints from  $K_{J3}$  decays in ANTONELLI 10.

<sup>3</sup> From the pole position of the  $K\pi$  vector form factor in the complex  $s$ -plane and using EPIFANOV 07 data.

<sup>4</sup> Systematic uncertainties not estimated.

<sup>5</sup> Reanalysis of EPIFANOV 07 using resonance chiral theory.

<sup>6</sup> With mass and width of the  $K^*(1410)$  fixed at 1412 MeV and 227 MeV, respectively.

NODE=M018W5  
NODE=M018W5

NODE=M018W5;LINKAGE=EF  
NODE=M018W5;LINKAGE=BT

NODE=M018W5;LINKAGE=BI

NODE=M018W5;LINKAGE=NS  
NODE=M018W5;LINKAGE=JA  
NODE=M018W5;LINKAGE=BA

**NEUTRAL ONLY**

| VALUE (MeV)                                 | EVTS                                                        | DOCUMENT ID                   | TECN     | COMMENT                                              |
|---------------------------------------------|-------------------------------------------------------------|-------------------------------|----------|------------------------------------------------------|
| <b>47.3 <math>\pm</math>0.5 OUR FIT</b>     | Error includes scale factor of 1.9.                         |                               |          |                                                      |
| <b>47.3 <math>\pm</math>0.5 OUR AVERAGE</b> | Error includes scale factor of 2.0. See the ideogram below. |                               |          |                                                      |
| 46.53 $\pm$ 0.56 $\pm$ 0.31                 |                                                             | <sup>1</sup> ABLIKIM          | 16F BES3 | $D^+ \rightarrow K^- \pi^+ e^+ \nu_e$                |
| 46.5 $\pm$ 0.3 $\pm$ 0.2                    | 243k                                                        | <sup>2</sup> DEL-AMO-SA...11I | BABR     | $D^+ \rightarrow K^- \pi^+ e^+ \nu_e$                |
| 45.3 $\pm$ 0.5 $\pm$ 0.6                    | 141k                                                        | <sup>3</sup> BONVICINI        | 08A CLEO | $D^+ \rightarrow K^- \pi^+ \pi^+$                    |
| 47.79 $\pm$ 0.86 $^{+1.32}_{-1.06}$         | 18k                                                         | <sup>4</sup> LINK             | 05I FOCS | $D^+ \rightarrow K^- \pi^+ \mu^+ \nu_\mu$            |
| 54 $\pm$ 3                                  |                                                             | BARBERIS                      | 98E OMEG | 450 $pp \rightarrow p_f p_s K^* \bar{K}^*$           |
| 50.8 $\pm$ 0.8 $\pm$ 0.9                    |                                                             | ASTON                         | 88 LASS  | 11 $K^- p \rightarrow K^- \pi^+ n$                   |
| 46.5 $\pm$ 4.3                              | 5900                                                        | BARTH                         | 83 HBC   | 70 $K^+ p \rightarrow K^+ \pi^- X$                   |
| 54 $\pm$ 2                                  | 28k                                                         | EVANGELIS...                  | 80 OMEG  | 10 $\pi^- p \rightarrow K^+ \pi^- (\Lambda, \Sigma)$ |
| 45.9 $\pm$ 4.8                              | 1180                                                        | AGUILAR-...                   | 78B HBC  | 0.76 $\bar{p} p \rightarrow K^\mp K_S^0 \pi^\pm$     |
| 51.2 $\pm$ 1.7                              |                                                             | WICKLUND                      | 78 ASPK  | 3,4,6 $K^\pm N \rightarrow (K\pi)^0 N$               |
| 48.9 $\pm$ 2.5                              |                                                             | BOWLER                        | 77 DBC   | 5.4 $K^+ d \rightarrow K^+ \pi^- pp$                 |
| 48 $^{+3}_{-2}$                             | 3600                                                        | MCCUBBIN                      | 75 HBC   | 3.6 $K^- p \rightarrow K^- \pi^+ n$                  |
| 50.6 $\pm$ 2.5                              | 22k                                                         | <sup>5</sup> PALER            | 75 HBC   | 14.3 $K^- p \rightarrow (K\pi)^0 X$                  |
| 47 $\pm$ 2                                  | 10k                                                         | FOX                           | 74 RVUE  | 2 $K^- p \rightarrow K^- \pi^+ n$                    |
| 51 $\pm$ 2                                  |                                                             | FOX                           | 74 RVUE  | 2 $K^+ n \rightarrow K^+ \pi^- p$                    |
| 46.0 $\pm$ 3.3                              | 3186                                                        | <sup>6</sup> LEWIS            | 73 HBC   | 2.1-2.7 $K^+ p \rightarrow K\pi\pi p$                |
| 51.4 $\pm$ 5.0                              | 1700                                                        | <sup>6</sup> BUCHNER          | 72 DBC   | 4.6 $K^+ n \rightarrow K^+ \pi^- p$                  |
| 55.8 $^{+4.2}_{-3.4}$                       | 2934                                                        | <sup>6</sup> AGUILAR-...      | 71B HBC  | 3.9,4.6 $K^- p \rightarrow K^- \pi^+ n$              |
| 48.5 $\pm$ 2.7                              | 5362                                                        | AGUILAR-...                   | 71B HBC  | 3.9,4.6 $K^- p \rightarrow K^- \pi^+ \pi^- p$        |
| 54.0 $\pm$ 3.3                              | 4300                                                        | <sup>6,7</sup> HABER          | 70 DBC   | 3 $K^- N \rightarrow K^- \pi^+ X$                    |
| 53.2 $\pm$ 2.1                              | 10k                                                         | <sup>6</sup> DAVIS            | 69 HBC   | 12 $K^+ p \rightarrow K^+ \pi^- \pi^+ p$             |
| 44 $\pm$ 5.5                                | 1040                                                        | <sup>6</sup> DAUBER           | 67B HBC  | 2.0 $K^- p \rightarrow K^- \pi^+ \pi^- p$            |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |       |                              |           |                                                        |
|--------------------------|-------|------------------------------|-----------|--------------------------------------------------------|
| 48.8 $\pm$ 1.8 $\pm$ 2.0 |       | <sup>8</sup> ADUSZKIEW...20A | NA61      | 158 $pp$                                               |
| 52.6 $\pm$ 1.7           | 4k    | <sup>9</sup> LEES            | 17C BABR  | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$               |
| 44.90 $\pm$ 0.30         |       | LEES                         | 13F BABR  | $D^+ \rightarrow K^+ K^- \pi^+$                        |
| 45.7 $\pm$ 1.1 $\pm$ 0.5 | 14.4k | <sup>10</sup> MITCHELL       | 09A CLEO  | $D_s^+ \rightarrow K^+ K^- \pi^+$                      |
| 50.6 $\pm$ 0.9           | 20k   | <sup>11</sup> AUBERT         | 07AK BABR | 10.6 $e^+ e^- \rightarrow K^{*0} K^\pm \pi^\mp \gamma$ |

<sup>1</sup> Taking also into account the  $K_0^*(1430)^0$  and  $K_2^*(1430)^0$ .

<sup>2</sup> Taking into account the  $K^*(892)^0$ ,  $S$ -wave and  $P$ -wave ( $K^*(1410)^0$ ).

<sup>3</sup> From the isobar model with a complex pole for the  $\kappa$ .

<sup>4</sup> Fit to  $K\pi$  mass spectrum includes a non-resonant scalar component.

<sup>5</sup> Inclusive reaction. Complicated background and phase-space effects.

<sup>6</sup> Width errors enlarged by us to  $4 \times \Gamma/\sqrt{N}$ ; see note.

<sup>7</sup> Number of events in peak reevaluated by us.

<sup>8</sup> For transverse momenta between 0.6 and 0.8 GeV/c and rapidity  $0 < y < 0.5$ .

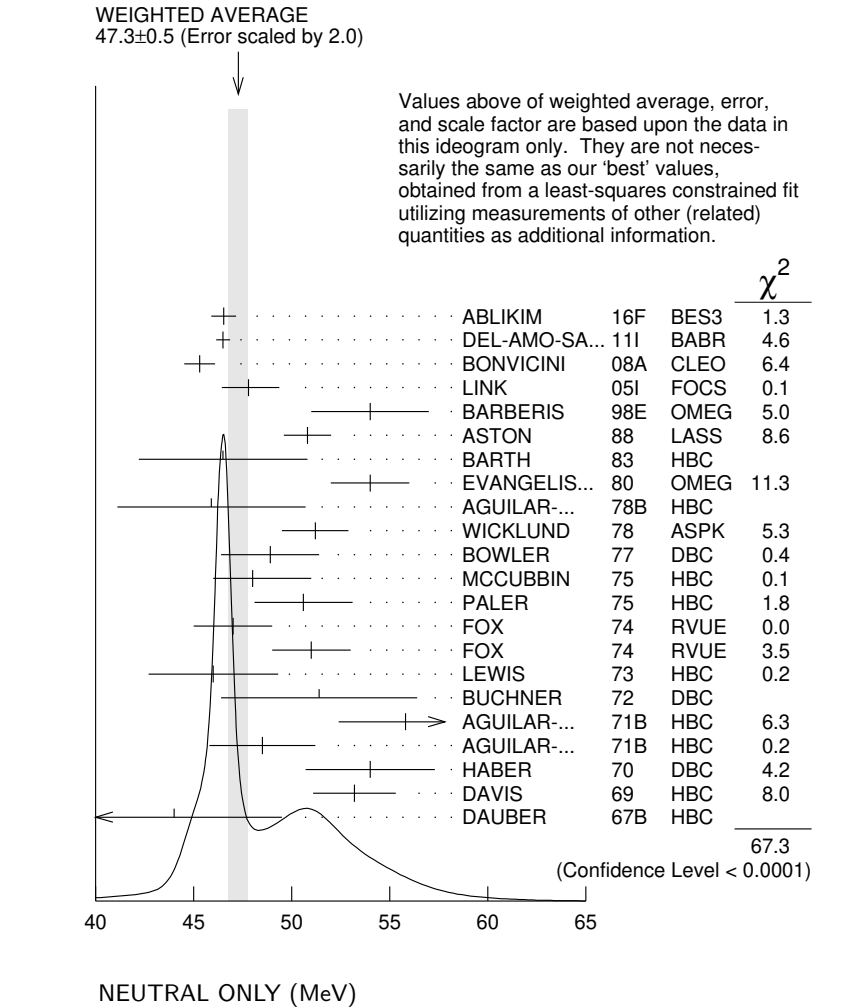
<sup>9</sup> From a Dalitz plot analysis in an isobar model with charged and neutral  $K^*(892)$  masses and widths floating.

<sup>10</sup> This value comes from a fit with  $\chi^2$  of 178/117.

<sup>11</sup> Systematic uncertainties not estimated.

NODE=M018W2;LINKAGE=B  
NODE=M018W2;LINKAGE=DE  
NODE=M018W2;LINKAGE=BO  
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NODE=M018W2;LINKAGE=W  
NODE=M018W2;LINKAGE=C  
NODE=M018W2;LINKAGE=A

NODE=M018W2;LINKAGE=MI  
NODE=M018W2;LINKAGE=NS



K\*(892) DECAY MODES

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ )   | Confidence level |
|--------------------------|----------------------------------|------------------|
| $\Gamma_1$ $K\pi$        | $\sim 100$                       | %                |
| $\Gamma_2$ $(K\pi)^\pm$  | $(99.902 \pm 0.009) \%$          |                  |
| $\Gamma_3$ $(K\pi)^0$    | $(99.754 \pm 0.021) \%$          |                  |
| $\Gamma_4$ $K^0\gamma$   | $(2.46 \pm 0.21) \times 10^{-3}$ |                  |
| $\Gamma_5$ $K^\pm\gamma$ | $(9.8 \pm 0.9) \times 10^{-4}$   |                  |
| $\Gamma_6$ $K\pi\pi$     | $< 7 \times 10^{-4}$             | 95%              |

NODE=M018220;NODE=M018

DESIG=1;OUR EVAL;→ UNCHECKED ←  
DESIG=11  
DESIG=12  
DESIG=4  
DESIG=3  
DESIG=2

CONSTRAINED FIT INFORMATION

An overall fit to the total width and a partial width uses 14 measurements and one constraint to determine 3 parameters. The overall fit has a  $\chi^2 = 10.7$  for 12 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |
|----------|-------|-------|
| $x_5$    | -100  |       |
| $\Gamma$ | 17    | -17   |
|          | $x_2$ | $x_5$ |

| Mode                     | Rate (MeV)    |
|--------------------------|---------------|
| $\Gamma_2$ $(K\pi)^\pm$  | 51.4 ± 0.8    |
| $\Gamma_5$ $K^\pm\gamma$ | 0.050 ± 0.005 |

DESIG=11  
DESIG=3

## CONSTRAINED FIT INFORMATION

An overall fit to the total width and a partial width uses 23 measurements and one constraint to determine 3 parameters. The overall fit has a  $\chi^2 = 68.4$  for 21 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |
|----------|-------|-------|
| $x_4$    | −100  |       |
| $\Gamma$ | 12    | −12   |
|          | $x_3$ | $x_4$ |

|            | Mode        | Rate (MeV)        | Scale factor |
|------------|-------------|-------------------|--------------|
| $\Gamma_3$ | $(K\pi)^0$  | 47.2 $\pm$ 0.5    | 1.9          |
| $\Gamma_4$ | $K^0\gamma$ | 0.117 $\pm$ 0.010 |              |

DESIG=12

DESIG=4

### $K^*(892)$ PARTIAL WIDTHS

NODE=M018225

| $\Gamma(K^0\gamma)$                    |      |             |      |      |         | $\Gamma_4$                          |
|----------------------------------------|------|-------------|------|------|---------|-------------------------------------|
| VALUE (keV)                            | EVTS | DOCUMENT ID | TECN | CHG  | COMMENT |                                     |
| <b>116 <math>\pm</math> 10 OUR FIT</b> |      |             |      |      |         |                                     |
| <b>116.5 <math>\pm</math> 9.9</b>      | 584  | CARLSMITH   | 86   | SPEC | 0       | $K_L^0 A \rightarrow K_S^0 \pi^0 A$ |

NODE=M018W4  
NODE=M018W4

| $\Gamma(K^\pm\gamma)$                    |  |             |      |      |         | $\Gamma_5$                            |
|------------------------------------------|--|-------------|------|------|---------|---------------------------------------|
| VALUE (keV)                              |  | DOCUMENT ID | TECN | CHG  | COMMENT |                                       |
| <b>50 <math>\pm</math> 5 OUR FIT</b>     |  |             |      |      |         |                                       |
| <b>50 <math>\pm</math> 5 OUR AVERAGE</b> |  |             |      |      |         |                                       |
| 48 $\pm$ 11                              |  | BERG        | 83   | SPEC | −       | 156 $K^- A \rightarrow \bar{K} \pi A$ |
| 51 $\pm$ 5                               |  | CHANDLEE    | 83   | SPEC | +       | 200 $K^+ A \rightarrow K \pi A$       |

NODE=M018W3  
NODE=M018W3

### $K^*(892)$ BRANCHING RATIOS

NODE=M018230

| $\Gamma(K^0\gamma)/\Gamma_{\text{total}}$                                     |  |             |      |      |         | $\Gamma_4/\Gamma$  |
|-------------------------------------------------------------------------------|--|-------------|------|------|---------|--------------------|
| VALUE (units $10^{-3}$ )                                                      |  | DOCUMENT ID | TECN | CHG  | COMMENT |                    |
| <b>2.46 <math>\pm</math> 0.21 OUR FIT</b>                                     |  |             |      |      |         |                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |             |      |      |         |                    |
| 1.5 $\pm$ 0.7                                                                 |  | CARITHERS   | 75B  | CNTR | 0       | 8–16 $\bar{K}^0 A$ |

NODE=M018R3  
NODE=M018R3

| $\Gamma(K^\pm\gamma)/\Gamma_{\text{total}}$       |     |             |      |     |         | $\Gamma_5/\Gamma$ |
|---------------------------------------------------|-----|-------------|------|-----|---------|-------------------|
| VALUE (units $10^{-3}$ )                          | CL% | DOCUMENT ID | TECN | CHG | COMMENT |                   |
| <b>0.98 <math>\pm</math> 0.09 OUR FIT</b>         |     |             |      |     |         |                   |
| [(0.99 $\pm$ 0.09) $\times 10^{-3}$ OUR 2020 FIT] |     |             |      |     |         |                   |

NODE=M018R2  
NODE=M018R2  
NEW

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |          |    |      |   |               |
|------|----|----------|----|------|---|---------------|
| <1.6 | 95 | BEMPORAD | 73 | CNTR | + | 10–16 $K^+ A$ |
|------|----|----------|----|------|---|---------------|

| $\Gamma(K\pi\pi)/\Gamma((K\pi)^\pm)$                                          |     |             |      |     |                                        | $\Gamma_6/\Gamma_2$                       |
|-------------------------------------------------------------------------------|-----|-------------|------|-----|----------------------------------------|-------------------------------------------|
| VALUE                                                                         | CL% | DOCUMENT ID | TECN | CHG | COMMENT                                |                                           |
| <b>&lt; 7 <math>\times 10^{-4}</math></b>                                     | 95  | JONGEJANS   | 78   | HBC | 4 $K^- p \rightarrow p \bar{K}^0 2\pi$ |                                           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |     |                                        |                                           |
| <20 $\times 10^{-4}$                                                          |     | WOJCICKI    | 64   | HBC | −                                      | 1.7 $K^- p \rightarrow \bar{K}^0 \pi^- p$ |

NODE=M018R1  
NODE=M018R1

**K\*(892) REFERENCES**

NODE=M018

|               |      |                     |                                              |                            |             |
|---------------|------|---------------------|----------------------------------------------|----------------------------|-------------|
| ADUSZKIEW...  | 20A  | EPJ C80 460         | A. Aduszkiewicz <i>et al.</i>                | (CERN NA61 Collab.)        | REFID=60631 |
| ALBRECHT      | 20   | EPJ C80 453         | M. Albrecht <i>et al.</i>                    | (Crystal Barrel Collab.)   | REFID=60439 |
| PELAEZ        | 20   | PRL 124 172001      | J.R. Pelaez <i>et al.</i>                    |                            | REFID=60559 |
| ABLIKIM       | 19AQ | PR D100 032004      | M. Ablikim <i>et al.</i>                     | (BESIII Collab.)           | REFID=59909 |
| LEES          | 17C  | PR D95 072007       | J.P. Lees <i>et al.</i>                      | (BABAR Collab.)            | REFID=57981 |
| PELAEZ        | 17   | EPJ C77 91          | J.R. Pelaez, A.Rodas, J.R. de Elvira         |                            | REFID=57836 |
| AAIJ          | 16N  | PR D93 052018       | R. Aaij <i>et al.</i>                        | (LHCb Collab.)             | REFID=57273 |
| ABLIKIM       | 16F  | PR D94 032001       | M. Ablikim <i>et al.</i>                     | (BESIII Collab.)           | REFID=57307 |
| LEES          | 13F  | PR D87 052010       | J.P. Lees <i>et al.</i>                      | (BABAR Collab.)            | REFID=55127 |
| DEL-AMO-SA... | 11I  | PR D83 072001       | P. del Amo Sanchez <i>et al.</i>             | (BABAR Collab.)            | REFID=16493 |
| ANTONELLI     | 10   | EPJ C69 399         | M. Antonelli <i>et al.</i>                   | (FlaviaNet Working Group)  | REFID=53448 |
| BOITO         | 10   | JHEP 1009 031       | D.R. Boito, R. Escribano, M. Jamin           | (BARC)                     | REFID=53632 |
| BOITO         | 09   | EPJ C59 821         | D.R. Boito, R. Escribano, M. Jamin           |                            | REFID=52728 |
| MITCHELL      | 09A  | PR D79 072008       | R.E. Mitchell <i>et al.</i>                  | (CLEO Collab.)             | REFID=52756 |
| BONVICINI     | 08A  | PR D78 052001       | G. Bonvicini <i>et al.</i>                   | (CLEO Collab.)             | REFID=52426 |
| JAMIN         | 08   | PL B664 78          | M. Jamin, A. Pich, J. Portoles               |                            | REFID=52285 |
| AUBERT        | 07AK | PR D76 012008       | B. Aubert <i>et al.</i>                      | (BABAR Collab.)            | REFID=51908 |
| EPIFANOV      | 07   | PL B654 65          | D. Epifanov <i>et al.</i>                    | (BELLE Collab.)            | REFID=51929 |
| LINK          | 05I  | PL B621 72          | J.M. Link <i>et al.</i>                      | (FNAL FOCUS Collab.)       | REFID=50679 |
| PELAEZ        | 04A  | MPL A19 2879        | J.R. Pelaez                                  | (MADU)                     | REFID=50347 |
| BONVICINI     | 02   | PRL 88 111803       | G. Bonvicini <i>et al.</i>                   | (CLEO Collab.)             | REFID=48701 |
| PDG           | 00   | EPJ C15 1           | D.E. Groom <i>et al.</i>                     | (PDG Collab.)              | REFID=47469 |
| ABELE         | 99D  | PL B468 178         | A. Abele <i>et al.</i>                       | (Crystal Barrel Collab.)   | REFID=47401 |
| BARATE        | 99R  | EPJ C11 599         | R. Barate <i>et al.</i>                      | (ALEPH Collab.)            | REFID=47366 |
| BARBERIS      | 98E  | PL B436 204         | D. Barberis <i>et al.</i>                    | (Omega Expt.)              | REFID=46348 |
| BIRD          | 89   | SLAC-332            | P.F. Bird                                    | (SLAC)                     | REFID=41002 |
| ASTON         | 88   | NP B296 493         | D. Aston <i>et al.</i>                       | (SLAC, NAGO, CINC, INUS)   | REFID=40262 |
| ATKINSON      | 86   | ZPHY C30 521        | M. Atkinson <i>et al.</i>                    | (BONN, CERN, GLAS+)        | REFID=20564 |
| CARLSMITH     | 86   | PRL 56 18           | D. Carlsmith <i>et al.</i>                   | (EFI, SACL)                | REFID=22461 |
| BAUBILLIER    | 84B  | ZPHY C26 37         | M. Baubillier <i>et al.</i>                  | (BIRM, CERN, GLAS+)        | REFID=22459 |
| NAPIER        | 84   | PL 149B 514         | A. Napier <i>et al.</i>                      | (TUFTS, ARIZ, FNAL, FLOR+) | REFID=22460 |
| BARTH         | 83   | NP B223 296         | M. Barth <i>et al.</i>                       | (BRUX, CERN, GENO, MONS+)  | REFID=22456 |
| BERG          | 83   | Thesis UMI 83-21652 | D.M. Berg                                    | (ROCH)                     | REFID=22457 |
| CHANDLEE      | 83   | PRL 51 168          | C. Chandlee <i>et al.</i>                    | (ROCH, FNAL, MINN)         | REFID=22458 |
| CLELAND       | 82   | NP B208 189         | W.E. Cleland <i>et al.</i>                   | (DURH, GEVA, LAUS+)        | REFID=22455 |
| DELFOSSSE     | 81   | NP B183 349         | A. Delfosse <i>et al.</i>                    | (GEVA, LAUS)               | REFID=21277 |
| TOAFF         | 81   | PR D23 1500         | S. Toaff <i>et al.</i>                       | (ANL, KANS)                | REFID=22454 |
| AJINENKO      | 80   | ZPHY C5 177         | I.V. Ajinenko <i>et al.</i>                  | (SERP, BRUX, MONS+)        | REFID=22449 |
| EVANGELIS...  | 80   | NP B165 383         | C. Evangelista <i>et al.</i>                 | (BARI, BONN, CERN+)        | REFID=22450 |
| AGUILAR-...   | 78B  | NP B141 101         | M. Aguilar-Benitez <i>et al.</i>             | (MADR, TATA+)              | REFID=22438 |
| BALAND        | 78   | NP B140 220         | J.F. Baland <i>et al.</i>                    | (MONS, BELG, CERN+)        | REFID=20369 |
| COOPER        | 78   | NP B136 365         | A.M. Cooper <i>et al.</i>                    | (TATA, CERN, CDEF+)        | REFID=22441 |
| ESTABROOKS    | 78   | NP B133 490         | P.G. Estabrooks <i>et al.</i>                | (MCGI, CARL, DURH+)        | REFID=22443 |
| Also          |      | PR D17 658          | P.G. Estabrooks <i>et al.</i>                | (MCGI, CARL, DURH+)        | REFID=22444 |
| JONGEJANS     | 78   | NP B139 383         | B. Jongejans <i>et al.</i>                   | (ZEEM, CERN, NIJ+)         | REFID=22445 |
| WICKLUND      | 78   | PR D17 1197         | A.B. Wicklund <i>et al.</i>                  | (ANL)                      | REFID=20124 |
| BOWLER        | 77   | NP B126 31          | M.G. Bowler <i>et al.</i>                    | (OXF)                      | REFID=22437 |
| CARITHERS     | 75B  | PRL 35 349          | W.C.J. Carithers <i>et al.</i>               | (ROCH, MCGI)               | REFID=22433 |
| MCCUBBIN      | 75   | NP B86 13           | N.A. McCubbin, L. Lyons                      | (OXF)                      | REFID=22434 |
| PALER         | 75   | NP B96 1            | K. Paler <i>et al.</i>                       | (RHEL, SACL, EPOL)         | REFID=22435 |
| FOX           | 74   | NP B80 403          | G.C. Fox, M.L. Griss                         | (CIT)                      | REFID=22430 |
| MATISON       | 74   | PR D9 1872          | M.J. Matison <i>et al.</i>                   | (LBL)                      | REFID=22431 |
| BEMPORAD      | 73   | NP B51 1            | C. Bemporad <i>et al.</i>                    | (CERN, ETH, LOIC)          | REFID=22416 |
| CLARK         | 73   | NP B54 432          | A.G. Clark, L. Lyons, D. Radojicic           | (OXF)                      | REFID=22426 |
| LEWIS         | 73   | NP B60 283          | P.H. Lewis <i>et al.</i>                     | (LOWC, LOIC, CDEF)         | REFID=22427 |
| LINGLIN       | 73   | NP B55 408          | D. Linglin                                   | (CERN)                     | REFID=22428 |
| BUCHNER       | 72   | NP B45 333          | K. Buchner <i>et al.</i>                     | (MPIM, CERN, BRUX)         | REFID=22418 |
| AGUILAR-...   | 71B  | PR D4 2583          | M. Aguilar-Benitez, R.L. Eisner, J.B. Kinson | (BNL)                      | REFID=22408 |
| HABER         | 70   | NP B17 289          | B. Haber <i>et al.</i>                       | (REHO, SACL, BGNA, EPOL)   | REFID=22406 |
| CRENNELL      | 69D  | PRL 22 487          | D.J. Crennell <i>et al.</i>                  | (BNL)                      | REFID=22399 |
| DAVIS         | 69   | PRL 23 1071         | P.J. Davis <i>et al.</i>                     | (LRL)                      | REFID=22400 |
| SCHWEING...   | 68   | PR 166 1317         | F. Schweingruber <i>et al.</i>               | (ANL, NWES)                | REFID=22398 |
| BARASH        | 67B  | PR 156 1399         | N. Barash <i>et al.</i>                      | (COLU)                     | REFID=20160 |
| BARLOW        | 67   | NC 50A 701          | J. Barlow <i>et al.</i>                      | (CERN, CDEF, IRAD, LIPV)   | REFID=20041 |
| DAUBER        | 67B  | PR 153 1403         | P.M. Dauber <i>et al.</i>                    | (UCLA)                     | REFID=22389 |
| DEBAERE       | 67B  | NC 51A 401          | W. de Baere <i>et al.</i>                    | (BRUX, CERN)               | REFID=22390 |
| WOJCICKI      | 64   | PR 135 B484         | S.G. Wojcicki                                | (LRL)                      | REFID=22379 |

**$K_1(1270)$** 

$$I(J^P) = \frac{1}{2}(1^+)$$

NODE=M028

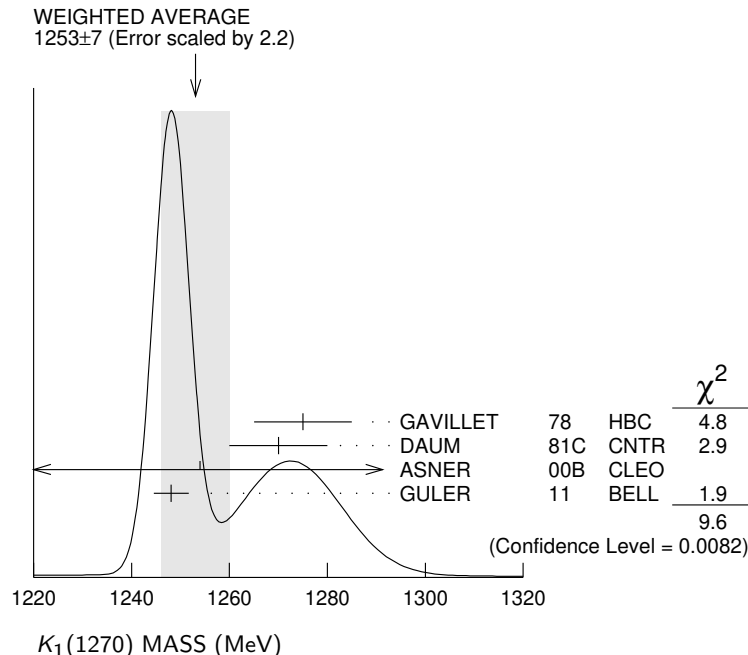
 **$K_1(1270)$  MASS**

NODE=M028MX

NODE=M028MX

VALUE (MeV) DOCUMENT ID

**1253±7 OUR AVERAGE** Includes data from the 4 datablocks that follow this one. Error includes scale factor of 2.2. See the ideogram below.

**PRODUCED BY  $K^-$ , BACKWARD SCATTERING, HYPERON EXCHANGE**

VALUE (MeV) EVTS DOCUMENT ID TECN CHG COMMENT

The data in this block is included in the average printed for a previous datablock.

**1275±10** 700 GAVILLET 78 HBC + 4.2  $K^- p \rightarrow \Xi^- (K\pi\pi)^+$

NODE=M028M2  
NODE=M028M2**PRODUCED BY  $K$  BEAMS**

VALUE (MeV) DOCUMENT ID TECN CHG COMMENT

The data in this block is included in the average printed for a previous datablock.

**1270±10** <sup>1</sup> DAUM 81C CNTR - 63  $K^- p \rightarrow K^- 2\pi p$   
 • • • We do not use the following data for averages, fits, limits, etc. • • •  
 ~ 1276 <sup>2</sup> TORNQVIST 82B RVUE  
 ~ 1300 VERGEEST 79 HBC - 4.2  $K^- p \rightarrow (\bar{K}\pi\pi)^- p$   
 1289±25 <sup>3</sup> CARNEGIE 77 ASPK ± 13  $K^\pm p \rightarrow (K\pi\pi)^\pm p$   
 ~ 1300 BRANDENB... 76 ASPK ± 13  $K^\pm p \rightarrow (K\pi\pi)^\pm p$   
 ~ 1270 OTTER 76 HBC - 10,14,16  $K^- p \rightarrow (\bar{K}\pi\pi)^- p$   
 1260 DAVIS 72 HBC + 12  $K^+ p$   
 1234±12 FIRESTONE 72B DBC + 12  $K^+ d$

NODE=M028M3  
NODE=M028M3

<sup>1</sup> Well described in the chiral unitary approach of GENG 07 with two poles at 1195 and 1284 MeV and widths of 246 and 146 MeV, respectively.

<sup>2</sup> From a unitarized quark-model calculation.

<sup>3</sup> From a model-dependent fit with Gaussian background to BRANDENBURG 76 data.

NODE=M028M3;LINKAGE=DA

NODE=M028M3;LINKAGE=T  
NODE=M028M3;LINKAGE=E**PRODUCED BY BEAMS OTHER THAN  $K$  MESONS**

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT

The data in this block is included in the average printed for a previous datablock.

**1248.1 ± 3.3 ±1.4** GULER 11 BELL  $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$

NODE=M028M1  
NODE=M028M1



• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                        |      |                      |     |      |                                                 |
|--------------------------------------------------------|------|----------------------|-----|------|-------------------------------------------------|
| 1289.81 ± 0.56 ± 1.66                                  | 894k | AAIJ                 | 18A | LHCB | $D^0 \rightarrow K^\mp \pi^\pm \pi^\pm \pi^\mp$ |
| 1279 ± 10                                              | 25k  | <sup>1</sup> ABLIKIM | 06C | BES2 | $J/\psi \rightarrow \bar{K}^*(892)^0 K^+ \pi^-$ |
| 1294 ± 10                                              | 310  | RODEBACK             | 81  | HBC  | $4 \pi^- p \rightarrow \Lambda K 2\pi$          |
| 1300                                                   | 40   | CRENNELL             | 72  | HBC  | $4.5 \pi^- p \rightarrow \Lambda K 2\pi$        |
| 1242 $\begin{smallmatrix} +9 \\ -10 \end{smallmatrix}$ |      | <sup>2</sup> ASTIER  | 69  | HBC  | $\bar{p} p$                                     |
| 1300                                                   | 45   | CRENNELL             | 67  | HBC  | $6 \pi^- p \rightarrow \Lambda K 2\pi$          |

<sup>1</sup> Systematic errors not estimated.  
<sup>2</sup> This was called the C meson.

NODE=M028M1;LINKAGE=AB  
NODE=M028M1;LINKAGE=A

PRODUCED IN  $\tau$  LEPTON DECAYS

| VALUE (MeV)                                                                         | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------------------------------------------------------------------------------|------|-------------|------|-----|---------|
| The data in this block is included in the average printed for a previous datablock. |      |             |      |     |         |

NODE=M028MT  
NODE=M028MT

|                |    |       |     |      |       |                                               |
|----------------|----|-------|-----|------|-------|-----------------------------------------------|
| 1254 ± 33 ± 34 | 7k | ASNER | 00B | CLEO | $\pm$ | $\tau^- \rightarrow K^- \pi^+ \pi^- \nu_\tau$ |
|----------------|----|-------|-----|------|-------|-----------------------------------------------|

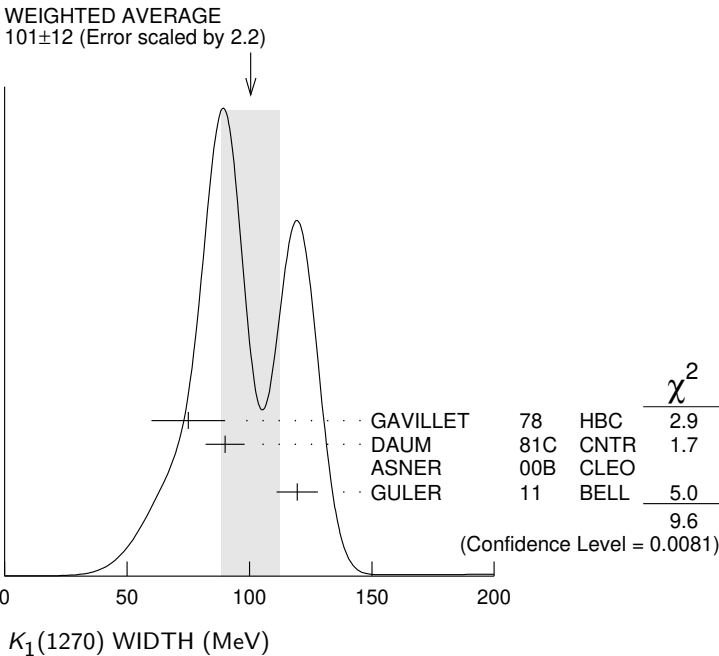
$K_1(1270)$  WIDTH

NODE=M028WX

| VALUE (MeV) | DOCUMENT ID |
|-------------|-------------|
|-------------|-------------|

**90 ± 20 OUR ESTIMATE** This is only an educated guess; the error given is larger than the error on the average of the published values.  
**101 ± 12 OUR AVERAGE** Includes data from the 4 datablocks that follow this one. Error includes scale factor of 2.2. See the ideogram below.

NODE=M028WX  
→ UNCHECKED ←



PRODUCED BY  $K^-$ , BACKWARD SCATTERING, HYPERON EXCHANGE

| VALUE (MeV)                                                                         | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------------------------------------------------------------------------------|------|-------------|------|-----|---------|
| The data in this block is included in the average printed for a previous datablock. |      |             |      |     |         |

NODE=M028W2  
NODE=M028W2

|         |     |          |    |     |   |                                         |
|---------|-----|----------|----|-----|---|-----------------------------------------|
| 75 ± 15 | 700 | GAVILLET | 78 | HBC | + | $4.2 K^- p \rightarrow \Xi^- K \pi \pi$ |
|---------|-----|----------|----|-----|---|-----------------------------------------|

PRODUCED BY K BEAMS

| VALUE (MeV)                                                                         | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------------------------------------------------------------------------------|-------------|------|-----|---------|
| The data in this block is included in the average printed for a previous datablock. |             |      |     |         |

NODE=M028W3  
NODE=M028W3

|                                                                               |                       |     |      |       |                                               |
|-------------------------------------------------------------------------------|-----------------------|-----|------|-------|-----------------------------------------------|
| 90 ± 8                                                                        | <sup>1</sup> DAUM     | 81C | CNTR | -     | 63 $K^- p \rightarrow K^- 2\pi p$             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |     |      |       |                                               |
| ~ 150                                                                         | VERGEEST              | 79  | HBC  | -     | $4.2 K^- p \rightarrow (\bar{K} \pi \pi)^- p$ |
| 150 ± 71                                                                      | <sup>2</sup> CARNEGIE | 77  | ASPK | $\pm$ | $13 K^\pm p \rightarrow (K \pi \pi)^\pm p$    |
| ~ 200                                                                         | BRANDENB...           | 76  | ASPK | $\pm$ | $13 K^\pm p \rightarrow (K \pi \pi)^\pm p$    |
| 120                                                                           | DAVIS                 | 72  | HBC  | +     | $12 K^+ p$                                    |
| 188 ± 21                                                                      | FIRESTONE             | 72B | DBC  | +     | $12 K^+ d$                                    |

<sup>1</sup> Well described in the chiral unitary approach of GENG 07 with two poles at 1195 and 1284 MeV and widths of 246 and 146 MeV, respectively.  
<sup>2</sup> From a model-dependent fit with Gaussian background to BRANDENBURG 76 data.

NODE=M028W3;LINKAGE=DA  
NODE=M028W3;LINKAGE=E

**PRODUCED BY BEAMS OTHER THAN K MESONS**

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

The data in this block is included in the average printed for a previous datablock.

NODE=M028W1  
 NODE=M028W1

**119.5 ± 5.2 ± 6.7**GULER 11 BELL  $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                       |      |                      |     |      |                                                 |
|-------------------------------------------------------|------|----------------------|-----|------|-------------------------------------------------|
| 116.11 ± 1.65 ± 2.96                                  | 894k | AAIJ                 | 18A | LHCB | $D^0 \rightarrow K^\mp \pi^\pm \pi^\pm \pi^\mp$ |
| 131 ± 21                                              | 25k  | <sup>1</sup> ABLIKIM | 06C | BES2 | $J/\psi \rightarrow \bar{K}^*(892)^0 K^+ \pi^-$ |
| 66 ± 15                                               | 310  | RODEBACK             | 81  | HBC  | $4 \pi^- p \rightarrow \Lambda K 2\pi$          |
| 60                                                    | 40   | CRENNELL             | 72  | HBC  | $4.5 \pi^- p \rightarrow \Lambda K 2\pi$        |
| 127 $\begin{smallmatrix} +7 \\ -25 \end{smallmatrix}$ |      | ASTIER               | 69  | HBC  | $\bar{p} p$                                     |
| 60                                                    | 45   | CRENNELL             | 67  | HBC  | $6 \pi^- p \rightarrow \Lambda K 2\pi$          |

<sup>1</sup> Systematic errors not estimated.

NODE=M028W1;LINKAGE=AB

**PRODUCED IN  $\tau$  LEPTON DECAYS**

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

The data in this block is included in the average printed for a previous datablock.

NODE=M028WT  
 NODE=M028WT

 **$260^{+90}_{-70} \pm 80$** 

7k

ASNER

00B

CLEO

±

 $\tau^- \rightarrow K^- \pi^+ \pi^- \nu_\tau$  **$K_1(1270)$  DECAY MODES**

NODE=M028215;NODE=M028

| Mode                         | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------|--------------------------------|
| $\Gamma_1$ $K \rho$          | (42 ± 6 ) %                    |
| $\Gamma_2$ $K_0^*(1430) \pi$ | (28 ± 4 ) %                    |
| $\Gamma_3$ $K^*(892) \pi$    | (16 ± 5 ) %                    |
| $\Gamma_4$ $K \omega$        | (11.0 ± 2.0) %                 |
| $\Gamma_5$ $K f_0(1370)$     | ( 3.0 ± 2.0) %                 |
| $\Gamma_6$ $\gamma K^0$      | seen                           |

DESIG=2

DESIG=7

DESIG=1

DESIG=5

DESIG=8

DESIG=9;OUR EST;→ UNCHECKED ←

 **$K_1(1270)$  PARTIAL WIDTHS**

NODE=M028220

 **$\Gamma(K \rho)$**  **$\Gamma_1$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |           |     |      |   |                                             |
|--------|-----------|-----|------|---|---------------------------------------------|
| 57 ± 5 | MAZZUCATO | 79  | HBC  | + | $4.2 K^- p \rightarrow \Xi^- (K \pi \pi)^+$ |
| 75 ± 6 | CARNEGIE  | 77B | ASPK | ± | $13 K^\pm p \rightarrow (K \pi \pi)^\pm p$  |

NODE=M028W5  
 NODE=M028W5

 **$\Gamma(K_0^*(1430) \pi)$**  **$\Gamma_2$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |          |     |      |   |                                            |
|--------|----------|-----|------|---|--------------------------------------------|
| 26 ± 6 | CARNEGIE | 77B | ASPK | ± | $13 K^\pm p \rightarrow (K \pi \pi)^\pm p$ |
|--------|----------|-----|------|---|--------------------------------------------|

NODE=M028W7  
 NODE=M028W7

 **$\Gamma(K^*(892) \pi)$**  **$\Gamma_3$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |           |     |      |   |                                             |
|---------|-----------|-----|------|---|---------------------------------------------|
| 14 ± 11 | MAZZUCATO | 79  | HBC  | + | $4.2 K^- p \rightarrow \Xi^- (K \pi \pi)^+$ |
| 2 ± 2   | CARNEGIE  | 77B | ASPK | ± | $13 K^\pm p \rightarrow (K \pi \pi)^\pm p$  |

NODE=M028W4  
 NODE=M028W4

 **$\Gamma(K \omega)$**  **$\Gamma_4$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |           |     |      |   |                                             |
|--------|-----------|-----|------|---|---------------------------------------------|
| 4 ± 4  | MAZZUCATO | 79  | HBC  | + | $4.2 K^- p \rightarrow \Xi^- (K \pi \pi)^+$ |
| 24 ± 3 | CARNEGIE  | 77B | ASPK | ± | $13 K^\pm p \rightarrow (K \pi \pi)^\pm p$  |

NODE=M028W6  
 NODE=M028W6

 **$\Gamma(K f_0(1370))$**  **$\Gamma_5$** 

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |          |     |      |   |                                            |
|--------|----------|-----|------|---|--------------------------------------------|
| 22 ± 5 | CARNEGIE | 77B | ASPK | ± | $13 K^\pm p \rightarrow (K \pi \pi)^\pm p$ |
|--------|----------|-----|------|---|--------------------------------------------|

NODE=M028W8  
 NODE=M028W8

$\Gamma(\gamma K^0)$  $\Gamma_6$ 

VALUE (keV)

DOCUMENT ID

TECN

COMMENT

**73.2±6.1±28.3**

ALAVI-HARATI02B

KTEV

 $K + A \rightarrow K^* + A$ NODE=M028W9  
NODE=M028W9 **$K_1(1270)$  BRANCHING RATIOS**

NODE=M028225

 $\Gamma(K\rho)/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

**0.42 ±0.06**

1

DAUM

81C

CNTR

 $63 K^- p \rightarrow K^- 2\pi p$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.584±0.043

2

GULER

11

BELL

 $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$ 

dominant

RODEBACK

81

HBC

 $4 \pi^- p \rightarrow \Lambda K 2\pi$ NODE=M028R2  
NODE=M028R2 $\Gamma(K_0^*(1430)\pi)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

**0.28 ±0.04**

1

DAUM

81C

CNTR

 $63 K^- p \rightarrow K^- 2\pi p$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.0201±0.0064

2

GULER

11

BELL

 $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$ NODE=M028R4  
NODE=M028R4 $\Gamma(K^*(892)\pi)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

**0.16 ±0.05**

1

DAUM

81C

CNTR

 $63 K^- p \rightarrow K^- 2\pi p$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.171±0.023

2

GULER

11

BELL

 $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$ NODE=M028R1  
NODE=M028R1 $\Gamma(K\omega)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

**0.11 ±0.02**

1

DAUM

81C

CNTR

 $63 K^- p \rightarrow K^- 2\pi p$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.225±0.052

2

GULER

11

BELL

 $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$ NODE=M028R3  
NODE=M028R3 $\Gamma(K\omega)/\Gamma(K\rho)$  $\Gamma_4/\Gamma_1$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt;0.30

95

RODEBACK

81

HBC

 $4 \pi^- p \rightarrow \Lambda K 2\pi$ NODE=M028R6  
NODE=M028R6 $\Gamma(K f_0(1370))/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

**0.03±0.02**

1

DAUM

81C

CNTR

 $63 K^- p \rightarrow K^- 2\pi p$ NODE=M028R5  
NODE=M028R5**D-wave/S-wave RATIO FOR  $K_1(1270) \rightarrow K^*(892)\pi$** NODE=M028R9  
NODE=M028R9

VALUE

DOCUMENT ID

TECN

COMMENT

**1.0±0.7**

1

DAUM

81C

CNTR

 $63 K^- p \rightarrow K^- 2\pi p$ <sup>1</sup> Average from low and high  $t$  data.<sup>2</sup> Assuming that decays are saturated by the  $K\rho$ ,  $K_0^*(1430)\pi$ ,  $K^*(892)\pi$ ,  $K\omega$  decay modes and neglecting interference between them. The values  $B(\omega \rightarrow \pi^+\pi^-) = (1.53^{+0.11}_{-0.13})\%$  and  $B(K_0^*(1430) \rightarrow K\pi) = (93 \pm 10)\%$  are used. Systematic uncertainties not estimated.NODE=M028R;LINKAGE=F  
NODE=M028R1;LINKAGE=GU **$K_1(1270)$  REFERENCES**

NODE=M028

|              |      |               |                                |                               |
|--------------|------|---------------|--------------------------------|-------------------------------|
| AAIJ         | 18AI | EPJ C78 443   | R. Aaij <i>et al.</i>          | (LHCb Collab.)                |
| GULER        | 11   | PR D83 032005 | H. Guler <i>et al.</i>         | (BELLE Collab.)               |
| GENG         | 07   | PR D75 014017 | L.S. Geng <i>et al.</i>        |                               |
| ABLIKIM      | 06C  | PL B633 681   | M. Ablikim <i>et al.</i>       | (BES Collab.)                 |
| ALAVI-HARATI | 02B  | PRL 89 072001 | A. Alavi-Harati <i>et al.</i>  | (FNAL KTeV Collab.)           |
| ASNER        | 00B  | PR D62 072006 | D.M. Asner <i>et al.</i>       | (CLEO Collab.)                |
| TORNQVIST    | 82B  | NP B203 268   | N.A. Tornqvist                 | (HELs)                        |
| DAUM         | 81C  | NP B187 1     | C. Daum <i>et al.</i>          | (AMST, CERN, CRAC, MPIM+)     |
| RODEBACK     | 81   | ZPHY C9 9     | S. Rodeback <i>et al.</i>      | (CERN, CDEF, MADR+)           |
| MAZZUCATO    | 79   | NP B156 532   | M. Mazzucato <i>et al.</i>     | (CERN, ZEEM, NIJM+)           |
| VERGEEST     | 79   | NP B158 265   | J.S.M. Vergeest <i>et al.</i>  | (NIJM, AMST, CERN+)           |
| GAVILLET     | 78   | PL 76B 517    | P. Gavillet <i>et al.</i>      | (AMST, CERN, NIJM+) JP        |
| CARNEGIE     | 77   | NP B127 509   | R.K. Carnegie <i>et al.</i>    | (SLAC)                        |
| CARNEGIE     | 77B  | PL 68B 287    | R.K. Carnegie <i>et al.</i>    | (SLAC)                        |
| BRANDENB...  | 76   | PRL 36 703    | G.W. Brandenburg <i>et al.</i> | (SLAC) JP                     |
| OTTER        | 76   | NP B106 77    | G. Otter <i>et al.</i>         | (AACH3, BERL, CERN, LOIC+) JP |
| CRENNELL     | 72   | PR D6 1220    | D.J. Crennell <i>et al.</i>    | (BNL)                         |
| DAVIS        | 72   | PR D5 2688    | P.J. Davis <i>et al.</i>       | (LBL)                         |
| FIRESTONE    | 72B  | PR D5 505     | A. Firestone <i>et al.</i>     | (LBL)                         |
| ASTIER       | 69   | NP B10 65     | A. Astier <i>et al.</i>        | (CDEF, CERN, IPNP, LIPV) IJP  |
| CRENNELL     | 67   | PRL 19 44     | D.J. Crennell <i>et al.</i>    | (BNL) I                       |

REFID=59187  
REFID=53668  
REFID=51623  
REFID=51037  
REFID=48822  
REFID=47766  
REFID=20573  
REFID=22548  
REFID=22550  
REFID=20867  
REFID=22542  
REFID=22538  
REFID=22535  
REFID=22536  
REFID=22532  
REFID=22533  
REFID=22419  
REFID=22505  
REFID=22506  
REFID=22482  
REFID=22473

**$K_1(1400)$** 

$$I(J^P) = \frac{1}{2}(1^+)$$

NODE=M064

 **$K_1(1400)$  MASS**

NODE=M064M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | CHG  | COMMENT                                          |
|-------------------------------------------------------------------------------|------|------------------------|------|------|--------------------------------------------------|
| <b>1403± 7 OUR AVERAGE</b>                                                    |      |                        |      |      |                                                  |
| 1463±64±68                                                                    | 7k   | ASNER                  | 00B  | CLEO | ± $\tau^- \rightarrow K^- \pi^+ \pi^- \nu_\tau$  |
| 1373±14±18                                                                    |      | <sup>1</sup> ASTON     | 87   | LASS | 0 $11 K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| 1392±18                                                                       |      | BAUBILLIER             | 82B  | HBC  | 0 $8.25 K^- p \rightarrow K_S^0 \pi^+ \pi^- n$   |
| 1410±25                                                                       |      | DAUM                   | 81C  | CNTR | — $63 K^- p \rightarrow K^- 2\pi p$              |
| 1415±15                                                                       |      | ETKIN                  | 80   | MPS  | 0 $6 K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$  |
| 1404±10                                                                       |      | <sup>2</sup> CARNEGIE  | 77   | ASPK | ± $13 K^\pm p \rightarrow (K\pi\pi)^\pm p$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |      |      |                                                  |
| 1418± 8                                                                       | 25k  | <sup>3</sup> ABLIKIM   | 06C  | BES2 | $J/\psi \rightarrow \bar{K}^*(892)^0 K^+ \pi^-$  |
| ~ 1350                                                                        |      | <sup>4</sup> TORNQVIST | 82B  | RVUE |                                                  |
| ~ 1400                                                                        |      | VERGEEST               | 79   | HBC  | — $4.2 K^- p \rightarrow (\bar{K}\pi\pi)^- p$    |
| ~ 1400                                                                        |      | BRANDENB...            | 76   | ASPK | ± $13 K^\pm p \rightarrow (K\pi\pi)^\pm p$       |
| 1420                                                                          |      | DAVIS                  | 72   | HBC  | + $12 K^+ p$                                     |
| 1368±18                                                                       |      | FIRESTONE              | 72B  | DBC  | + $12 K^+ d$                                     |

<sup>1</sup> From partial-wave analysis of  $K^0 \pi^+ \pi^-$  system.<sup>2</sup> From a model-dependent fit with Gaussian background to BRANDENBURG 76 data.<sup>3</sup> Systematic errors not estimated.<sup>4</sup> From a unitarized quark-model calculation.

NODE=M064M;LINKAGE=P  
 NODE=M064M;LINKAGE=E  
 NODE=M064M;LINKAGE=AB  
 NODE=M064M;LINKAGE=T

 **$K_1(1400)$  WIDTH**

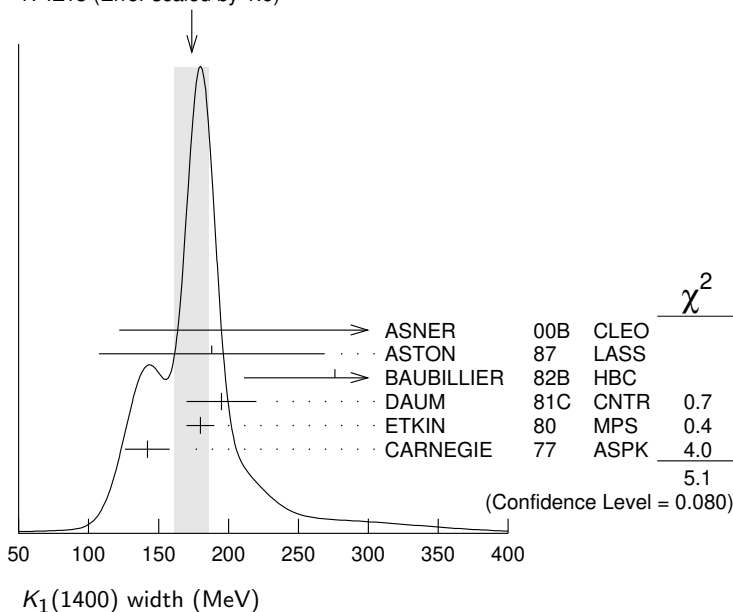
NODE=M064W

| VALUE (MeV)                                                                            | EVTS | DOCUMENT ID           | TECN | CHG  | COMMENT                                          |
|----------------------------------------------------------------------------------------|------|-----------------------|------|------|--------------------------------------------------|
| <b>174± 13 OUR AVERAGE</b> Error includes scale factor of 1.6. See the ideogram below. |      |                       |      |      |                                                  |
| $300^{+370}_{-110} \pm 140$                                                            | 7k   | ASNER                 | 00B  | CLEO | ± $\tau^- \rightarrow K^- \pi^+ \pi^- \nu_\tau$  |
| 188± 54± 60                                                                            |      | <sup>5</sup> ASTON    | 87   | LASS | 0 $11 K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| 276± 65                                                                                |      | BAUBILLIER            | 82B  | HBC  | 0 $8.25 K^- p \rightarrow K_S^0 \pi^+ \pi^- n$   |
| 195± 25                                                                                |      | DAUM                  | 81C  | CNTR | — $63 K^- p \rightarrow K^- 2\pi p$              |
| 180± 10                                                                                |      | ETKIN                 | 80   | MPS  | 0 $6 K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$  |
| 142± 16                                                                                |      | <sup>6</sup> CARNEGIE | 77   | ASPK | ± $13 K^\pm p \rightarrow (K\pi\pi)^\pm p$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • •          |      |                       |      |      |                                                  |
| 152± 16                                                                                | 25k  | <sup>7</sup> ABLIKIM  | 06C  | BES2 | $J/\psi \rightarrow \bar{K}^*(892)^0 K^+ \pi^-$  |
| ~ 200                                                                                  |      | VERGEEST              | 79   | HBC  | — $4.2 K^- p \rightarrow (\bar{K}\pi\pi)^- p$    |
| ~ 160                                                                                  |      | BRANDENB...           | 76   | ASPK | ± $13 K^\pm p \rightarrow (K\pi\pi)^\pm p$       |
| 80                                                                                     |      | DAVIS                 | 72   | HBC  | + $12 K^+ p$                                     |
| 241± 30                                                                                |      | FIRESTONE             | 72B  | DBC  | + $12 K^+ d$                                     |

<sup>5</sup> From partial-wave analysis of  $K^0 \pi^+ \pi^-$  system.<sup>6</sup> From a model-dependent fit with Gaussian background to BRANDENBURG 76 data.<sup>7</sup> Systematic errors not estimated.

NODE=M064W;LINKAGE=P  
 NODE=M064W;LINKAGE=E  
 NODE=M064W;LINKAGE=AB

WEIGHTED AVERAGE  
174±13 (Error scaled by 1.6)



### $K_1(1400)$ DECAY MODES

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $K^*(892)\pi$    | (94 ± 6) %                     |
| $\Gamma_2$ $K\rho$          | (3.0 ± 3.0) %                  |
| $\Gamma_3$ $K f_0(1370)$    | (2.0 ± 2.0) %                  |
| $\Gamma_4$ $K\omega$        | (1.0 ± 1.0) %                  |
| $\Gamma_5$ $K_0^*(1430)\pi$ | not seen                       |
| $\Gamma_6$ $\gamma K^0$     | seen                           |

NODE=M064215;NODE=M064

DESIG=1

DESIG=2

DESIG=8

DESIG=5

DESIG=7;OUR EST;→ UNCHECKED ←

DESIG=9;OUR EST;→ UNCHECKED ←

### $K_1(1400)$ PARTIAL WIDTHS

| $\Gamma(K^*(892)\pi)$ | $\Gamma_1$                                                  |
|-----------------------|-------------------------------------------------------------|
| VALUE (MeV)           | DOCUMENT ID TECN CHG COMMENT                                |
| 117 ± 10              | CARNEGIE 77 ASPK ± 13 $K^\pm p \rightarrow (K\pi\pi)^\pm p$ |
| $\Gamma(K\rho)$       | $\Gamma_2$                                                  |
| VALUE (MeV)           | DOCUMENT ID TECN CHG COMMENT                                |
| 2 ± 1                 | CARNEGIE 77 ASPK ± 13 $K^\pm p \rightarrow (K\pi\pi)^\pm p$ |
| $\Gamma(K\omega)$     | $\Gamma_4$                                                  |
| VALUE (MeV)           | DOCUMENT ID TECN CHG COMMENT                                |
| 23 ± 12               | CARNEGIE 77 ASPK ± 13 $K^\pm p \rightarrow (K\pi\pi)^\pm p$ |
| $\Gamma(\gamma K^0)$  | $\Gamma_6$                                                  |
| VALUE (keV)           | DOCUMENT ID TECN COMMENT                                    |
| 280.8 ± 23.2 ± 40.4   | ALAVI-HARATI02B KTEV $K + A \rightarrow K^* + A$            |

NODE=M064220

NODE=M064W1  
NODE=M064W1

NODE=M064W2  
NODE=M064W2

NODE=M064W5  
NODE=M064W5

NODE=M064W6  
NODE=M064W6

### $K_1(1400)$ BRANCHING RATIOS

| $\Gamma(K^*(892)\pi)/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$                                            |
|---------------------------------------------|--------------------------------------------------------------|
| VALUE                                       | DOCUMENT ID TECN COMMENT                                     |
| 0.94 ± 0.06                                 | <sup>8</sup> DAUM 81C CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |
| $\Gamma(K\rho)/\Gamma_{\text{total}}$       | $\Gamma_2/\Gamma$                                            |
| VALUE                                       | DOCUMENT ID TECN COMMENT                                     |
| 0.03 ± 0.03                                 | <sup>8</sup> DAUM 81C CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |
| $\Gamma(K f_0(1370))/\Gamma_{\text{total}}$ | $\Gamma_3/\Gamma$                                            |
| VALUE                                       | DOCUMENT ID TECN COMMENT                                     |
| 0.02 ± 0.02                                 | <sup>8</sup> DAUM 81C CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |

NODE=M064225

NODE=M064R1  
NODE=M064R1

NODE=M064R2  
NODE=M064R2

NODE=M064R5  
NODE=M064R5

$\Gamma(K\omega)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE            | DOCUMENT ID       | TECN | COMMENT                                |
|------------------|-------------------|------|----------------------------------------|
| <b>0.01±0.01</b> | <sup>8</sup> DAUM | 81C  | CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |

NODE=M064R3  
 NODE=M064R3

 $\Gamma(K_0^*(1430)\pi)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE    | DOCUMENT ID       | TECN | COMMENT                                |
|----------|-------------------|------|----------------------------------------|
| not seen | <sup>8</sup> DAUM | 81C  | CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |

NODE=M064R4  
 NODE=M064R4

**D-wave/S-wave RATIO FOR  $K_1(1400) \rightarrow K^*(892)\pi$** 

| VALUE            | DOCUMENT ID       | TECN | COMMENT                                |
|------------------|-------------------|------|----------------------------------------|
| <b>0.04±0.01</b> | <sup>8</sup> DAUM | 81C  | CNTR 63 $K^- p \rightarrow K^- 2\pi p$ |

NODE=M064R9  
 NODE=M064R9

<sup>8</sup> Average from low and high  $t$  data.

NODE=M064R;LINKAGE=F

 **$K_1(1400)$  REFERENCES**

|              |     |               |                                |                           |
|--------------|-----|---------------|--------------------------------|---------------------------|
| ABLIKIM      | 06C | PL B633 681   | M. Ablikim <i>et al.</i>       | (BES Collab.)             |
| ALAVI-HARATI | 02B | PRL 89 072001 | A. Alavi-Harati <i>et al.</i>  | (FNAL KTeV Collab.)       |
| ASNER        | 00B | PR D62 072006 | D.M. Asner <i>et al.</i>       | (CLEO Collab.)            |
| ASTON        | 87  | NP B292 693   | D. Aston <i>et al.</i>         | (SLAC, NAGO, CINC, INUS)  |
| BAUBILLIER   | 82B | NP B202 21    | M. Baubillier <i>et al.</i>    | (BIRM, CERN, GLAS+)       |
| TORNQVIST    | 82B | NP B203 268   | N.A. Tornqvist                 | (HELS)                    |
| DAUM         | 81C | NP B187 1     | C. Daum <i>et al.</i>          | (AMST, CERN, CRAC, MPIM+) |
| ETKIN        | 80  | PR D22 42     | A. Etkin <i>et al.</i>         | (BNL, CUNY) JP            |
| VERGEEST     | 79  | NP B158 265   | J.S.M. Vergeest <i>et al.</i>  | (NIJM, AMST, CERN+)       |
| CARNEGIE     | 77  | NP B127 509   | R.K. Carnegie <i>et al.</i>    | (SLAC)                    |
| BRANDENB...  | 76  | PRL 36 703    | G.W. Brandenburg <i>et al.</i> | (SLAC) JP                 |
| DAVIS        | 72  | PR D5 2688    | P.J. Davis <i>et al.</i>       | (LBL)                     |
| FIRESTONE    | 72B | PR D5 505     | A. Firestone <i>et al.</i>     | (LBL)                     |

NODE=M064

REFID=51037  
 REFID=48822  
 REFID=47766  
 REFID=40234  
 REFID=22551  
 REFID=20573  
 REFID=22548  
 REFID=22545  
 REFID=22542  
 REFID=22535  
 REFID=22532  
 REFID=22505  
 REFID=22506

 **$K^*(1410)$** 

$$I(J^P) = \frac{1}{2}(1^-)$$

NODE=M094

 **$K^*(1410)$  T-MATRIX POLE  $\sqrt{s}$** 

NODE=M094PP

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

(1368 ± 38) −  $i$  (106<sup>+48</sup><sub>−59</sub>) <sup>1</sup> PELAEZ 17 RVUE  $\pi K \rightarrow \pi K$ 

NODE=M094PP

OCCUR=2

<sup>1</sup> Reanalysis of ESTABROOKS 78 and ASTON 88 satisfying Forward Dispersion Relations and using sequences of Pade approximants.

NODE=M094PP;LINKAGE=B

 **$K^*(1410)$  MASS**

NODE=M094M

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

**1414±15 OUR AVERAGE** Error includes scale factor of 1.3.1380±21±19 ASTON 88 LASS 0 11  $K^- p \rightarrow K^- \pi^+ n$ 1420± 7±10 ASTON 87 LASS 0 11  $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

1437± 8±16 190k <sup>1</sup> AAIJ 16N LHCB  $D^0 \rightarrow (K_S^0 \pi^\mp) K^\pm$ 1426± 8±24 190k <sup>2</sup> AAIJ 16N LHCB  $D^0 \rightarrow K_S^0 (K^\pm \pi^\mp)$ 1276<sup>+72</sup><sub>−77</sub> <sup>3,4</sup> BOITO 09 RVUE  $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$ 1367±54 BIRD 89 LASS − 11  $K^- p \rightarrow \bar{K}^0 \pi^- p$ 1474±25 BAUBILLIER 82B HBC 0 8.25  $K^- p \rightarrow \bar{K}^0 2\pi n$ 1500±30 ETKIN 80 MPS 0 6  $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ 

OCCUR=2

<sup>1</sup> Using a parametrization for the  $K\pi$   $S$ -wave similar to ASTON 88 with fixed resonance width.

NODE=M094M;LINKAGE=A

<sup>2</sup> Using a  $K\pi$   $S$ -wave parametrization with resonant and non-resonant contributions.

NODE=M094M;LINKAGE=C

<sup>3</sup> From the pole position of the  $K\pi$  vector form factor in the complex  $s$ -plane and using EPIFANOV 07 data.

NODE=M094M;LINKAGE=BI

<sup>4</sup> Systematic uncertainties not estimated.

NODE=M094M;LINKAGE=NS

 **$K^*(1410)$  WIDTH**

NODE=M094W

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

**232± 21 OUR AVERAGE** Error includes scale factor of 1.1.176± 52±22 ASTON 88 LASS 0 11  $K^- p \rightarrow K^- \pi^+ n$ 240± 18±12 ASTON 87 LASS 0 11  $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ 

NODE=M094W

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                 |      |                   |     |      |                                                 |
|---------------------------------|------|-------------------|-----|------|-------------------------------------------------|
| 210± 20±60                      | 190k | <sup>1</sup> AAIJ | 16N | LHCB | $D^0 \rightarrow (K_S^0 \pi^\mp) K^\pm$         |
| 270± 20±40                      | 190k | <sup>1</sup> AAIJ | 16N | LHCB | $D^0 \rightarrow K_S^0 (K^\pm \pi^\mp)$         |
| 198 <sup>+</sup> <sub>-87</sub> |      | 2,3 BOITO         | 09  | RVUE | $\tau^- \rightarrow K_S^0 \pi^- \nu_\tau$       |
| 114±101                         |      | BIRD              | 89  | LASS | — 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$      |
| 275± 65                         |      | BAUBILLIER        | 82B | HBC  | 0 8.25 $K^- p \rightarrow \bar{K}^0 2\pi n$     |
| 500±100                         |      | ETKIN             | 80  | MPS  | 0 6 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |

<sup>1</sup> Using a  $K\pi$  S-wave parametrization with resonant and non-resonant contributions.

<sup>2</sup> From the pole position of the  $K\pi$  vector form factor in the complex  $s$ -plane and using EPIFANOV 07 data.

<sup>3</sup> Systematic uncertainties not estimated.

OCCUR=2

NODE=M094W;LINKAGE=A

NODE=M094W;LINKAGE=BI

NODE=M094W;LINKAGE=NS

NODE=M094215;NODE=M094

### $K^*(1410)$ DECAY MODES

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|--------------------------|--------------------------------|------------------|
| $\Gamma_1$ $K^*(892)\pi$ | > 40 %                         | 95%              |
| $\Gamma_2$ $K\pi$        | ( 6.6±1.3) %                   |                  |
| $\Gamma_3$ $K\rho$       | < 7 %                          | 95%              |
| $\Gamma_4$ $\gamma K^0$  | < 2.3 $\times 10^{-4}$         | 90%              |

DESIG=2

DESIG=1

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4

### $K^*(1410)$ PARTIAL WIDTHS

| $\Gamma(\gamma K^0)$ |     |                 |      |                             | $\Gamma_4$ |
|----------------------|-----|-----------------|------|-----------------------------|------------|
| VALUE (keV)          | CL% | DOCUMENT ID     | TECN | COMMENT                     |            |
| <52.9                | 90  | ALAVI-HARATI02B | KTEV | $K + A \rightarrow K^* + A$ |            |

NODE=M094217

NODE=M094W1

NODE=M094W1

### $K^*(1410)$ BRANCHING RATIOS

| $\Gamma(K\rho)/\Gamma(K^*(892)\pi)$ |     |             |      |      | $\Gamma_3/\Gamma_1$                       |
|-------------------------------------|-----|-------------|------|------|-------------------------------------------|
| VALUE                               | CL% | DOCUMENT ID | TECN | CHG  | COMMENT                                   |
| <0.17                               | 95  | ASTON       | 84   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 2\pi n$ |

NODE=M094220

NODE=M094R1

NODE=M094R1

| $\Gamma(K\pi)/\Gamma(K^*(892)\pi)$ |     |             |      |      | $\Gamma_2/\Gamma_1$                       |
|------------------------------------|-----|-------------|------|------|-------------------------------------------|
| VALUE                              | CL% | DOCUMENT ID | TECN | CHG  | COMMENT                                   |
| <0.16                              | 95  | ASTON       | 84   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 2\pi n$ |

NODE=M094R2

NODE=M094R2

| $\Gamma(K\pi)/\Gamma_{\text{total}}$ |             |      |      |                                      | $\Gamma_2/\Gamma$ |
|--------------------------------------|-------------|------|------|--------------------------------------|-------------------|
| VALUE                                | DOCUMENT ID | TECN | CHG  | COMMENT                              |                   |
| 0.066±0.010±0.008                    | ASTON       | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$ |                   |

NODE=M094R3

NODE=M094R3

### $K^*(1410)$ REFERENCES

|              |     |               |                                                   |
|--------------|-----|---------------|---------------------------------------------------|
| PELAEZ       | 17  | EPJ C77 91    | J.R. Pelaez, A.Rodas, J.R. de Elvira              |
| AAIJ         | 16N | PR D93 052018 | R. Aaij <i>et al.</i> (LHCb Collab.)              |
| BOITO        | 09  | EPJ C59 821   | D.R. Boito, R. Escribano, M. Jamin                |
| EPIFANOV     | 07  | PL B654 65    | D. Epifanov <i>et al.</i> (BELLE Collab.)         |
| ALAVI-HARATI | 02B | PRL 89 072001 | A. Alavi-Harati <i>et al.</i> (FNAL KTeV Collab.) |
| BIRD         | 89  | SLAC-332      | P.F. Bird (SLAC)                                  |
| ASTON        | 88  | NP B296 493   | D. Aston <i>et al.</i> (SLAC, NAGO, CINC, INUS)   |
| ASTON        | 87  | NP B292 693   | D. Aston <i>et al.</i> (SLAC, NAGO, CINC, INUS)   |
| ASTON        | 84  | PL 149B 258   | D. Aston <i>et al.</i> (SLAC, CARL, OTTA) JP      |
| BAUBILLIER   | 82B | NP B202 21    | M. Baubillier <i>et al.</i> (BIRM, CERN, GLAS+)   |
| ETKIN        | 80  | PR D22 42     | A. Etkin <i>et al.</i> (BNL, CUNY) JP             |
| ESTABROOKS   | 78  | NP B133 490   | P.G. Estabrooks <i>et al.</i> (MCGI, CARL, DURH+) |

NODE=M094

REFID=57836

REFID=57273

REFID=52728

REFID=51929

REFID=48822

REFID=41002

REFID=40262

REFID=40234

REFID=22689

REFID=22551

REFID=22545

REFID=22443

**$K_0^*(1430)$** 

$$I(J^P) = \frac{1}{2}(0^+)$$

See our minireview in the 1994 edition and in this edition under the  $f_0(500)$ .

NODE=M019

NODE=M019

 **$K_0^*(1430)$  T-MATRIX POLE  $\sqrt{s}$** 

NODE=M019PP

NODE=M019PP

| VALUE (MeV)                                                                                                                             | DOCUMENT ID         | TECN    | COMMENT                   |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------|---------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                           |                     |         |                           |
| $(1431 \pm 6) - i(110 \pm 19)$                                                                                                          | <sup>1</sup> PELAEZ | 17 RVUE | $\pi K \rightarrow \pi K$ |
| <sup>1</sup> Reanalysis of ESTABROOKS 78 and ASTON 88 satisfying Forward Dispersion Relations and using sequences of Pade approximants. |                     |         |                           |

NODE=M019PP;LINKAGE=A

 **$K_0^*(1430)$  MASS**

NODE=M019M

NODE=M019M  
→ UNCHECKED ←

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID              | TECN     | COMMENT                                                |
|-------------------------------------------------------------------------------|------|--------------------------|----------|--------------------------------------------------------|
| <b>1425 ± 50 OUR ESTIMATE</b>                                                 |      |                          |          |                                                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                          |          |                                                        |
| 1438 ± 8 ± 4                                                                  | 5.4k | <sup>1</sup> LEES        | 14E BABR | $\eta_c(1S) \rightarrow K^+ K^- \eta/\pi^0$            |
| 1427 ± 4 ± 13                                                                 |      | <sup>2</sup> BUGG        | 10 RVUE  | S-matrix pole                                          |
| 1466.6 ± 0.7 ± 3.4                                                            | 141k | <sup>3</sup> BONVICINI   | 08A CLEO | $D^+ \rightarrow K^- \pi^+ \pi^+$                      |
| ~ 1412                                                                        |      | <sup>4</sup> LINK        | 07 FOCS  | $D^+ \rightarrow K^- K^+ \pi^+$                        |
| 1461.0 ± 4.0 ± 2.1                                                            | 54k  | <sup>5</sup> LINK        | 07B FOCS | $D^+ \rightarrow K^- \pi^+ \pi^+$                      |
| 1406 ± 29                                                                     |      | <sup>6</sup> BUGG        | 06 RVUE  |                                                        |
| 1435 ± 6                                                                      |      | <sup>7</sup> ZHOU        | 06 RVUE  | $K p \rightarrow K^- \pi^+ n$                          |
| 1455 ± 20 ± 15                                                                |      | ABLIKIM                  | 05Q BES2 | $\psi(2S) \rightarrow$<br>$\gamma \pi^+ \pi^- K^+ K^-$ |
| 1456 ± 8                                                                      |      | <sup>8</sup> ZHENG       | 04 RVUE  | $K^- p \rightarrow K^- \pi^+ n$                        |
| ~ 1419                                                                        |      | <sup>9</sup> BUGG        | 03 RVUE  | $11 K^- p \rightarrow K^- \pi^+ n$                     |
| ~ 1440                                                                        |      | <sup>10</sup> LI         | 03 RVUE  | $11 K^- p \rightarrow K^- \pi^+ n$                     |
| 1459 ± 9                                                                      | 15k  | <sup>11</sup> AITALA     | 02 E791  | $D^+ \rightarrow K^- \pi^+ \pi^+$                      |
| ~ 1440                                                                        |      | <sup>12</sup> JAMIN      | 00 RVUE  | $K p \rightarrow K p$                                  |
| 1436 ± 8                                                                      |      | <sup>13</sup> BARBERIS   | 98E OMEG | $450 p p \rightarrow$<br>$p_f p_s K^+ K^- \pi^+ \pi^-$ |
| 1415 ± 25                                                                     |      | <sup>9</sup> ANISOVICH   | 97C RVUE | $11 K^- p \rightarrow K^- \pi^+ n$                     |
| ~ 1450                                                                        |      | <sup>14</sup> TORNQVIST  | 96 RVUE  | $\pi \pi \rightarrow \pi \pi, K \bar{K}, K \pi$        |
| 1412 ± 6                                                                      |      | <sup>15</sup> ASTON      | 88 LASS  | $11 K^- p \rightarrow K^- \pi^+ n$                     |
| ~ 1430                                                                        |      | BAUBILLIER               | 84B HBC  | $8.25 K^- p \rightarrow \bar{K}^0 \pi^- p$             |
| ~ 1425                                                                        |      | <sup>16</sup> ESTABROOKS | 78 ASPK  | $13 K^\pm p \rightarrow K^\pm \pi^\pm(n, \Delta)$      |
| ~ 1450.0                                                                      |      | MARTIN                   | 78 SPEC  | $10 K^\pm p \rightarrow K_S^0 \pi p$                   |

NODE=M019M;LINKAGE=LE

NODE=M019M;LINKAGE=BG

NODE=M019M;LINKAGE=BO  
NODE=M019M;LINKAGE=LI  
NODE=M019M;LINKAGE=BW  
NODE=M019M;LINKAGE=BU

NODE=M019M;LINKAGE=ZU  
NODE=M019M;LINKAGE=ZH  
NODE=M019M;LINKAGE=A1  
NODE=M019M;LINKAGE=E  
NODE=M019M;LINKAGE=A0  
NODE=M019M;LINKAGE=JM  
NODE=M019M;LINKAGE=JP  
NODE=M019M;LINKAGE=TT  
NODE=M019M;LINKAGE=D

NODE=M019M;LINKAGE=A

<sup>1</sup> Using both  $\eta \rightarrow \gamma\gamma$  and  $\eta \rightarrow \pi^+ \pi^- \pi^0$ . From a likelihood scan in the presence of several interfering scalar-meson resonances with fixed width  $\Gamma(K_0^*(1430)) = 210$  MeV.

<sup>2</sup> S-Matrix pole. Supersedes BUGG 06. Combined analysis of ASTON 88, ABLIKIM 06C, AITALA 06, and LINK 09 using an s-dependent width with couplings to  $K\pi$  and  $K\eta'$ , and the Adler zero near thresholds.

<sup>3</sup> From the isobar model with a complex pole for the  $\kappa$ .

<sup>4</sup> From a non-parametric analysis.

<sup>5</sup> A Breit-Wigner mass and width.

<sup>6</sup> S-matrix pole. Reanalysis of ASTON 88, AITALA 02, and ABLIKIM 06C including the  $\kappa$  with an s-dependent width and an Adler zero near threshold.

<sup>7</sup> S-matrix pole. Using ASTON 88 and assuming  $K_0^*(700)$ ,  $K_0^*(1950)$ .

<sup>8</sup> Using ASTON 88 and assuming  $K_0^*(700)$ .

<sup>9</sup> T-matrix pole. Reanalysis of ASTON 88 data.

<sup>10</sup> Breit-Wigner fit. Using ASTON 88.

<sup>11</sup> Assuming a low-mass scalar  $K\pi$  resonance,  $\kappa(700)$ .

<sup>12</sup> T-matrix pole. Using data from ESTABROOKS 78 and ASTON 88.

<sup>13</sup>  $J^P$  not determined, could be  $K_2^*(1430)$ .

<sup>14</sup> T-matrix pole.

<sup>15</sup> Uses a model for the background, without this background they get a mass 1340 MeV, where the phase shift passes  $90^\circ$ .

<sup>16</sup> Mass defined by pole position. From elastic  $K\pi$  partial-wave analysis.



**$K_0^*(1430)$  WIDTH**

NODE=M019W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID              | TECN | COMMENT                                                          |
|-------------------------------------------------------------------------------|------|--------------------------|------|------------------------------------------------------------------|
| <b>270 ±80 OUR ESTIMATE</b>                                                   |      |                          |      |                                                                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                          |      |                                                                  |
| 210 ±20 ±12                                                                   | 5.4k | <sup>1</sup> LEES        | 14E  | BABR $\eta_c(1S) \rightarrow K^+ K^- \eta/\pi^0$                 |
| 270 ±10 ±40                                                                   |      | <sup>2</sup> BUGG        | 10   | RVUE S-matrix pole                                               |
| 174.2 ± 1.9 ± 3.2                                                             | 141k | <sup>3</sup> BONVICINI   | 08A  | CLEO $D^+ \rightarrow K^- \pi^+ \pi^+$                           |
| ~ 500                                                                         |      | <sup>4</sup> LINK        | 07   | FOCS $D^+ \rightarrow K^- K^+ \pi^+$                             |
| 177.0 ± 8.0 ± 3.4                                                             | 54k  | <sup>5</sup> LINK        | 07B  | FOCS $D^+ \rightarrow K^- \pi^+ \pi^+$                           |
| 350 ±40                                                                       |      | <sup>6</sup> BUGG        | 06   | RVUE                                                             |
| 288 ±22                                                                       |      | <sup>7</sup> ZHOU        | 06   | RVUE $K\rho \rightarrow K^- \pi^+ n$                             |
| 270 ±45 <sup>+30</sup> <sub>-35</sub>                                         |      | ABLIKIM                  | 05Q  | BES2 $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$           |
| 217 ±31                                                                       |      | <sup>8</sup> ZHENG       | 04   | RVUE $K^- \rho \rightarrow K^- \pi^+ n$                          |
| ~ 316                                                                         |      | <sup>9</sup> BUGG        | 03   | RVUE $11 K^- \rho \rightarrow K^- \pi^+ n$                       |
| ~ 350                                                                         |      | <sup>10</sup> LI         | 03   | RVUE $11 K^- \rho \rightarrow K^- \pi^+ n$                       |
| 175 ±17                                                                       | 15k  | <sup>11</sup> AITALA     | 02   | E791 $D^+ \rightarrow K^- \pi^+ \pi^+$                           |
| ~ 300                                                                         |      | <sup>12</sup> JAMIN      | 00   | RVUE $K\rho \rightarrow K\rho$                                   |
| 196 ±45                                                                       |      | <sup>13</sup> BARBERIS   | 98E  | OMEG $450 \rho\rho \rightarrow$<br>$p_f p_s K^+ K^- \pi^+ \pi^-$ |
| 330 ±50                                                                       |      | <sup>9</sup> ANISOVICH   | 97C  | RVUE $11 K^- \rho \rightarrow K^- \pi^+ n$                       |
| ~ 320                                                                         |      | <sup>14</sup> TORNQVIST  | 96   | RVUE $\pi\pi \rightarrow \pi\pi, K\bar{K}, K\pi$                 |
| 294 ±23                                                                       |      | ASTON                    | 88   | LASS $11 K^- \rho \rightarrow K^- \pi^+ n$                       |
| ~ 200                                                                         |      | BAUBILLIER               | 84B  | HBC $8.25 K^- \rho \rightarrow \bar{K}^0 \pi^- p$                |
| 200 to 300                                                                    |      | <sup>15</sup> ESTABROOKS | 78   | ASPK $13 K^\pm \rho \rightarrow K^\pm \pi^\pm (n, \Delta)$       |

NODE=M019W

→ UNCHECKED ←

<sup>1</sup> Using both  $\eta \rightarrow \gamma\gamma$  and  $\eta \rightarrow \pi^+ \pi^- \pi^0$ . From a likelihood scan in the presence of several interfering scalar-meson resonances with fixed mass  $M(K_0^*(1430)) = 1435$  MeV.

<sup>2</sup> S-Matrix pole. Supersedes BUGG 06. Combined analysis of ASTON 88, ABLIKIM 06C, AITALA 06, and LINK 09 using an s-dependent width with couplings to  $K\pi$  and  $K\eta'$ , and the Adler zero near thresholds.

<sup>3</sup> From the isobar model with a complex pole for the  $\kappa$ .

<sup>4</sup> From a non-parametric analysis.

<sup>5</sup> A Breit-Wigner mass and width.

<sup>6</sup> S-matrix pole. Reanalysis of ASTON 88, AITALA 02, and ABLIKIM 06C including the  $\kappa$  with an s-dependent width and an Adler zero near threshold.

<sup>7</sup> S-matrix pole. Using ASTON 88 and assuming  $K_0^*(700)$ ,  $K_0^*(1950)$ .

<sup>8</sup> Using ASTON 88 and assuming  $K_0^*(700)$ .

<sup>9</sup> T-matrix pole. Reanalysis of ASTON 88 data.

<sup>10</sup> Breit-Wigner fit. Using ASTON 88.

<sup>11</sup> Assuming a low-mass scalar  $K\pi$  resonance,  $\kappa(700)$ .

<sup>12</sup> T-matrix pole. Using data from ESTABROOKS 78 and ASTON 88.

<sup>13</sup>  $J^P$  not determined, could be  $K_2^*(1430)$ .

<sup>14</sup> T-matrix pole.

<sup>15</sup> From elastic  $K\pi$  partial-wave analysis.

NODE=M019W;LINKAGE=LE

NODE=M019W;LINKAGE=BG

NODE=M019W;LINKAGE=BO  
NODE=M019W;LINKAGE=LI  
NODE=M019W;LINKAGE=BW  
NODE=M019W;LINKAGE=BU

NODE=M019W;LINKAGE=ZU  
NODE=M019W;LINKAGE=ZH  
NODE=M019W;LINKAGE=A1  
NODE=M019W;LINKAGE=E  
NODE=M019W;LINKAGE=A0  
NODE=M019W;LINKAGE=JM  
NODE=M019W;LINKAGE=JP  
NODE=M019W;LINKAGE=TT  
NODE=M019W;LINKAGE=C

 **$K_0^*(1430)$  DECAY MODES**

NODE=M019215;NODE=M019

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ )                                        |
|--------------------------|-----------------------------------------------------------------------|
| $\Gamma_1$ $K\pi$        | (93 ±10 ) %                                                           |
| $\Gamma_2$ $K\eta$       | ( 8.6 <sup>+</sup> <sub>-</sub> 2.7 <sup>+</sup> <sub>-</sub> 3.4 ) % |
| $\Gamma_3$ $K\eta'(958)$ | seen                                                                  |

DESIG=1

DESIG=2

DESIG=3

 **$K_0^*(1430)$  BRANCHING RATIOS**

NODE=M019220

| $\Gamma(K\pi)/\Gamma_{\text{total}}$         |             |                   |      |                                                  |                                       | $\Gamma_1/\Gamma$   |
|----------------------------------------------|-------------|-------------------|------|--------------------------------------------------|---------------------------------------|---------------------|
| VALUE                                        | DOCUMENT ID | TECN              | CHG  | COMMENT                                          |                                       |                     |
| <b>0.93±0.04±0.09</b>                        | ASTON       | 88                | LASS | 0                                                | 11 $K^- \rho \rightarrow K^- \pi^+ n$ |                     |
| $\Gamma(K\eta)/\Gamma(K\pi)$                 |             |                   |      |                                                  |                                       | $\Gamma_2/\Gamma_1$ |
| VALUE (%)                                    | EVTS        | DOCUMENT ID       | TECN | COMMENT                                          |                                       |                     |
| <b>9.2±2.5<sup>+1.0</sup><sub>-2.5</sub></b> | 5.4k        | <sup>1</sup> LEES | 14E  | BABR $\eta_c(1S) \rightarrow K^+ K^- \eta/\pi^0$ |                                       |                     |

NODE=M019R1  
NODE=M019R1

NODE=M019R01  
NODE=M019R01

<sup>1</sup> Using both  $\eta \rightarrow \gamma\gamma$  and  $\eta \rightarrow \pi^+ \pi^- \pi^0$ . From a Dalitz analysis in the presence of several interfering scalar-meson resonances.

NODE=M019R01;LINKAGE=LE

$\Gamma(K\eta'(958))/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE | DOCUMENT ID | TECN     | COMMENT                                          |
|-------|-------------|----------|--------------------------------------------------|
| seen  | ABLIKIM     | 14J BES3 | $\psi(2S) \rightarrow \gamma K^+ K^- \eta'(958)$ |

NODE=M019R00  
 NODE=M019R00

 **$K_0^*(1430)$  REFERENCES**

NODE=M019

|            |     |                        |                                      |                          |
|------------|-----|------------------------|--------------------------------------|--------------------------|
| PELAEZ     | 17  | EPJ C77 91             | J.R. Pelaez, A.Rodas, J.R. de Elvira |                          |
| ABLIKIM    | 14J | PR D89 074030          | M. Ablikim <i>et al.</i>             | (BESIII Collab.)         |
| LEES       | 14E | PR D89 112004          | J.P. Lees <i>et al.</i>              | (BABAR Collab.)          |
| BUGG       | 10  | PR D81 014002          | D.V. Bugg                            | (LOQM)                   |
| LINK       | 09  | PL B681 14             | J.M. Link <i>et al.</i>              | (FNAL FOCUS Collab.)     |
| BONVICINI  | 08A | PR D78 052001          | G. Bonvicini <i>et al.</i>           | (CLEO Collab.)           |
| LINK       | 07  | PL B648 156            | J.M. Link <i>et al.</i>              | (FNAL FOCUS Collab.)     |
| LINK       | 07B | PL B653 1              | J.M. Link <i>et al.</i>              | (FNAL FOCUS Collab.)     |
| ABLIKIM    | 06C | PL B633 681            | M. Ablikim <i>et al.</i>             | (BES Collab.)            |
| AITALA     | 06  | PR D73 032004          | E.M. Aitala <i>et al.</i>            | (FNAL E791 Collab.)      |
| Also       |     | PR D74 059901 (errat.) | E.M. Aitala <i>et al.</i>            | (FNAL E791 Collab.)      |
| BUGG       | 06  | PL B632 471            | D.V. Bugg                            | (LOQM)                   |
| ZHOU       | 06  | NP A775 212            | Z.Y. Zhou, H.Q. Zheng                |                          |
| ABLIKIM    | 05Q | PR D72 092002          | M. Ablikim <i>et al.</i>             | (BES Collab.)            |
| ZHENG      | 04  | NP A733 235            | H.Q. Zheng <i>et al.</i>             |                          |
| BUGG       | 03  | PL B572 1              | D.V. Bugg                            |                          |
| LI         | 03  | PR D67 034025          | L. Li, B. Zou, G. Li                 |                          |
| AITALA     | 02  | PRL 89 121801          | E.M. Aitala <i>et al.</i>            | (FNAL E791 Collab.)      |
| JAMIN      | 00  | NP B587 331            | M. Jamin <i>et al.</i>               |                          |
| BARBERIS   | 98E | PL B436 204            | D. Barberis <i>et al.</i>            | (Omega Expt.)            |
| ANISOVICH  | 97C | PL B413 137            | A.V. Anisovich, A.V. Sarantsev       |                          |
| TORNQVIST  | 96  | PRL 76 1575            | N.A. Tornqvist, M. Roos              | (HELS)                   |
| ASTON      | 88  | NP B296 493            | D. Aston <i>et al.</i>               | (SLAC, NAGO, CINC, INUS) |
| BAUBILLIER | 84B | ZPHY C26 37            | M. Baubillier <i>et al.</i>          | (BIRM, CERN, GLAS+)      |
| ESTABROOKS | 78  | NP B133 490            | P.G. Estabrooks <i>et al.</i>        | (MCGI, CARL, DURH+)      |
| MARTIN     | 78  | NP B134 392            | A.D. Martin <i>et al.</i>            | (DURH, GEVA)             |

REFID=57836  
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 REFID=44507  
 REFID=40262  
 REFID=22459  
 REFID=22443  
 REFID=22446

 $K_2^*(1430)$ 

$$I(J^P) = \frac{1}{2}(2^+)$$

We consider that phase-shift analyses provide more reliable determinations of the mass and width.

NODE=M022

NODE=M022

 **$K_2^*(1430)$  T-MATRIX POLE  $\sqrt{s}$** 

NODE=M022PP

NODE=M022PP

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

$(1424 \pm 4) - i(66 \pm 2)$  <sup>1</sup> PELAEZ 17 RVUE  $\pi K \rightarrow \pi K$

<sup>1</sup> Reanalysis of ESTABROOKS 78 and ASTON 88 satisfying Forward Dispersion Relations and using sequences of Pade approximants.

NODE=M022PP;LINKAGE=A

 **$K_2^*(1430)$  MASS**

NODE=M022205

**CHARGED ONLY, WITH FINAL STATE  $K\pi$** 

NODE=M022M1  
 NODE=M022M1

| VALUE (MeV)                                  | EVTS | DOCUMENT ID                                                 | TECN     | CHG | COMMENT                                       |
|----------------------------------------------|------|-------------------------------------------------------------|----------|-----|-----------------------------------------------|
| <b>1427.3 ± 1.5 OUR AVERAGE</b>              |      | Error includes scale factor of 1.3. See the ideogram below. |          |     |                                               |
| 1432.7 ± 0.7 <sup>+2.2</sup> <sub>-2.3</sub> | 183k | ABLIKIM                                                     | 19AQ BES | ±   | $J/\psi \rightarrow K^+ K^- \pi^0$            |
| 1420 ± 4                                     | 1587 | BAUBILLIER                                                  | 84B HBC  | −   | $8.25 K^- p \rightarrow \bar{K}^0 \pi^- p$    |
| 1436 ± 5.5                                   | 400  | <sup>2,3</sup> CLELAND                                      | 82 SPEC  | +   | $30 K^+ p \rightarrow K_S^0 \pi^+ p$          |
| 1430 ± 3.2                                   | 1500 | <sup>2,3</sup> CLELAND                                      | 82 SPEC  | +   | $50 K^+ p \rightarrow K_S^0 \pi^+ p$          |
| 1430 ± 3.2                                   | 1200 | <sup>2,3</sup> CLELAND                                      | 82 SPEC  | −   | $50 K^+ p \rightarrow K_S^0 \pi^- p$          |
| 1423 ± 5                                     | 935  | TOAFF                                                       | 81 HBC   | −   | $6.5 K^- p \rightarrow \bar{K}^0 \pi^- p$     |
| 1428.0 ± 4.6                                 |      | <sup>4</sup> MARTIN                                         | 78 SPEC  | +   | $10 K^\pm p \rightarrow K_S^0 \pi p$          |
| 1423.8 ± 4.6                                 |      | <sup>4</sup> MARTIN                                         | 78 SPEC  | −   | $10 K^\pm p \rightarrow K_S^0 \pi p$          |
| 1420.0 ± 3.1                                 | 1400 | AGUILAR-...                                                 | 71B HBC  | −   | $3.9, 4.6 K^- p$                              |
| 1425 ± 8.0                                   | 225  | <sup>2,3</sup> BARNHAM                                      | 71C HBC  | +   | $K^+ p \rightarrow K^0 \pi^+ p$               |
| 1416 ± 10                                    | 220  | CRENNELL                                                    | 69D DBC  | −   | $3.9 K^- N \rightarrow \bar{K}^0 \pi^- N$     |
| 1414 ± 13.0                                  | 60   | <sup>2</sup> LIND                                           | 69 HBC   | +   | $9 K^+ p \rightarrow K^0 \pi^+ p$             |
| 1427 ± 12                                    | 63   | <sup>2</sup> SCHWEING...                                    | 68 HBC   | −   | $5.5 K^- p \rightarrow \bar{K} \pi N$         |
| 1423 ± 11.0                                  | 39   | <sup>2</sup> BASSANO                                        | 67 HBC   | −   | $4.6-5.0 K^- p \rightarrow \bar{K}^0 \pi^- p$ |

OCCUR=2

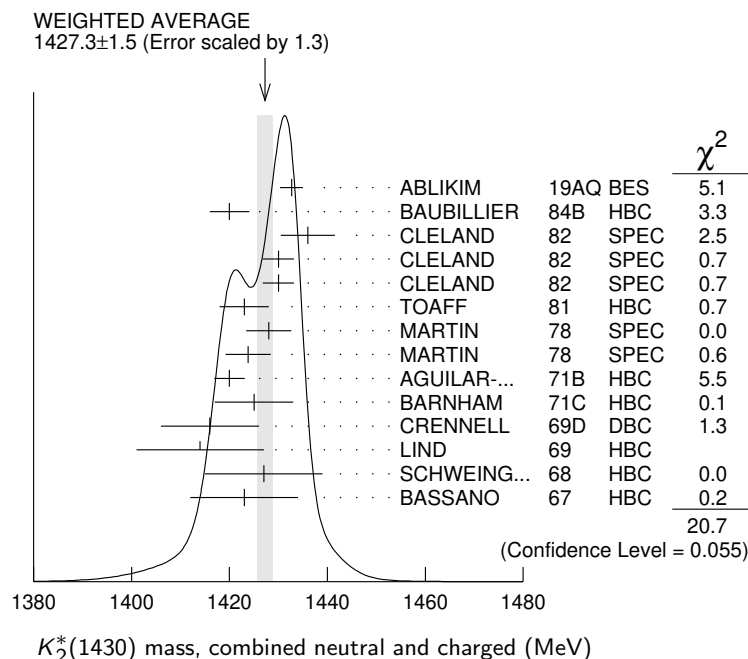
OCCUR=3

OCCUR=2

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

1423.4 ± 2 ± 3 24809 ± 820 <sup>5</sup> BIRD 89 LASS - 11  $K^- p \rightarrow \bar{K}^0 \pi^- p$



### NEUTRAL ONLY

| VALUE (MeV)                                                                   | EVTS       | DOCUMENT ID    | TECN      | COMMENT                                                |
|-------------------------------------------------------------------------------|------------|----------------|-----------|--------------------------------------------------------|
| <b>1432.4 ± 1.3 OUR AVERAGE</b>                                               |            |                |           |                                                        |
| 1431.2 ± 1.8 ± 0.7                                                            | 6          | ASTON 88       | LASS      | 11 $K^- p \rightarrow K^- \pi^+ n$                     |
| 1434 ± 4 ± 6                                                                  | 6          | ASTON 87       | LASS      | 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$         |
| 1433 ± 6 ± 10                                                                 | 6          | ASTON 84B      | LASS      | 11 $K^- p \rightarrow \bar{K}^0 2\pi n$                |
| 1471 ± 12                                                                     | 6          | BAUBILLIER 82B | HBC       | 8.25 $K^- p \rightarrow NK_S^0 \pi \pi$                |
| 1428 ± 3                                                                      | 6          | ASTON 81C      | LASS      | 11 $K^- p \rightarrow K^- \pi^+ n$                     |
| 1434 ± 2                                                                      | 6          | ESTABROOKS 78  | ASPK      | 13 $K^\pm p \rightarrow p K \pi$                       |
| 1440 ± 10                                                                     | 6          | BOWLER 77      | DBC       | 5.5 $K^+ d \rightarrow K \pi p p$                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |            |                |           |                                                        |
| 1428.5 ± 3.9                                                                  | 1786 ± 127 | 7 AUBERT       | 07AK BABR | 10.6 $e^+ e^- \rightarrow K^{*0} K^\pm \pi^\mp \gamma$ |
| 1420 ± 7                                                                      | 300        | HENDRICK 76    | DBC       | 8.25 $K^+ N \rightarrow K^+ \pi N$                     |
| 1421.6 ± 4.2                                                                  | 800        | MCCUBBIN 75    | HBC       | 3.6 $K^- p \rightarrow K^- \pi^+ n$                    |
| 1420.1 ± 4.3                                                                  |            | 8 LINGLIN 73   | HBC       | 2-13 $K^+ p \rightarrow K^+ \pi^- X$                   |
| 1419.1 ± 3.7                                                                  | 1800       | AGUILAR...     | 71B HBC   | 3.9, 4.6 $K^- p$                                       |
| 1416 ± 6                                                                      | 600        | CORDS 71       | DBC       | 9 $K^+ n \rightarrow K^+ \pi^- p$                      |
| 1421.1 ± 2.6                                                                  | 2200       | DAVIS 69       | HBC       | 12 $K^+ p \rightarrow K^+ \pi^- X$                     |

<sup>2</sup> Errors enlarged by us to  $\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.

<sup>3</sup> Number of events in peak re-evaluated by us.

<sup>4</sup> Systematic error added by us.

<sup>5</sup> From a partial wave amplitude analysis.

<sup>6</sup> From phase shift or partial-wave analysis.

<sup>7</sup> Systematic errors not estimated.

<sup>8</sup> From pole extrapolation, using world  $K^+ p$  data summary tape.

NODE=M022M4  
NODE=M022M4

NODE=M022M;LINKAGE=D  
NODE=M022M;LINKAGE=W  
NODE=M022M;LINKAGE=B  
NODE=M022M;LINKAGE=F  
NODE=M022M;LINKAGE=P  
NODE=M022M4;LINKAGE=NS  
NODE=M022M;LINKAGE=C

### $K_2^*(1430)$ WIDTH

NODE=M022210

### CHARGED ONLY, WITH FINAL STATE $K\pi$

| VALUE (MeV)                                 | EVTS                                | DOCUMENT ID  | TECN     | CHG | COMMENT                                   |
|---------------------------------------------|-------------------------------------|--------------|----------|-----|-------------------------------------------|
| <b>100.0 ± 2.1 OUR FIT</b>                  |                                     |              |          |     |                                           |
| <b>100.0 ± 2.2 OUR AVERAGE</b>              | Error includes scale factor of 1.1. |              |          |     |                                           |
| 102.5 ± 1.6 <sup>+3.1</sup> <sub>-2.8</sub> | 183k                                | ABLIKIM      | 19AQ BES | ±   | $J/\psi \rightarrow K^+ K^- \pi^0$        |
| 109 ± 22                                    | 400                                 | 9,10 CLELAND | 82 SPEC  | +   | 30 $K^+ p \rightarrow K_S^0 \pi^+ p$      |
| 124 ± 12.8                                  | 1500                                | 9,10 CLELAND | 82 SPEC  | +   | 50 $K^+ p \rightarrow K_S^0 \pi^+ p$      |
| 113 ± 12.8                                  | 1200                                | 9,10 CLELAND | 82 SPEC  | -   | 50 $K^+ p \rightarrow K_S^0 \pi^- p$      |
| 85 ± 16                                     | 935                                 | TOAFF        | 81 HBC   | -   | 6.5 $K^- p \rightarrow \bar{K}^0 \pi^- p$ |
| 96.5 ± 3.8                                  |                                     | MARTIN       | 78 SPEC  | +   | 10 $K^\pm p \rightarrow K_S^0 \pi p$      |

NODE=M022W1  
NODE=M022W1

OCCUR=2

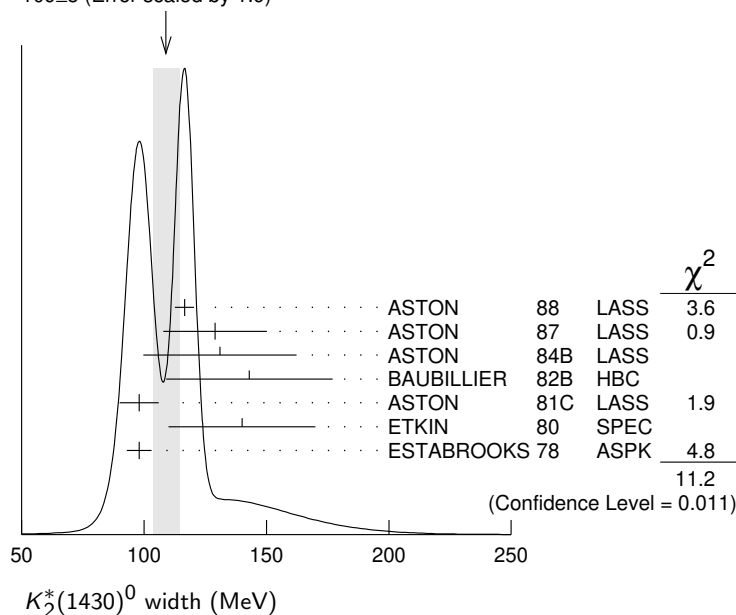
OCCUR=3

|                                                                               |      |             |     |      |   |                                          |
|-------------------------------------------------------------------------------|------|-------------|-----|------|---|------------------------------------------|
| 97.7 ± 4.0                                                                    |      | MARTIN      | 78  | SPEC | — | 10 $K^\pm p \rightarrow K_S^0 \pi p$     |
| 94.7 <sup>+15.1</sup> <sub>-12.5</sub>                                        | 1400 | AGUILAR-... | 71B | HBC  | — | 3.9,4.6 $K^- p$                          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |     |      |   |                                          |
| 98 ± 4 ± 4                                                                    | 25k  | 11 BIRD     | 89  | LASS | — | 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$ |

OCCUR=2

**NEUTRAL ONLY**

| VALUE (MeV)                                                                   | EVTS       | DOCUMENT ID                                                 | TECN      | COMMENT                                                |
|-------------------------------------------------------------------------------|------------|-------------------------------------------------------------|-----------|--------------------------------------------------------|
| <b>109 ± 5 OUR AVERAGE</b>                                                    |            | Error includes scale factor of 1.9. See the ideogram below. |           |                                                        |
| 116.5 ± 3.6 ± 1.7                                                             |            | 12 ASTON                                                    | 88 LASS   | 11 $K^- p \rightarrow K^- \pi^+ n$                     |
| 129 ± 15 ± 15                                                                 |            | 12 ASTON                                                    | 87 LASS   | 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$         |
| 131 ± 24 ± 20                                                                 |            | 12 ASTON                                                    | 84B LASS  | 11 $K^- p \rightarrow \bar{K}^0 2\pi n$                |
| 143 ± 34                                                                      |            | 12 BAUBILLIER                                               | 82B HBC   | 8.25 $K^- p \rightarrow N K_S^0 \pi \pi$               |
| 98 ± 8                                                                        |            | 12 ASTON                                                    | 81C LASS  | 11 $K^- p \rightarrow K^- \pi^+ n$                     |
| 140 ± 30                                                                      |            | 12 ETKIN                                                    | 80 SPEC   | 6 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$          |
| 98 ± 5                                                                        |            | 12 ESTABROOKS                                               | 78 ASPK   | 13 $K^\pm p \rightarrow p K \pi$                       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |            |                                                             |           |                                                        |
| 113.7 ± 9.2                                                                   | 1786 ± 127 | 13 AUBERT                                                   | 07AK BABR | 10.6 $e^+ e^- \rightarrow K^{*0} K^\pm \pi^\mp \gamma$ |
| 125 ± 29                                                                      | 300        | 9 HENDRICK                                                  | 76 DBC    | 8.25 $K^+ N \rightarrow K^+ \pi N$                     |
| 116 ± 18                                                                      | 800        | MCCUBBIN                                                    | 75 HBC    | 3.6 $K^- p \rightarrow K^- \pi^+ n$                    |
| 61 ± 14                                                                       |            | 14 LINGLIN                                                  | 73 HBC    | 2-13 $K^+ p \rightarrow K^+ \pi^- X$                   |
| 116.6 <sup>+10.3</sup> <sub>-15.5</sub>                                       | 1800       | AGUILAR-...                                                 | 71B HBC   | 3.9,4.6 $K^- p$                                        |
| 144 ± 24.0                                                                    | 600        | 9 CORDS                                                     | 71 DBC    | 9 $K^+ n \rightarrow K^+ \pi^- p$                      |
| 101 ± 10                                                                      | 2200       | DAVIS                                                       | 69 HBC    | 12 $K^+ p \rightarrow K^+ \pi^- \pi^+ p$               |

NODE=M022W4  
NODE=M022W4WEIGHTED AVERAGE  
109±5 (Error scaled by 1.9)<sup>9</sup> Errors enlarged by us to  $4\Gamma/\sqrt{N}$ ; see the note with the  $K^*(892)$  mass.<sup>10</sup> Number of events in peak re-evaluated by us.<sup>11</sup> From a partial wave amplitude analysis.<sup>12</sup> From phase shift or partial-wave analysis.<sup>13</sup> Systematic errors not estimated.<sup>14</sup> From pole extrapolation, using world  $K^+ p$  data summary tape.NODE=M022W;LINKAGE=D  
NODE=M022W;LINKAGE=W  
NODE=M022W;LINKAGE=F  
NODE=M022W;LINKAGE=P  
NODE=M022W4;LINKAGE=NS  
NODE=M022W;LINKAGE=C **$K_2^*(1430)$  DECAY MODES**

NODE=M022215;NODE=M022

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) | Scale factor/<br>Confidence level |
|-------------------------------|--------------------------------|-----------------------------------|
| $\Gamma_1$ $K \pi$            | (49.9 ± 1.2) %                 |                                   |
| $\Gamma_2$ $K^*(892) \pi$     | (24.7 ± 1.5) %                 |                                   |
| $\Gamma_3$ $K^*(892) \pi \pi$ | (13.4 ± 2.2) %                 |                                   |
| $\Gamma_4$ $K \rho$           | ( 8.7 ± 0.8) %                 | S=1.2                             |

DESIG=1  
DESIG=2  
DESIG=6  
DESIG=3

|            |              |                                      |        |  |
|------------|--------------|--------------------------------------|--------|--|
| $\Gamma_5$ | $K\omega$    | $(2.9 \pm 0.8) \%$                   |        |  |
| $\Gamma_6$ | $K^+\gamma$  | $(2.4 \pm 0.5) \times 10^{-3}$       | S=1.1  |  |
| $\Gamma_7$ | $K\eta$      | $(1.5^{+3.4}_{-1.0}) \times 10^{-3}$ | S=1.3  |  |
| $\Gamma_8$ | $K\omega\pi$ | $< 7.2 \times 10^{-4}$               | CL=95% |  |
| $\Gamma_9$ | $K^0\gamma$  | $< 9 \times 10^{-4}$                 | CL=90% |  |

DESIG=4

DESIG=8

DESIG=5

DESIG=7

DESIG=10;OUR EVAL;→ UNCHECKED ←

### CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, and 10 branching ratios uses 32 measurements and one constraint to determine 8 parameters. The overall fit has a  $\chi^2 = 21.1$  for 25 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |       |       |       |       |       |
|----------|-------|-------|-------|-------|-------|-------|-------|
| $x_2$    | −9    |       |       |       |       |       |       |
| $x_3$    | −40   | −73   |       |       |       |       |       |
| $x_4$    | −8    | 36    | −52   |       |       |       |       |
| $x_5$    | −11   | −3    | −26   | −7    |       |       |       |
| $x_6$    | −1    | −1    | −1    | −1    | 0     |       |       |
| $x_7$    | −4    | −7    | −5    | −5    | −2    | 0     |       |
| $\Gamma$ | 0     | 0     | 0     | 0     | 0     | −10   | 0     |
|          | $x_1$ | $x_2$ | $x_3$ | $x_4$ | $x_5$ | $x_6$ | $x_7$ |

| Mode                        | Rate (MeV)             | Scale factor |
|-----------------------------|------------------------|--------------|
| $\Gamma_1$ $K\pi$           | $49.9 \pm 1.6$         |              |
| $\Gamma_2$ $K^*(892)\pi$    | $24.7 \pm 1.6$         |              |
| $\Gamma_3$ $K^*(892)\pi\pi$ | $13.5 \pm 2.3$         |              |
| $\Gamma_4$ $K\rho$          | $8.7 \pm 0.8$          | 1.2          |
| $\Gamma_5$ $K\omega$        | $2.9 \pm 0.8$          |              |
| $\Gamma_6$ $K^+\gamma$      | $0.24 \pm 0.05$        | 1.1          |
| $\Gamma_7$ $K\eta$          | $0.15^{+0.34}_{-0.10}$ | 1.3          |

DESIG=1

DESIG=2

DESIG=6

DESIG=3

DESIG=4

DESIG=8

DESIG=5

### $K_2^*(1430)$ PARTIAL WIDTHS

NODE=M022220

| $\Gamma(K^+\gamma)$                    |                                     |      |      |         |                                                         | $\Gamma_6$  |
|----------------------------------------|-------------------------------------|------|------|---------|---------------------------------------------------------|-------------|
| VALUE (keV)                            | DOCUMENT ID                         | TECN | CHG  | COMMENT |                                                         |             |
| <b><math>241 \pm 50</math> OUR FIT</b> | Error includes scale factor of 1.1. |      |      |         |                                                         | NODE=M022W8 |
| <b><math>240 \pm 45</math></b>         | CIHANGIR                            | 82   | SPEC | +       | $200 K^+ Z \rightarrow Z K^+ \pi^0,$<br>$Z K_S^0 \pi^+$ | NODE=M022W8 |

| $\Gamma(K^0\gamma)$                                                           |     |                 |      |      |                                                           | $\Gamma_9$  |
|-------------------------------------------------------------------------------|-----|-----------------|------|------|-----------------------------------------------------------|-------------|
| VALUE (keV)                                                                   | CL% | DOCUMENT ID     | TECN | CHG  | COMMENT                                                   |             |
| <b><math>&lt; 5.4</math></b>                                                  | 90  | ALAVI-HARATI02B | KTEV |      | $K + A \rightarrow K^* + A$                               | NODE=M022W9 |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                 |      |      |                                                           |             |
| $< 84$                                                                        | 90  | CARLSMITH       | 87   | SPEC | 0 $60\text{--}200 K_L^0 A \rightarrow$<br>$K_S^0 \pi^0 A$ | NODE=M022W9 |

### $K_2^*(1430)$ BRANCHING RATIOS

NODE=M022225

| $\Gamma(K\pi)/\Gamma_{\text{total}}$            |                          |      |      |         |                                    | $\Gamma_1/\Gamma$ |
|-------------------------------------------------|--------------------------|------|------|---------|------------------------------------|-------------------|
| VALUE                                           | DOCUMENT ID              | TECN | CHG  | COMMENT |                                    |                   |
| <b><math>0.499 \pm 0.012</math> OUR FIT</b>     |                          |      |      |         |                                    | NODE=M022R1       |
| <b><math>0.488 \pm 0.014</math> OUR AVERAGE</b> |                          |      |      |         |                                    | NODE=M022R1       |
| $0.485 \pm 0.006 \pm 0.020$                     | <sup>15</sup> ASTON      | 88   | LASS | 0       | $11 K^- p \rightarrow K^- \pi^+ n$ |                   |
| $0.49 \pm 0.02$                                 | <sup>15</sup> ESTABROOKS | 78   | ASPK | ±       | $13 K^\pm p \rightarrow p K \pi$   |                   |

$\Gamma(K^*(892)\pi)/\Gamma(K\pi)$  $\Gamma_2/\Gamma_1$ NODE=M022R4  
NODE=M022R4

| VALUE                         | DOCUMENT ID | TECN | CHG  | COMMENT                                   |
|-------------------------------|-------------|------|------|-------------------------------------------|
| <b>0.496±0.034 OUR FIT</b>    |             |      |      |                                           |
| <b>0.47 ±0.04 OUR AVERAGE</b> |             |      |      |                                           |
| 0.44 ±0.09                    | ASTON       | 84B  | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 2\pi n$ |
| 0.62 ±0.19                    | LAUSCHER    | 75   | HBC  | 0 10,16 $K^- p \rightarrow K^- \pi^+ n$   |
| 0.54 ±0.16                    | DEHM        | 74   | DBC  | 0 4.6 $K^+ N$                             |
| 0.47 ±0.08                    | AGUILAR-... | 71B  | HBC  | 3.9,4.6 $K^- p$                           |
| 0.47 ±0.10                    | BASSANO     | 67   | HBC  | -0 4.6,5.0 $K^- p$                        |
| 0.45 ±0.13                    | BADIER      | 65c  | HBC  | - 3 $K^- p$                               |

 $\Gamma(K\omega)/\Gamma(K\pi)$  $\Gamma_5/\Gamma_1$ NODE=M022R5  
NODE=M022R5

| VALUE                          | DOCUMENT ID  | TECN | CHG | COMMENT         |
|--------------------------------|--------------|------|-----|-----------------|
| <b>0.059±0.017 OUR FIT</b>     |              |      |     |                 |
| <b>0.070±0.035 OUR AVERAGE</b> |              |      |     |                 |
| 0.05 ±0.04                     | AGUILAR-...  | 71B  | HBC | 3.9,4.6 $K^- p$ |
| 0.13 ±0.07                     | BASSOMPIE... | 69   | HBC | 0 5 $K^+ p$     |

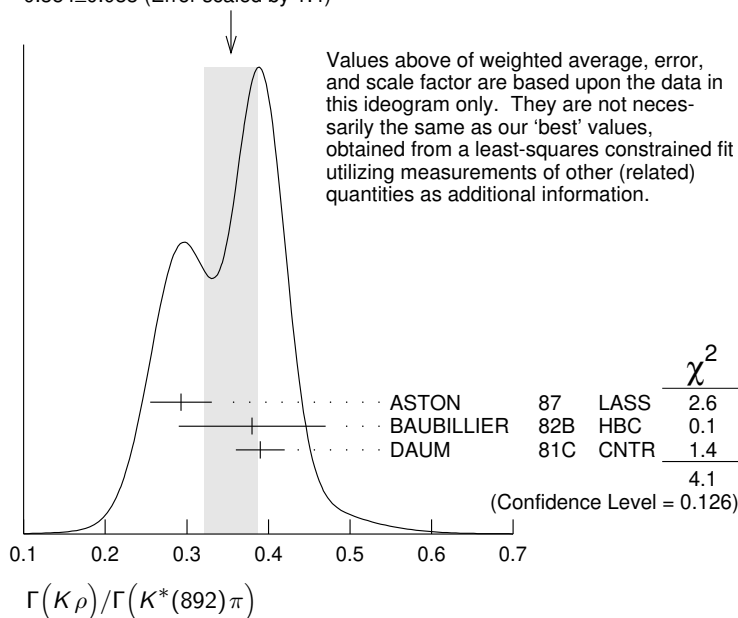
OCCUR=2

 $\Gamma(K\rho)/\Gamma(K\pi)$  $\Gamma_4/\Gamma_1$ NODE=M022R6  
NODE=M022R6

| VALUE                                                      | DOCUMENT ID                         | TECN | CHG  | COMMENT                                   |
|------------------------------------------------------------|-------------------------------------|------|------|-------------------------------------------|
| <b>0.174±0.017 OUR FIT</b>                                 | Error includes scale factor of 1.2. |      |      |                                           |
| <b>0.150<sup>+0.029</sup><sub>-0.017</sub> OUR AVERAGE</b> |                                     |      |      |                                           |
| 0.18 ±0.05                                                 | ASTON                               | 84B  | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 2\pi n$ |
| 0.02 <sup>+0.10</sup> <sub>-0.02</sub>                     | DEHM                                | 74   | DBC  | 0 4.6 $K^+ N$                             |
| 0.16 ±0.05                                                 | AGUILAR-...                         | 71B  | HBC  | 3.9,4.6 $K^- p$                           |
| 0.14 ±0.10                                                 | BASSANO                             | 67   | HBC  | -0 4.6,5.0 $K^- p$                        |
| 0.14 ±0.07                                                 | BADIER                              | 65c  | HBC  | - 3 $K^- p$                               |

 $\Gamma(K\rho)/\Gamma(K^*(892)\pi)$  $\Gamma_4/\Gamma_2$ NODE=M022R7  
NODE=M022R7

| VALUE                          | DOCUMENT ID                                                 | TECN | CHG  | COMMENT                                          |
|--------------------------------|-------------------------------------------------------------|------|------|--------------------------------------------------|
| <b>0.350±0.031 OUR FIT</b>     | Error includes scale factor of 1.4.                         |      |      |                                                  |
| <b>0.354±0.033 OUR AVERAGE</b> | Error includes scale factor of 1.4. See the ideogram below. |      |      |                                                  |
| 0.293±0.032±0.020              | ASTON                                                       | 87   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| 0.38 ±0.09                     | BAUBILLIER                                                  | 82B  | HBC  | 0 8.25 $K^- p \rightarrow NK_S^0 \pi \pi$        |
| 0.39 ±0.03                     | DAUM                                                        | 81C  | CNTR | 63 $K^- p \rightarrow K^- 2\pi p$                |

WEIGHTED AVERAGE  
0.354±0.033 (Error scaled by 1.4) $\Gamma(K\omega)/\Gamma(K^*(892)\pi)$  $\Gamma_5/\Gamma_2$ NODE=M022R8  
NODE=M022R8

| VALUE                      | DOCUMENT ID | TECN | CHG | COMMENT       |
|----------------------------|-------------|------|-----|---------------|
| <b>0.118±0.034 OUR FIT</b> |             |      |     |               |
| <b>0.10 ±0.04</b>          | FIELD       | 67   | HBC | - 3.8 $K^- p$ |

$\Gamma(K\eta)/\Gamma(K^*(892)\pi)$ 

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

**0.006<sup>+0.014</sup><sub>-0.004</sub> OUR FIT** Error includes scale factor of 1.2.

**0.07 ± 0.04** FIELD 67 HBC — 3.8  $K^- p$

 $\Gamma_7/\Gamma_2$ 

NODE=M022R9  
NODE=M022R9

 $\Gamma(K\eta)/\Gamma(K\pi)$ 

| VALUE | CL% | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-----|-------------|------|-----|---------|
|-------|-----|-------------|------|-----|---------|

**0.0030<sup>+0.0070</sup><sub>-0.0020</sub> OUR FIT** Error includes scale factor of 1.3.

**0 ± 0.0056** 16 ASTON 88B LASS — 11  $K^- p \rightarrow K^- \eta p$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.04 95 AGUILAR... 71B HBC 3.9,4.6  $K^- p$

<0.065 17 BASSOMPIE... 69 HBC 5.0  $K^+ p$

<0.02 BISHOP 69 HBC 3.5  $K^+ p$

 $\Gamma_7/\Gamma_1$ 

NODE=M022R10  
NODE=M022R10

 $\Gamma(K^*(892)\pi\pi)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

**0.134 ± 0.022 OUR FIT**

**0.12 ± 0.04** 18 GOLDBERG 76 HBC — 3  $K^- p \rightarrow p \bar{K}^0 \pi \pi$

 $\Gamma_3/\Gamma$ 

NODE=M022R11  
NODE=M022R11

 $\Gamma(K^*(892)\pi\pi)/\Gamma(K\pi)$ 

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

**0.27 ± 0.05 OUR FIT**

**0.21 ± 0.08** 17,18 JONGEJANS 78 HBC — 4  $K^- p \rightarrow p \bar{K}^0 \pi \pi$

 $\Gamma_3/\Gamma_1$ 

NODE=M022R12  
NODE=M022R12

 $\Gamma(K\omega\pi)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**<0.72** 95 0 JONGEJANS 78 HBC 4  $K^- p \rightarrow p \bar{K}^0 4\pi$

 $\Gamma_8/\Gamma$ 

NODE=M022R13  
NODE=M022R13

15 From phase shift analysis.

16 ASTON 88B quote < 0.0092 at CL=95%. We convert this to a central value and 1 sigma error in order to be able to use it in our constrained fit.

17 Restated by us.

18 Assuming  $\pi\pi$  system has isospin 1, which is supported by the data.

NODE=M022R;LINKAGE=P  
NODE=M022R;LINKAGE=PQ

NODE=M022R;LINKAGE=R  
NODE=M022R;LINKAGE=T

 $K_2^*(1430)$  REFERENCES

|              |      |                |                                              |                           |
|--------------|------|----------------|----------------------------------------------|---------------------------|
| ABLIKIM      | 19AQ | PR D100 032004 | M. Ablikim <i>et al.</i>                     | (BESIII Collab.)          |
| PELAEZ       | 17   | EPJ C77 91     | J.R. Pelaez, A.Rodas, J.R. de Elvira         |                           |
| AUBERT       | 07AK | PR D76 012008  | B. Aubert <i>et al.</i>                      | (BABAR Collab.)           |
| ALAVI-HARATI | 02B  | PRL 89 072001  | A. Alavi-Harati <i>et al.</i>                | (FNAL KTeV Collab.)       |
| BIRD         | 89   | SLAC-332       | P.F. Bird                                    | (SLAC)                    |
| ASTON        | 88   | NP B296 493    | D. Aston <i>et al.</i>                       | (SLAC, NAGO, CINC, INUS)  |
| ASTON        | 88B  | PL B201 169    | D. Aston <i>et al.</i>                       | (SLAC, NAGO, CINC, INUS)  |
| ASTON        | 87   | NP B292 693    | D. Aston <i>et al.</i>                       | (SLAC, NAGO, CINC, INUS)  |
| CARLSMITH    | 87   | PR D36 3502    | D. Carlsmith <i>et al.</i>                   | (EFI, SACL)               |
| ASTON        | 84B  | NP B247 261    | D. Aston <i>et al.</i>                       | (SLAC, CARL, OTTA)        |
| BAUBILLIER   | 84B  | ZPHY C26 37    | M. Baubillier <i>et al.</i>                  | (BIRM, CERN, GLAS+)       |
| BAUBILLIER   | 82B  | NP B202 21     | M. Baubillier <i>et al.</i>                  | (BIRM, CERN, GLAS+)       |
| CIHANGIR     | 82   | PL 117B 123    | S. Cihangir <i>et al.</i>                    | (FNAL, MINN, ROCH)        |
| CLELAND      | 82   | NP B208 189    | W.E. Cleland <i>et al.</i>                   | (DURH, GEVA, LAUS+)       |
| ASTON        | 81C  | PL 106B 235    | D. Aston <i>et al.</i>                       | (SLAC, CARL, OTTA) JP     |
| DAUM         | 81C  | NP B187 1      | C. Daum <i>et al.</i>                        | (AMST, CERN, CRAC, MPIM+) |
| TOAFF        | 81   | PR D23 1500    | S. Toaff <i>et al.</i>                       | (ANL, KANS)               |
| ETKIN        | 80   | PR D22 42      | A. Etkin <i>et al.</i>                       | (BNL, CUNY) JP            |
| ESTABROOKS   | 78   | NP B133 490    | P.G. Estabrooks <i>et al.</i>                | (MCGI, CARL, DURH+)       |
| Also         |      | PR D17 658     | P.G. Estabrooks <i>et al.</i>                | (MCGI, CARL, DURH+)       |
| JONGEJANS    | 78   | NP B139 383    | B. Jongejans <i>et al.</i>                   | (ZEEM, CERN, NIJM+)       |
| MARTIN       | 78   | NP B134 392    | A.D. Martin <i>et al.</i>                    | (DURH, GEVA)              |
| BOWLER       | 77   | NP B126 31     | M.G. Bowler <i>et al.</i>                    | (OXF)                     |
| GOLDBERG     | 76   | LNC 17 253     | J. Goldberg                                  | (HAIF)                    |
| HENDRICK     | 76   | NP B112 189    | K. Hendrickx <i>et al.</i>                   | (MONS, SACL, PARIS+)      |
| LAUSCHER     | 75   | NP B86 189     | P. Lauscher <i>et al.</i>                    | (ABCLV Collab.) JP        |
| MCCUBBIN     | 75   | NP B86 13      | N.A. McCubbin, L. Lyons                      | (OXF)                     |
| DEHM         | 74   | NP B75 47      | G. Dehm <i>et al.</i>                        | (MPIM, BRUX, MONS, CERN)  |
| LINGLIN      | 73   | NP B55 408     | D. Linglin                                   | (CERN)                    |
| AGUILAR...   | 71B  | PR D4 2583     | M. Aguilar-Benitez, R.L. Eisner, J.B. Kinson | (BNL)                     |
| BARNHAM      | 71C  | NP B28 171     | K.W.J. Barnham <i>et al.</i>                 | (BIRM, GLAS)              |
| CORDS        | 71   | PR D4 1974     | D. Cords <i>et al.</i>                       | (PURD, UCD, IUPU)         |
| BASSOMPIE... | 69   | NP B13 189     | G. Bassompierre <i>et al.</i>                | (CERN, BRUX) JP           |
| BISHOP       | 69   | NP B9 403      | J.M. Bishop <i>et al.</i>                    | (WISC)                    |
| CRENNELL     | 69D  | PRL 22 487     | D.J. Crennell <i>et al.</i>                  | (BNL)                     |
| DAVIS        | 69   | PRL 23 1071    | P.J. Davis <i>et al.</i>                     | (LRL)                     |
| LIND         | 69   | NP B14 1       | V.G. Lind <i>et al.</i>                      | (LRL) JP                  |
| SCHWEING...  | 68   | PR 166 1317    | F. Schweingruber <i>et al.</i>               | (ANL, NWES)               |
| Also         |      | Thesis         | F.L. Schweingruber                           | (NWES, NWES)              |
| BASSANO      | 67   | PRL 19 968     | D. Bassano <i>et al.</i>                     | (BNL, SYRA)               |
| FIELD        | 67   | PL 24B 638     | J.H. Field <i>et al.</i>                     | (UCSD)                    |
| BADIER       | 65C  | PL 19 612      | J. Badier <i>et al.</i>                      | (EPOL, SACL, AMST)        |

NODE=M022

REFID=59909  
REFID=57836  
REFID=51908  
REFID=48822  
REFID=41002  
REFID=40262  
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REFID=22404  
REFID=22398  
REFID=22709  
REFID=22695  
REFID=22701  
REFID=22690

**$K(1460)$** 

$$I(J^P) = \frac{1}{2}(0^-)$$

Observed in  $K\pi\pi$  partial-wave analysis. **$K(1460)$  MASS**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                              |      |                          |      |      |                                          |
|------------------------------|------|--------------------------|------|------|------------------------------------------|
| $1482.40 \pm 3.58 \pm 15.22$ | 894k | AAIJ                     | 18AI | LHCB | $D^0 \rightarrow K^\mp 2\pi^\pm \pi^\mp$ |
| $\sim 1460$                  | 63   | DAUM                     | 81C  | CNTR | $K^- p \rightarrow K^- 2\pi p$           |
| $\sim 1400$                  | 13   | <sup>1</sup> BRANDENB... | 76B  | ASPK | $K^\pm p \rightarrow K^\pm 2\pi p$       |

<sup>1</sup> Coupled mainly to  $K f_0(1370)$ . Decay into  $K^*(892)\pi$  seen. **$K(1460)$  WIDTH**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|------|-------------|------|-----|---------|
|-------------|------|-------------|------|-----|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                            |      |                          |      |      |                                          |
|----------------------------|------|--------------------------|------|------|------------------------------------------|
| $335.60 \pm 6.20 \pm 8.65$ | 894k | AAIJ                     | 18AI | LHCB | $D^0 \rightarrow K^\mp 2\pi^\pm \pi^\mp$ |
| $\sim 260$                 | 63   | DAUM                     | 81C  | CNTR | $K^- p \rightarrow K^- 2\pi p$           |
| $\sim 250$                 | 15   | <sup>1</sup> BRANDENB... | 76B  | ASPK | $K^\pm p \rightarrow K^\pm 2\pi p$       |

<sup>1</sup> Coupled mainly to  $K f_0(1370)$ . Decay into  $K^*(892)\pi$  seen. **$K(1460)$  DECAY MODES**

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $K^*(892)\pi$    | seen                           |
| $\Gamma_2$ $K\rho$          | seen                           |
| $\Gamma_3$ $K_0^*(1430)\pi$ | seen                           |

 **$K(1460)$  PARTIAL WIDTHS** **$\Gamma(K^*(892)\pi)$**  **$\Gamma_1$** 

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|            |      |     |      |                                   |
|------------|------|-----|------|-----------------------------------|
| $\sim 109$ | DAUM | 81C | CNTR | 63 $K^- p \rightarrow K^- 2\pi p$ |
|------------|------|-----|------|-----------------------------------|

 **$\Gamma(K\rho)$**  **$\Gamma_2$** 

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |      |     |      |                                   |
|-----------|------|-----|------|-----------------------------------|
| $\sim 34$ | DAUM | 81C | CNTR | 63 $K^- p \rightarrow K^- 2\pi p$ |
|-----------|------|-----|------|-----------------------------------|

 **$\Gamma(K_0^*(1430)\pi)$**  **$\Gamma_3$** 

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|            |      |     |      |                                   |
|------------|------|-----|------|-----------------------------------|
| $\sim 117$ | DAUM | 81C | CNTR | 63 $K^- p \rightarrow K^- 2\pi p$ |
|------------|------|-----|------|-----------------------------------|

 **$K(1460)$  REFERENCES**

|             |      |             |                                |                           |
|-------------|------|-------------|--------------------------------|---------------------------|
| AAIJ        | 18AI | EPJ C78 443 | R. Aaij <i>et al.</i>          | (LHCb Collab.)            |
| DAUM        | 81C  | NP B187 1   | C. Daum <i>et al.</i>          | (AMST, CERN, CRAC, MPIM+) |
| BRANDENB... | 76B  | PRL 36 1239 | G.W. Brandenburg <i>et al.</i> | (SLAC) JP                 |

NODE=M021

NODE=M021

NODE=M021M

NODE=M021M

NODE=M021M;LINKAGE=A

NODE=M021W

NODE=M021W

NODE=M021W;LINKAGE=A

NODE=M021215;NODE=M021

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=3;OUR EST;→ UNCHECKED ←

NODE=M021220

NODE=M021W1  
NODE=M021W1NODE=M021W2  
NODE=M021W2NODE=M021W3  
NODE=M021W3

NODE=M021

REFID=59187  
REFID=22548  
REFID=22767



**$K_2(1580)$** 

$$I(J^P) = \frac{1}{2}(2^-)$$

OMITTED FROM SUMMARY TABLE

Seen in partial-wave analysis of the  $K^- \pi^+ \pi^-$  system. Needs confirmation.

NODE=M039

NODE=M039

 **$K_2(1580)$  MASS**

NODE=M039M

| VALUE (MeV)                                                                   | DOCUMENT ID | CHG | COMMENT            |
|-------------------------------------------------------------------------------|-------------|-----|--------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |     |                    |
| ~ 1580                                                                        | OTTER       | 79  | — 10,14,16 $K^- p$ |

NODE=M039M

 **$K_2(1580)$  WIDTH**

NODE=M039W

| VALUE (MeV)                                                                   | DOCUMENT ID | CHG | COMMENT            |
|-------------------------------------------------------------------------------|-------------|-----|--------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |     |                    |
| ~ 110                                                                         | OTTER       | 79  | — 10,14,16 $K^- p$ |

NODE=M039W

 **$K_2(1580)$  DECAY MODES**

NODE=M039215;NODE=M039

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $K^*(892)\pi$    | seen                           |
| $\Gamma_2$ $K_2^*(1430)\pi$ | possibly seen                  |

DESIG=1

DESIG=2

 **$K_2(1580)$  BRANCHING RATIOS**

NODE=M039220

| $\Gamma(K^*(892)\pi)/\Gamma_{\text{total}}$                                   |                    |             |            |                                          | $\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------|--------------------|-------------|------------|------------------------------------------|-------------------|
| <i>VALUE</i>                                                                  | <i>DOCUMENT ID</i> | <i>TECN</i> | <i>CHG</i> | <i>COMMENT</i>                           |                   |
| seen                                                                          | OTTER              | 79          | HBC        | —                                        | 10,14,16 $K^- p$  |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                    |             |            |                                          |                   |
| possibly seen                                                                 | GULER              | 11          | BELL       | $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$ |                   |

NODE=M039R1  
NODE=M039R1

| $\Gamma(K_2^*(1430)\pi)/\Gamma_{\text{total}}$ |             |      |     |         |                  | $\Gamma_2/\Gamma$ |
|------------------------------------------------|-------------|------|-----|---------|------------------|-------------------|
| VALUE                                          | DOCUMENT ID | TECN | CHG | COMMENT |                  |                   |
| possibly seen                                  | OTTER       | 79   | HBC | —       | 10,14,16 $K^- p$ |                   |

NODE=M039R2  
NODE=M039R2 **$K_2(1580)$  REFERENCES**

NODE=M039

|       |    |               |                        |                               |
|-------|----|---------------|------------------------|-------------------------------|
| GULER | 11 | PR D83 032005 | H. Guler <i>et al.</i> | (BELLE Collab.)               |
| OTTER | 79 | NP B147 1     | G. Otter <i>et al.</i> | (AACH3, BERL, CERN, LOIC+) JP |

REFID=53668  
REFID=22772

**$K(1630)$** 

$$I(J^P) = \frac{1}{2}(?^?)$$

## OMITTED FROM SUMMARY TABLE

Seen as a narrow peak, compatible with the experimental resolution, in the invariant mass of the  $K_S^0 \pi^+ \pi^-$  system produced in  $\pi^- p$  interactions at high momentum transfers.

 **$K(1630)$  MASS**

| VALUE (MeV)                    | EVTS      | DOCUMENT ID  | TECN | COMMENT                                                      |
|--------------------------------|-----------|--------------|------|--------------------------------------------------------------|
| <b><math>1629 \pm 7</math></b> | $\sim 75$ | KARNAUKHOV98 | BC   | $16.0 \pi^- p \rightarrow (K_S^0 \pi^+ \pi^-) X^+ \pi^- X^0$ |

 **$K(1630)$  WIDTH**

| VALUE (MeV)                        | EVTS      | DOCUMENT ID               | TECN | COMMENT                                                      |
|------------------------------------|-----------|---------------------------|------|--------------------------------------------------------------|
| <b><math>16^{+19}_{-16}</math></b> | $\sim 75$ | <sup>1</sup> KARNAUKHOV98 | BC   | $16.0 \pi^- p \rightarrow (K_S^0 \pi^+ \pi^-) X^+ \pi^- X^0$ |

<sup>1</sup> Compatible with an experimental resolution of  $14 \pm 1$  MeV.

 **$K(1630)$  DECAY MODES**

| Mode                               |
|------------------------------------|
| $\Gamma_1 \quad K_S^0 \pi^+ \pi^-$ |

 **$K(1630)$  REFERENCES**

KARNAUKHOV 98 PAN 61 203 V.M. Karaukhov, C. Coca, V.I. Moroz  
Translated from YAF 61 252.

 **$K_1(1650)$** 

$$I(J^P) = \frac{1}{2}(1^+)$$

This entry contains various peaks in strange meson systems ( $K^+ \phi$ ,  $K \pi \pi$ ) reported in partial-wave analysis in the 1600–1900 mass region.

 **$K_1(1650)$  MASS**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                         | TECN | CHG    | COMMENT                           |
|-------------------------------------------------------------------------------|------|-------------------------------------|------|--------|-----------------------------------|
| <b><math>1672 \pm 50</math> OUR AVERAGE</b>                                   |      | Error includes scale factor of 1.1. |      |        |                                   |
| $1793 \pm 59^{+153}_{-101}$                                                   | 4289 | <sup>1</sup> AAIJ                   | 17C  | LHCB   | $B^+ \rightarrow J/\psi \phi K^+$ |
| $1650 \pm 50$                                                                 |      | FRAME                               | 86   | OMEG + | $13 K^+ p \rightarrow \phi K^+ p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                     |      |        |                                   |
| $\sim 1840$                                                                   |      | ARMSTRONG                           | 83   | OMEG – | $18.5 K^- p \rightarrow 3 K p$    |
| $\sim 1800$                                                                   |      | DAUM                                | 81C  | CNTR – | $63 K^- p \rightarrow K^- 2\pi p$ |

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of  $7.6 \sigma$ .

 **$K_1(1650)$  WIDTH**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID       | TECN | CHG    | COMMENT                           |
|-------------------------------------------------------------------------------|------|-------------------|------|--------|-----------------------------------|
| <b><math>158 \pm 50</math> OUR AVERAGE</b>                                    |      |                   |      |        |                                   |
| $365 \pm 157^{+138}_{-215}$                                                   | 4289 | <sup>2</sup> AAIJ | 17C  | LHCB   | $B^+ \rightarrow J/\psi \phi K^+$ |
| $150 \pm 50$                                                                  |      | FRAME             | 86   | OMEG + | $13 K^+ p \rightarrow \phi K^+ p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                   |      |        |                                   |
| $\sim 250$                                                                    |      | DAUM              | 81C  | CNTR – | $63 K^- p \rightarrow K^- 2\pi p$ |

<sup>2</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of  $7.6 \sigma$ .

NODE=M160

NODE=M160

NODE=M160M

NODE=M160M

NODE=M160W

NODE=M160W

NODE=M160W;LINKAGE=A

NODE=M160215;NODE=M160

DESIG=1

NODE=M160

REFID=46371

NODE=M099

NODE=M099

NODE=M099M

NODE=M099M

NODE=M099M;LINKAGE=A

NODE=M099W

NODE=M099W

NODE=M099W;LINKAGE=A

**$K_1(1650)$  DECAY MODES**

NODE=M099215;NODE=M099

| Mode       |           |
|------------|-----------|
| $\Gamma_1$ | $K\pi\pi$ |
| $\Gamma_2$ | $K\phi$   |

DESIG=1

DESIG=2

 **$K_1(1650)$  REFERENCES**

NODE=M099

|           |     |                |                              |                           |
|-----------|-----|----------------|------------------------------|---------------------------|
| AAIJ      | 17C | PRL 118 022003 | R. Aaij <i>et al.</i>        | (LHCb Collab.)            |
| Also      |     | PR D95 012002  | R. Aaij <i>et al.</i>        | (LHCb Collab.)            |
| FRAME     | 86  | NP B276 667    | D. Frame <i>et al.</i>       | (GLAS)                    |
| ARMSTRONG | 83  | NP B221 1      | T.A. Armstrong <i>et al.</i> | (BARI, BIRM, CERN+)       |
| DAUM      | 81C | NP B187 1      | C. Daum <i>et al.</i>        | (AMST, CERN, CRAC, MPIM+) |

REFID=57657  
REFID=57636  
REFID=20569  
REFID=22801  
REFID=22548

NODE=M095

|                               |                             |
|-------------------------------|-----------------------------|
| <b><math>K^*(1680)</math></b> | $I(J^P) = \frac{1}{2}(1^-)$ |
|-------------------------------|-----------------------------|

 **$K^*(1680)$  MASS**

NODE=M095M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID       | TECN | CHG  | COMMENT                                          |
|-------------------------------------------------------------------------------|------|-------------------|------|------|--------------------------------------------------|
| <b>1718±18 OUR AVERAGE</b>                                                    |      |                   |      |      |                                                  |
| 1722±20 <sup>+33</sup> <sub>-109</sub>                                        | 4289 | <sup>1</sup> AAIJ | 17C  | LHCB | $B^+ \rightarrow J/\psi\phi K^+$                 |
| 1677±10± 32                                                                   |      | ASTON             | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 1735±10± 20                                                                   |      | ASTON             | 87   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                   |      |      |                                                  |
| 1678±64                                                                       |      | BIRD              | 89   | LASS | - 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |
| 1800±70                                                                       |      | ETKIN             | 80   | MPS  | 0 6 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$  |
| ~ 1650                                                                        |      | ESTABROOKS        | 78   | ASPK | 0 13 $K^\pm p \rightarrow K^\pm \pi^\pm n$       |

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi\phi K^+$  with a significance of 8.5  $\sigma$ .

NODE=M095M;LINKAGE=A

 **$K^*(1680)$  WIDTH**

NODE=M095W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID       | TECN | CHG  | COMMENT                                          |
|-------------------------------------------------------------------------------|------|-------------------|------|------|--------------------------------------------------|
| <b>322±110 OUR AVERAGE</b> Error includes scale factor of 4.2.                |      |                   |      |      |                                                  |
| 354± 75 <sup>+140</sup> <sub>-181</sub>                                       | 4289 | <sup>2</sup> AAIJ | 17C  | LHCB | $B^+ \rightarrow J/\psi\phi K^+$                 |
| 205± 16± 34                                                                   |      | ASTON             | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 423± 18± 30                                                                   |      | ASTON             | 87   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                   |      |      |                                                  |
| 454±270                                                                       |      | BIRD              | 89   | LASS | - 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |
| 170± 30                                                                       |      | ETKIN             | 80   | MPS  | 0 6 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$  |
| 250 to 300                                                                    |      | ESTABROOKS        | 78   | ASPK | 0 13 $K^\pm p \rightarrow K^\pm \pi^\pm n$       |

<sup>2</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi\phi K^+$  with a significance of 8.5  $\sigma$ .

NODE=M095W;LINKAGE=A

 **$K^*(1680)$  DECAY MODES**

NODE=M095215;NODE=M095

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ )            |
|--------------------------|-------------------------------------------|
| $\Gamma_1$ $K\pi$        | (38.7±2.5) %                              |
| $\Gamma_2$ $K\rho$       | (31.4 <sup>+5.0</sup> <sub>-2.1</sub> ) % |
| $\Gamma_3$ $K^*(892)\pi$ | (29.9 <sup>+2.2</sup> <sub>-5.0</sub> ) % |
| $\Gamma_4$ $K\phi$       | seen                                      |
| $\Gamma_5$ $K\eta$       | ( 1.4 <sup>+1.0</sup> <sub>-0.8</sub> ) % |

DESIG=1

DESIG=3

DESIG=2

DESIG=4

DESIG=6

## CONSTRAINED FIT INFORMATION

An overall fit to 4 branching ratios uses 4 measurements and one constraint to determine 3 parameters. The overall fit has a  $\chi^2 = 2.9$  for 2 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|       |       |       |
|-------|-------|-------|
| $x_2$ | −36   |       |
| $x_3$ | −39   | −72   |
|       | $x_1$ | $x_2$ |

### $K^*(1680)$ BRANCHING RATIOS

NODE=M095220

| $\Gamma(K\pi)/\Gamma_{\text{total}}$          |             |      |      |         |                                    | $\Gamma_1/\Gamma$ |
|-----------------------------------------------|-------------|------|------|---------|------------------------------------|-------------------|
| VALUE                                         | DOCUMENT ID | TECN | CHG  | COMMENT |                                    |                   |
| <b><math>0.387 \pm 0.026</math> OUR FIT</b>   |             |      |      |         |                                    |                   |
| <b><math>0.388 \pm 0.014 \pm 0.022</math></b> | ASTON       | 88   | LASS | 0       | 11 $K^- p \rightarrow K^- \pi^+ n$ |                   |

NODE=M095R4  
NODE=M095R4

| $\Gamma(K\pi)/\Gamma(K^*(892)\pi)$               |             |      |      |         |                                         | $\Gamma_1/\Gamma_3$ |
|--------------------------------------------------|-------------|------|------|---------|-----------------------------------------|---------------------|
| VALUE                                            | DOCUMENT ID | TECN | CHG  | COMMENT |                                         |                     |
| <b><math>1.30^{+0.23}_{-0.14}</math> OUR FIT</b> |             |      |      |         |                                         |                     |
| <b><math>2.8 \pm 1.1</math></b>                  | ASTON       | 84   | LASS | 0       | 11 $K^- p \rightarrow \bar{K}^0 2\pi n$ |                     |

NODE=M095R2  
NODE=M095R2

| $\Gamma(K\rho)/\Gamma(K\pi)$                     |             |      |      |         |                                         | $\Gamma_2/\Gamma_1$ |
|--------------------------------------------------|-------------|------|------|---------|-----------------------------------------|---------------------|
| VALUE                                            | DOCUMENT ID | TECN | CHG  | COMMENT |                                         |                     |
| <b><math>0.81^{+0.14}_{-0.09}</math> OUR FIT</b> |             |      |      |         |                                         |                     |
| <b><math>1.2 \pm 0.4</math></b>                  | ASTON       | 84   | LASS | 0       | 11 $K^- p \rightarrow \bar{K}^0 2\pi n$ |                     |

NODE=M095R3  
NODE=M095R3

| $\Gamma(K\rho)/\Gamma(K^*(892)\pi)$               |             |      |      |         |                                                | $\Gamma_2/\Gamma_3$ |
|---------------------------------------------------|-------------|------|------|---------|------------------------------------------------|---------------------|
| VALUE                                             | DOCUMENT ID | TECN | CHG  | COMMENT |                                                |                     |
| <b><math>1.05^{+0.27}_{-0.11}</math> OUR FIT</b>  |             |      |      |         |                                                |                     |
| <b><math>0.97 \pm 0.09^{+0.30}_{-0.10}</math></b> | ASTON       | 87   | LASS | 0       | 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |                     |

NODE=M095R1  
NODE=M095R1

| $\Gamma(K\phi)/\Gamma_{\text{total}}$ |      |                   |      |                                        |  | $\Gamma_4/\Gamma$ |
|---------------------------------------|------|-------------------|------|----------------------------------------|--|-------------------|
| VALUE                                 | EVTS | DOCUMENT ID       | TECN | COMMENT                                |  |                   |
| <b>seen</b>                           | 4289 | <sup>3</sup> AAIJ | 17C  | LHCB $B^+ \rightarrow J/\psi \phi K^+$ |  |                   |

NODE=M095R00  
NODE=M095R00

<sup>3</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of  $8.5 \sigma$ .

NODE=M095R00;LINKAGE=A

| $\Gamma(K\eta)/\Gamma(K\pi)$                          |      |                   |      |                                       |  | $\Gamma_5/\Gamma_1$ |
|-------------------------------------------------------|------|-------------------|------|---------------------------------------|--|---------------------|
| VALUE                                                 | EVTS | DOCUMENT ID       | TECN | COMMENT                               |  |                     |
| <b><math>0.037 \pm 0.007^{+0.024}_{-0.018}</math></b> | 116k | <sup>4</sup> CHEN | 20A  | BELL $D^0 \rightarrow K^- \pi^+ \eta$ |  |                     |

NODE=M095R02  
NODE=M095R02

<sup>4</sup> CHEN 20A quotes the ratio  $\Gamma(K^*(1680)^- \rightarrow K^- \eta) / \Gamma(K^*(1680)^- \rightarrow K^- \pi^0) = 0.11 \pm 0.02^{+0.06}_{-0.04} \pm 0.04(\text{BPDG})$  where the last uncertainty comes from  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.20)\%$ . We divide it by 3 taking into account that  $\Gamma(K^*(1680)^- \rightarrow K^- \pi^0) / \Gamma(K^*(1680)^- \rightarrow (K\pi)^-) = 1/3$ .

NODE=M095R02;LINKAGE=A

| $\Gamma(K\eta)/\Gamma_{\text{total}}$ |      |             |      |         |  | $\Gamma_5/\Gamma$ |
|---------------------------------------|------|-------------|------|---------|--|-------------------|
| VALUE (units $10^{-2}$ )              | EVTS | DOCUMENT ID | TECN | COMMENT |  |                   |

NODE=M095R01  
NODE=M095R01

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                   |      |                   |     |                                       |  |  |
|---------------------------------------------------|------|-------------------|-----|---------------------------------------|--|--|
| <b><math>1.44 \pm 0.21^{+0.96}_{-0.73}</math></b> | 116k | <sup>5</sup> CHEN | 20A | BELL $D^0 \rightarrow K^- \pi^+ \eta$ |  |  |
|---------------------------------------------------|------|-------------------|-----|---------------------------------------|--|--|

<sup>5</sup> From an amplitude analysis of the decay  $D^0 \rightarrow K^- \pi^+ \eta$  with a significance of  $16 \sigma$ . Not independent of the CHEN 20A measurement of  $\Gamma(K^*(1680) \rightarrow K\eta) / \Gamma(K^*(1680) \rightarrow K\pi)$ .

NODE=M095R01;LINKAGE=A

**$K^*(1680)$  REFERENCES**

|            |     |                |                               |                          |
|------------|-----|----------------|-------------------------------|--------------------------|
| CHEN       | 20A | PR D102 012002 | Y.Q. Chen <i>et al.</i>       | (BELLE Collab.)          |
| AAIJ       | 17C | PRL 118 022003 | R. Aaij <i>et al.</i>         | (LHCb Collab.)           |
| Also       |     | PR D95 012002  | R. Aaij <i>et al.</i>         | (LHCb Collab.)           |
| BIRD       | 89  | SLAC-332       | P.F. Bird                     | (SLAC)                   |
| ASTON      | 88  | NP B296 493    | D. Aston <i>et al.</i>        | (SLAC, NAGO, CINC, INUS) |
| ASTON      | 87  | NP B292 693    | D. Aston <i>et al.</i>        | (SLAC, NAGO, CINC, INUS) |
| ASTON      | 84  | PL 149B 258    | D. Aston <i>et al.</i>        | (SLAC, CARL, OTTA) JP    |
| ETKIN      | 80  | PR D22 42      | A. Etkin <i>et al.</i>        | (BNL, CUNY) JP           |
| ESTABROOKS | 78  | NP B133 490    | P.G. Estabrooks <i>et al.</i> | (MCGI, CARL, DURH+) JP   |

NODE=M095

REFID=60333  
 REFID=57657  
 REFID=57636  
 REFID=41002  
 REFID=40262  
 REFID=40234  
 REFID=22689  
 REFID=22545  
 REFID=22443

NODE=M023

 **$K_2(1770)$** 

$$I(J^P) = \frac{1}{2}(2^-)$$

See our mini-review in the 2004 edition of this *Review*, PDG 04.

NODE=M023

 **$K_2(1770)$  MASS**

NODE=M023M

NODE=M023M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | CHG    | COMMENT                                        |
|-------------------------------------------------------------------------------|------|------------------------|------|--------|------------------------------------------------|
| <b>1773± 8 OUR AVERAGE</b>                                                    |      |                        |      |        |                                                |
| 1777±35 <sup>+122</sup> <sub>-77</sub>                                        | 4289 | <sup>1</sup> AAIJ      | 17C  | LHCB   | $B^+ \rightarrow J/\psi \phi K^+$              |
| 1773± 8                                                                       |      | <sup>2</sup> ASTON     | 93   | LASS   | $11K^- p \rightarrow K^- \omega p$             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |      |        |                                                |
| 1743±15                                                                       |      | TIKHOMIROV 03          | SPEC |        | $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| 1810±20                                                                       |      | FRAME                  | 86   | OMEG + | $13 K^+ p \rightarrow \phi K^+ p$              |
| ~ 1730                                                                        |      | ARMSTRONG              | 83   | OMEG - | $18.5 K^- p \rightarrow 3K p$                  |
| ~ 1780                                                                        |      | <sup>3</sup> DAUM      | 81C  | CNTR - | $63 K^- p \rightarrow K^- 2\pi p$              |
| 1710±15                                                                       | 60   | CHUNG                  | 74   | HBC -  | $7.3 K^- p \rightarrow K^- \omega p$           |
| 1767± 6                                                                       |      | BLIEDEN                | 72   | MMS -  | $11-16 K^- p$                                  |
| 1730±20                                                                       | 306  | <sup>4</sup> FIRESTONE | 72B  | DBC +  | $12 K^+ d$                                     |
| 1765±40                                                                       |      | <sup>5</sup> COLLEY    | 71   | HBC +  | $10 K^+ p \rightarrow K 2\pi N$                |
| 1740                                                                          |      | DENEGRI                | 71   | DBC -  | $12.6 K^- d \rightarrow \bar{K} 2\pi d$        |
| 1745±20                                                                       |      | AGUILAR-...            | 70C  | HBC -  | $4.6 K^- p$                                    |
| 1780±15                                                                       |      | BARTSCH                | 70C  | HBC -  | $10.1 K^- p$                                   |
| 1760±15                                                                       |      | LUDLAM                 | 70   | HBC -  | $12.6 K^- p$                                   |

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of 5.0  $\sigma$ .<sup>2</sup> From a partial wave analysis of the  $K^- \omega$  system.<sup>3</sup> From a partial wave analysis of the  $K^- 2\pi$  system.<sup>4</sup> Produced in conjunction with excited deuteron.<sup>5</sup> Systematic errors added correspond to spread of different fits.

NODE=M023M;LINKAGE=C  
 NODE=M023M;LINKAGE=A  
 NODE=M023M;LINKAGE=B  
 NODE=M023M;LINKAGE=P  
 NODE=M023M;LINKAGE=X

 **$K_2(1770)$  WIDTH**

NODE=M023W

NODE=M023W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | CHG    | COMMENT                                        |
|-------------------------------------------------------------------------------|------|------------------------|------|--------|------------------------------------------------|
| <b>186± 14 OUR AVERAGE</b>                                                    |      |                        |      |        |                                                |
| 217±116 <sup>+221</sup> <sub>-154</sub>                                       | 4289 | <sup>6</sup> AAIJ      | 17C  | LHCB   | $B^+ \rightarrow J/\psi \phi K^+$              |
| 186± 14                                                                       |      | <sup>7</sup> ASTON     | 93   | LASS   | $11K^- p \rightarrow K^- \omega p$             |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |      |        |                                                |
| 147± 70                                                                       |      | TIKHOMIROV 03          | SPEC |        | $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| 140± 40                                                                       |      | FRAME                  | 86   | OMEG + | $13 K^+ p \rightarrow \phi K^+ p$              |
| ~ 220                                                                         |      | ARMSTRONG              | 83   | OMEG - | $18.5 K^- p \rightarrow 3K p$                  |
| ~ 210                                                                         |      | <sup>8</sup> DAUM      | 81C  | CNTR - | $63 K^- p \rightarrow K^- 2\pi p$              |
| 110± 50                                                                       | 60   | CHUNG                  | 74   | HBC -  | $7.3 K^- p \rightarrow K^- \omega p$           |
| 100± 26                                                                       |      | BLIEDEN                | 72   | MMS -  | $11-16 K^- p$                                  |
| 210± 30                                                                       | 306  | <sup>9</sup> FIRESTONE | 72B  | DBC +  | $12 K^+ d$                                     |
| 90± 70                                                                        |      | <sup>10</sup> COLLEY   | 71   | HBC +  | $10 K^+ p \rightarrow K 2\pi N$                |
| 130                                                                           |      | DENEGRI                | 71   | DBC -  | $12.6 K^- d \rightarrow \bar{K} 2\pi d$        |
| 100± 50                                                                       |      | AGUILAR-...            | 70C  | HBC -  | $4.6 K^- p$                                    |
| 138± 40                                                                       |      | BARTSCH                | 70C  | HBC -  | $10.1 K^- p$                                   |
| 50 <sup>+</sup> <sub>-20</sub>                                                |      | LUDLAM                 | 70   | HBC -  | $12.6 K^- p$                                   |

<sup>6</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of 5.0  $\sigma$ .<sup>7</sup> From a partial wave analysis of the  $K^- \omega$  system.<sup>8</sup> From a partial wave analysis of the  $K^- 2\pi$  system.<sup>9</sup> Produced in conjunction with excited deuteron.<sup>10</sup> Systematic errors added correspond to spread of different fits.

NODE=M023W;LINKAGE=A  
 NODE=M023W;LINKAGE=B  
 NODE=M023W;LINKAGE=C  
 NODE=M023W;LINKAGE=P  
 NODE=M023W;LINKAGE=X

**$K_2(1770)$  DECAY MODES**

NODE=M023215;NODE=M023

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $K\pi\pi$        |                                |
| $\Gamma_2$ $K_2^*(1430)\pi$ | seen                           |
| $\Gamma_3$ $K^*(892)\pi$    | seen                           |
| $\Gamma_4$ $K f_2(1270)$    | seen                           |
| $\Gamma_5$ $K f_0(980)$     |                                |
| $\Gamma_6$ $K\phi$          | seen                           |
| $\Gamma_7$ $K\omega$        | seen                           |

DESIG=1;OUR EST;→ UNCHECKED ←  
 DESIG=2;OUR EST;→ UNCHECKED ←  
 DESIG=4;OUR EST;→ UNCHECKED ←  
 DESIG=9;OUR EST;→ UNCHECKED ←  
 DESIG=11  
 DESIG=10  
 DESIG=8

 **$K_2(1770)$  BRANCHING RATIOS**

NODE=M023220

**$\Gamma(K_2^*(1430)\pi)/\Gamma(K\pi\pi)$**   **$\Gamma_2/\Gamma_1$**   
 $(K_2^*(1430) \rightarrow K\pi)$

NODE=M023R1

NODE=M023R1  
 NODE=M023R1

| VALUE                                                                         | DOCUMENT ID             | TECN | CHG  | COMMENT                           |
|-------------------------------------------------------------------------------|-------------------------|------|------|-----------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                         |      |      |                                   |
| $\sim 0.03$                                                                   | DAUM                    | 81C  | CNTR | $63 K^- p \rightarrow K^- 2\pi p$ |
| $\sim 1.0$                                                                    | <sup>11</sup> FIRESTONE | 72B  | DBC  | $+ 12 K^+ d$                      |
| $< 1.0$                                                                       | COLLEY                  | 71   | HBC  | $10 K^+ p$                        |
| $0.2 \pm 0.2$                                                                 | AGUILAR-...             | 70C  | HBC  | $- 4.6 K^- p$                     |
| $< 1.0$                                                                       | BARTSCH                 | 70C  | HBC  | $- 10.1 K^- p$                    |
| $1.0$                                                                         | BARBARO-...             | 69   | HBC  | $+ 12.0 K^+ p$                    |

<sup>11</sup> Produced in conjunction with excited deuteron.

NODE=M023R1;LINKAGE=P

**$\Gamma(K^*(892)\pi)/\Gamma(K\pi\pi)$**   **$\Gamma_3/\Gamma_1$**

NODE=M023R3  
 NODE=M023R3

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                |
|-------------------------------------------------------------------------------|-------------|------|----------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |      |                                        |
| $\sim 0.23$                                                                   | DAUM        | 81C  | CNTR $63 K^- p \rightarrow K^- 2\pi p$ |

**$\Gamma(K f_2(1270))/\Gamma(K\pi\pi)$**   **$\Gamma_4/\Gamma_1$**   
 $(f_2(1270) \rightarrow \pi\pi)$

NODE=M023R4  
 NODE=M023R4  
 NODE=M023R4

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                |
|-------------------------------------------------------------------------------|-------------|------|----------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |      |                                        |
| $\sim 0.74$                                                                   | DAUM        | 81C  | CNTR $63 K^- p \rightarrow K^- 2\pi p$ |

**$\Gamma(K f_0(980))/\Gamma_{\text{total}}$**   **$\Gamma_5/\Gamma$**

NODE=M023R6  
 NODE=M023R6

| VALUE                                                                         | DOCUMENT ID | TECN | COMMENT                                             |
|-------------------------------------------------------------------------------|-------------|------|-----------------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |      |                                                     |
| possibly seen                                                                 | TIKHOMIROV  | 03   | SPEC $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |

**$\Gamma(K\phi)/\Gamma_{\text{total}}$**   **$\Gamma_6/\Gamma$**

NODE=M023R5  
 NODE=M023R5

| VALUE | EVTS | DOCUMENT ID        | TECN | CHG  | COMMENT                               |
|-------|------|--------------------|------|------|---------------------------------------|
| seen  | 4289 | <sup>12</sup> AAIJ | 17C  | LHCB | $B^+ \rightarrow J/\psi \phi K^+$     |
| seen  |      | ARMSTRONG          | 83   | OMEG | $- 18.5 K^- p \rightarrow K^- \phi N$ |

<sup>12</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of  $5.0 \sigma$ .

NODE=M023R5;LINKAGE=A

**$\Gamma(K\omega)/\Gamma_{\text{total}}$**   **$\Gamma_7/\Gamma$**

NODE=M023R2  
 NODE=M023R2

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT                                |
|-------|-------------|------|-----|----------------------------------------|
| seen  | OTTER       | 81   | HBC | $\pm 8.25, 10, 16 K^\pm p$             |
| seen  | CHUNG       | 74   | HBC | $- 7.3 K^- p \rightarrow K^- \omega p$ |

 **$K_2(1770)$  REFERENCES**

NODE=M023

|             |     |                |                                         |                                  |
|-------------|-----|----------------|-----------------------------------------|----------------------------------|
| AAIJ        | 17C | PRL 118 022003 | R. Aaij <i>et al.</i>                   | (LHCb Collab.)                   |
| Also        |     | PR D95 012002  | R. Aaij <i>et al.</i>                   | (LHCb Collab.)                   |
| PDG         | 04  | PL B592 1      | S. Eidelman <i>et al.</i>               | (PDG Collab.)                    |
| TIKHOMIROV  | 03  | PAN 66 828     | G.D. Tikhomirov <i>et al.</i>           |                                  |
| ASTON       | 93  | PL B308 186    | D. Aston <i>et al.</i>                  | (SLAC, NAGO, CINC, INUS)         |
| FRAME       | 86  | NP B276 667    | D. Frame <i>et al.</i>                  | (GLAS)                           |
| ARMSTRONG   | 83  | NP B221 1      | T.A. Armstrong <i>et al.</i>            | (BARI, BIRM, CERN+)              |
| DAUM        | 81C | NP B187 1      | C. Daum <i>et al.</i>                   | (AMST, CERN, CRAC, MPIM+)        |
| OTTER       | 81  | NP B181 1      | G. Otter                                | (AACH3, BERL, LOIC, VIEN, BIRM+) |
| CHUNG       | 74  | PL 51B 413     | S.U. Chung <i>et al.</i>                | (BNL)                            |
| BLIEDEN     | 72  | PL 39B 668     | H.R. Blieden <i>et al.</i>              | (STON, NEAS)                     |
| FIRESTONE   | 72B | PR D5 505      | A. Firestone <i>et al.</i>              | (LBL)                            |
| COLLEY      | 71  | NP B26 71      | D.C. Colley <i>et al.</i>               | (BIRM, GLAS)                     |
| DENEGRI     | 71  | NP B28 13      | D. Denegri <i>et al.</i>                | (JHU) JP                         |
| AGUILAR-... | 70C | PRL 25 54      | M. Aguilar-Benitez <i>et al.</i>        | (BNL)                            |
| BARTSCH     | 70C | PL 33B 186     | J. Bartsch <i>et al.</i>                | (AACH, BERL, CERN+)              |
| LUDLAM      | 70  | PR D2 1234     | T. Ludlam, J. Sandweiss, A.J. Slaughter | (YALE)                           |
| BARBARO-... | 69  | PRL 22 1207    | A. Barbaro-Galtieri <i>et al.</i>       | (LRL)                            |

REFID=57657  
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 REFID=49653  
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 REFID=22785  
 REFID=22497  
 REFID=22782  
 REFID=22783  
 REFID=22784  
 REFID=22483

**$K_3^*(1780)$** 

$$I(J^P) = \frac{1}{2}(3^-)$$

NODE=M060

 **$K_3^*(1780)$  T-MATRIX POLE  $\sqrt{s}$** 

NODE=M060PP

| VALUE (MeV)                                                                                                                             | DOCUMENT ID         | TECN | COMMENT                        |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|--------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                           |                     |      |                                |
| (1754 ± 13) − i (119 ± 14)                                                                                                              | <sup>1</sup> PELAEZ | 17   | RVUE $\pi K \rightarrow \pi K$ |
| <sup>1</sup> Reanalysis of ESTABROOKS 78 and ASTON 88 satisfying Forward Dispersion Relations and using sequences of Pade approximants. |                     |      |                                |

NODE=M060PP

NODE=M060PP;LINKAGE=A

 **$K_3^*(1780)$  MASS**

NODE=M060M

| VALUE (MeV)                                                                                                       | EVTS | DOCUMENT ID              | TECN | CHG  | COMMENT                                          |
|-------------------------------------------------------------------------------------------------------------------|------|--------------------------|------|------|--------------------------------------------------|
| <b>1779± 8 OUR AVERAGE</b> Error includes scale factor of 1.2. [1776 ± 7 MeV OUR 2020 AVERAGE Scale factor = 1.1] |      |                          |      |      |                                                  |
| 1813±15 <sup>+65</sup> <sub>-16</sub>                                                                             | 18k  | <sup>1</sup> ABLIKIM     | 20F  | BES3 | $\psi(2S) \rightarrow K^+ K^- \eta$              |
| 1781± 8± 4                                                                                                        |      | <sup>2</sup> ASTON       | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 1740±14±15                                                                                                        |      | <sup>2</sup> ASTON       | 87   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| 1779±11                                                                                                           |      | <sup>3</sup> BALDI       | 76   | SPEC | + 10 $K^+ p \rightarrow K^0 \pi^+ p$             |
| 1776±26                                                                                                           |      | <sup>4</sup> BRANDENB... | 76D  | ASPK | 0 13 $K^\pm p \rightarrow K^\pm \pi^\mp N$       |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                                     |      |                          |      |      |                                                  |
| 1720±10±15                                                                                                        | 6111 | <sup>5</sup> BIRD        | 89   | LASS | - 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |
| 1749±10                                                                                                           |      | ASTON                    | 88B  | LASS | - 11 $K^- p \rightarrow K^- \eta p$              |
| 1780± 9                                                                                                           | 300  | BAUBILLIER               | 84B  | HBC  | - 8.25 $K^- p \rightarrow \bar{K}^0 \pi^- p$     |
| 1790±15                                                                                                           |      | BAUBILLIER               | 82B  | HBC  | 0 8.25 $K^- p \rightarrow K_S^0 2\pi N$          |
| 1784± 9                                                                                                           | 2060 | CLELAND                  | 82   | SPEC | ± 50 $K^+ p \rightarrow K_S^0 \pi^\pm p$         |
| 1786±15                                                                                                           |      | <sup>6</sup> ASTON       | 81D  | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 1762± 9                                                                                                           | 190  | TOAFF                    | 81   | HBC  | - 6.5 $K^- p \rightarrow \bar{K}^0 \pi^- p$      |
| 1850±50                                                                                                           |      | ETKIN                    | 80   | MPS  | 0 6 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^-$    |
| 1812±28                                                                                                           |      | BEUSCH                   | 78   | OMEG | 10 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$   |
| 1786± 8                                                                                                           |      | CHUNG                    | 78   | MPS  | 0 6 $K^- p \rightarrow K^- \pi^+ n$              |

NODE=M060M

NEW

<sup>1</sup> Seen in  $\psi(2S)$  decay with branching ratio  $\psi(2S) \rightarrow K^\pm X \rightarrow K^+ K^- \eta = (2.0 \pm 0.4^{+1.9}_{-0.4}) \times 10^{-6}$ .

<sup>2</sup> From energy-independent partial-wave analysis.

<sup>3</sup> From a fit to  $Y_6^2$  moment.  $J^P = 3^-$  found.

<sup>4</sup> Confirmed by phase shift analysis of ESTABROOKS 78, yields  $J^P = 3^-$ .

<sup>5</sup> From a partial wave amplitude analysis.

<sup>6</sup> From a fit to the  $Y_6^0$  moment.

NODE=M060M;LINKAGE=D

NODE=M060M;LINKAGE=K

NODE=M060M;LINKAGE=M

NODE=M060M;LINKAGE=A

NODE=M060M;LINKAGE=F

NODE=M060M;LINKAGE=J

 **$K_3^*(1780)$  WIDTH**

NODE=M060W

| VALUE (MeV)                                                                                                      | EVTS | DOCUMENT ID          | TECN | CHG  | COMMENT                                          |
|------------------------------------------------------------------------------------------------------------------|------|----------------------|------|------|--------------------------------------------------|
| <b>161±17 OUR AVERAGE</b> Error includes scale factor of 1.1. [159 ± 21 MeV OUR 2020 AVERAGE Scale factor = 1.3] |      |                      |      |      |                                                  |
| 191 <sup>+43+3</sup> <sub>-37-81</sub>                                                                           | 1.8k | <sup>1</sup> ABLIKIM | 20F  | BES3 | $\psi(2S) \rightarrow K^+ K^- \eta$              |
| 203±30± 8                                                                                                        |      | <sup>2</sup> ASTON   | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$             |
| 171±42±20                                                                                                        |      | <sup>2</sup> ASTON   | 87   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| 135±22                                                                                                           |      | <sup>3</sup> BALDI   | 76   | SPEC | + 10 $K^+ p \rightarrow K^0 \pi^+ p$             |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                                    |      |                      |      |      |                                                  |
| 187±31±20                                                                                                        | 6111 | <sup>4</sup> BIRD    | 89   | LASS | - 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |
| 193 <sup>+51</sup> <sub>-37</sub>                                                                                |      | ASTON                | 88B  | LASS | - 11 $K^- p \rightarrow K^- \eta p$              |
| 99±30                                                                                                            | 300  | BAUBILLIER           | 84B  | HBC  | - 8.25 $K^- p \rightarrow \bar{K}^0 \pi^- p$     |
| ~ 130                                                                                                            |      | BAUBILLIER           | 82B  | HBC  | 0 8.25 $K^- p \rightarrow K_S^0 2\pi N$          |
| 191±24                                                                                                           | 2060 | CLELAND              | 82   | SPEC | ± 50 $K^+ p \rightarrow K_S^0 \pi^\pm p$         |
| 225±60                                                                                                           |      | <sup>5</sup> ASTON   | 81D  | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$             |

NODE=M060W

NEW

|                                                                                                                                                                   |     |                          |     |      |   |                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|-----|------|---|------------------------------------------------|
| ~ 80                                                                                                                                                              | 190 | TOAFF                    | 81  | HBC  | — | $6.5 K^- p \rightarrow \bar{K}^0 \pi^- p$      |
| $240 \pm 50$                                                                                                                                                      |     | ETKIN                    | 80  | MPS  | 0 | $6 K^- p \rightarrow \bar{K}^0 \pi^+ \pi^-$    |
| $181 \pm 44$                                                                                                                                                      |     | <sup>6</sup> BEUSCH      | 78  | OMEG |   | $10 K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| $96 \pm 31$                                                                                                                                                       |     | CHUNG                    | 78  | MPS  | 0 | $6 K^- p \rightarrow K^- \pi^+ n$              |
| $270 \pm 70$                                                                                                                                                      |     | <sup>7</sup> BRANDENB... | 76D | ASPK | 0 | $13 K^\pm p \rightarrow K^\pm \pi^\mp N$       |
| <sup>1</sup> Seen in $\psi(2S)$ decay with branching ratio $\psi(2S) \rightarrow K^\pm X \rightarrow K^+ K^- \eta = (2.0 \pm 0.4^{+1.9}_{-0.4}) \times 10^{-6}$ . |     |                          |     |      |   |                                                |
| <sup>2</sup> From energy-independent partial-wave analysis.                                                                                                       |     |                          |     |      |   |                                                |
| <sup>3</sup> From a fit to $Y_6^2$ moment. $J^P = 3^-$ found.                                                                                                     |     |                          |     |      |   |                                                |
| <sup>4</sup> From a partial wave amplitude analysis.                                                                                                              |     |                          |     |      |   |                                                |
| <sup>5</sup> From a fit to $Y_6^0$ moment.                                                                                                                        |     |                          |     |      |   |                                                |
| <sup>6</sup> Errors enlarged by us to $4\Gamma/\sqrt{N}$ ; see the note with the $K^*(892)$ mass.                                                                 |     |                          |     |      |   |                                                |
| <sup>7</sup> ESTABROOKS 78 find that BRANDENBURG 76D data are consistent with 175 MeV width. Not averaged.                                                        |     |                          |     |      |   |                                                |

NODE=M060W;LINKAGE=A

NODE=M060W;LINKAGE=K

NODE=M060W;LINKAGE=M

NODE=M060W;LINKAGE=F

NODE=M060W;LINKAGE=J

NODE=M060W;LINKAGE=D

NODE=M060W;LINKAGE=E

 **$K_3^*(1780)$  DECAY MODES**

NODE=M060215;NODE=M060

| Mode                       | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|----------------------------|--------------------------------|------------------|
| $\Gamma_1 K \rho$          | $(31 \pm 9) \%$                |                  |
| $\Gamma_2 K^*(892) \pi$    | $(20 \pm 5) \%$                |                  |
| $\Gamma_3 K \pi$           | $(18.8 \pm 1.0) \%$            |                  |
| $\Gamma_4 K \eta$          | $(30 \pm 13) \%$               |                  |
| $\Gamma_5 K_2^*(1430) \pi$ | $< 16 \%$                      | 95%              |

DESIG=3

DESIG=2

DESIG=1

DESIG=6

DESIG=4

**CONSTRAINED FIT INFORMATION**

An overall fit to 3 branching ratios uses 4 measurements and one constraint to determine 4 parameters. The overall fit has a  $\chi^2 = 0.0$  for 1 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i/\Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|       |       |       |       |
|-------|-------|-------|-------|
| $x_2$ | 85    |       |       |
| $x_3$ | 18    | 21    |       |
| $x_4$ | -98   | -94   | -27   |
|       | $x_1$ | $x_2$ | $x_3$ |

 **$K_3^*(1780)$  BRANCHING RATIOS**

NODE=M060220

| $\Gamma(K \rho)/\Gamma(K^*(892) \pi)$           |             |      |      |         |                                                | $\Gamma_1/\Gamma_2$ |
|-------------------------------------------------|-------------|------|------|---------|------------------------------------------------|---------------------|
| VALUE                                           | DOCUMENT ID | TECN | CHG  | COMMENT |                                                |                     |
| <b><math>1.52 \pm 0.23</math> OUR FIT</b>       |             |      |      |         |                                                |                     |
| <b><math>1.52 \pm 0.21 \pm 0.10</math></b>      | ASTON       | 87   | LASS | 0       | $11 K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |                     |
| $\Gamma(K^*(892) \pi)/\Gamma(K \pi)$            |             |      |      |         |                                                | $\Gamma_2/\Gamma_3$ |
| VALUE                                           | DOCUMENT ID | TECN | CHG  | COMMENT |                                                |                     |
| <b><math>1.09 \pm 0.26</math> OUR FIT</b>       |             |      |      |         |                                                |                     |
| <b><math>1.09 \pm 0.26</math></b>               | ASTON       | 84B  | LASS | 0       | $11 K^- p \rightarrow \bar{K}^0 2 \pi n$       |                     |
| $\Gamma(K \pi)/\Gamma_{\text{total}}$           |             |      |      |         |                                                | $\Gamma_3/\Gamma$   |
| VALUE                                           | DOCUMENT ID | TECN | CHG  | COMMENT |                                                |                     |
| <b><math>0.188 \pm 0.010</math> OUR FIT</b>     |             |      |      |         |                                                |                     |
| <b><math>0.188 \pm 0.010</math> OUR AVERAGE</b> |             |      |      |         |                                                |                     |
| $0.187 \pm 0.008 \pm 0.008$                     | ASTON       | 88   | LASS | 0       | $11 K^- p \rightarrow K^- \pi^+ n$             |                     |
| $0.19 \pm 0.02$                                 | ESTABROOKS  | 78   | ASPK | 0       | $13 K^\pm p \rightarrow K \pi N$               |                     |

NODE=M060R5  
NODE=M060R5NODE=M060R7  
NODE=M060R7NODE=M060R4  
NODE=M060R4



$\Gamma(K\eta)/\Gamma(K\pi)$ 

| VALUE | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-------------|------|-----|---------|
|-------|-------------|------|-----|---------|

**1.6 ± 0.7 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |                   |     |      |   |                                          |
|--------------|-------------------|-----|------|---|------------------------------------------|
| 0.41 ± 0.050 | <sup>1</sup> BIRD | 89  | LASS | — | 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$ |
| 0.50 ± 0.18  | ASTON             | 88B | LASS | — | 11 $K^- p \rightarrow K^- \eta p$        |

<sup>1</sup> This result supersedes ASTON 88B. $\Gamma(K_2^*(1430)\pi)/\Gamma(K^*(892)\pi)$ 

| VALUE | CL% | DOCUMENT ID | TECN | CHG | COMMENT |
|-------|-----|-------------|------|-----|---------|
|-------|-----|-------------|------|-----|---------|

|                 |    |       |    |      |                                                  |
|-----------------|----|-------|----|------|--------------------------------------------------|
| <b>&lt;0.78</b> | 95 | ASTON | 87 | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
|-----------------|----|-------|----|------|--------------------------------------------------|

 **$K_3^*(1780)$  REFERENCES**

|             |     |                |                                      |                             |
|-------------|-----|----------------|--------------------------------------|-----------------------------|
| ABLIKIM     | 20F | PR D101 032008 | M. Ablikim <i>et al.</i>             | (BESIII Collab.)            |
| PELAEZ      | 17  | EPJ C77 91     | J.R. Pelaez, A.Rodas, J.R. de Elvira |                             |
| BIRD        | 89  | SLAC-332       | P.F. Bird                            | (SLAC)                      |
| ASTON       | 88  | NP B296 493    | D. Aston <i>et al.</i>               | (SLAC, NAGO, CINC, INUS)    |
| ASTON       | 88B | PL B201 169    | D. Aston <i>et al.</i>               | (SLAC, NAGO, CINC, INUS) JP |
| ASTON       | 87  | NP B292 693    | D. Aston <i>et al.</i>               | (SLAC, NAGO, CINC, INUS)    |
| ASTON       | 84B | NP B247 261    | D. Aston <i>et al.</i>               | (SLAC, CARL, OTTA)          |
| BAUBILLIER  | 84B | ZPHY C26 37    | M. Baubillier <i>et al.</i>          | (BIRM, CERN, GLAS+)         |
| BAUBILLIER  | 82B | NP B202 21     | M. Baubillier <i>et al.</i>          | (BIRM, CERN, GLAS+)         |
| CLELAND     | 82  | NP B208 189    | W.E. Cleland <i>et al.</i>           | (DURH, GEVA, LAUS+)         |
| ASTON       | 81D | PL 99B 502     | D. Aston <i>et al.</i>               | (SLAC, CARL, OTTA) JP       |
| TOAFF       | 81  | PR D23 1500    | S. Toaff <i>et al.</i>               | (ANL, KANS)                 |
| ETKIN       | 80  | PR D22 42      | A. Etkin <i>et al.</i>               | (BNL, CUNY) JP              |
| BEUSCH      | 78  | PL 74B 282     | W. Beusch <i>et al.</i>              | (CERN, AACH3, ETH) JP       |
| CHUNG       | 78  | PRL 40 355     | S.U. Chung <i>et al.</i>             | (BNL, BRAN, CUNY+) JP       |
| ESTABROOKS  | 78  | NP B133 490    | P.G. Estabrooks <i>et al.</i>        | (MCGI, CARL, DURH+) JP      |
| Also        |     | PR D17 658     | P.G. Estabrooks <i>et al.</i>        | (MCGI, CARL, DURH+)         |
| BALDI       | 76  | PL 63B 344     | R. Baldi <i>et al.</i>               | (GEVA) JP                   |
| BRANDENB... | 76D | PL 60B 478     | G.W. Brandenburg <i>et al.</i>       | (SLAC) JP                   |

 **$K_2(1820)$** 

$$I(J^P) = \frac{1}{2}(2^-)$$

See our mini-review in the 2004 edition of this *Review* (PDG 04) under  $K_2(1770)$ . **$K_2(1820)$  MASS**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**1819 ± 12 OUR AVERAGE**

|                                         |      |                   |     |                                        |
|-----------------------------------------|------|-------------------|-----|----------------------------------------|
| 1853 ± 27 <sup>+18</sup> <sub>-35</sub> | 4289 | <sup>1</sup> AAIJ | 17C | LHCB $B^+ \rightarrow J/\psi \phi K^+$ |
|-----------------------------------------|------|-------------------|-----|----------------------------------------|

|           |  |                    |    |                                         |
|-----------|--|--------------------|----|-----------------------------------------|
| 1816 ± 13 |  | <sup>2</sup> ASTON | 93 | LASS $11K^- p \rightarrow K^- \omega p$ |
|-----------|--|--------------------|----|-----------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |  |                   |     |                                        |
|--------|--|-------------------|-----|----------------------------------------|
| ~ 1840 |  | <sup>3</sup> DAUM | 81C | CNTR $63 K^- p \rightarrow K^- 2\pi p$ |
|--------|--|-------------------|-----|----------------------------------------|

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of 3.0  $\sigma$ .<sup>2</sup> From a partial wave analysis of the  $K^- \omega$  system.<sup>3</sup> From a partial wave analysis of the  $K^- 2\pi$  system. **$K_2(1820)$  WIDTH**

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**264 ± 34 OUR AVERAGE**

|                                        |      |                   |     |                                        |
|----------------------------------------|------|-------------------|-----|----------------------------------------|
| 167 ± 58 <sup>+82</sup> <sub>-72</sub> | 4289 | <sup>4</sup> AAIJ | 17C | LHCB $B^+ \rightarrow J/\psi \phi K^+$ |
|----------------------------------------|------|-------------------|-----|----------------------------------------|

|          |  |                    |    |                                         |
|----------|--|--------------------|----|-----------------------------------------|
| 276 ± 35 |  | <sup>5</sup> ASTON | 93 | LASS $11K^- p \rightarrow K^- \omega p$ |
|----------|--|--------------------|----|-----------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |  |                   |     |                                        |
|-------|--|-------------------|-----|----------------------------------------|
| ~ 230 |  | <sup>6</sup> DAUM | 81C | CNTR $63 K^- p \rightarrow K^- 2\pi p$ |
|-------|--|-------------------|-----|----------------------------------------|

<sup>4</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of 3.0  $\sigma$ .<sup>5</sup> From a partial wave analysis of the  $K^- \omega$  system.<sup>6</sup> From a partial wave analysis of the  $K^- 2\pi$  system. $\Gamma_4/\Gamma_3$ NODE=M060R8  
NODE=M060R8 $\Gamma_5/\Gamma_2$ NODE=M060R6  
NODE=M060R6

NODE=M060R8;LINKAGE=H

NODE=M060

REFID=60256  
REFID=57836  
REFID=41002  
REFID=40262  
REFID=40281  
REFID=40234  
REFID=22763  
REFID=22459  
REFID=22551  
REFID=22455  
REFID=22820  
REFID=22454  
REFID=22545  
REFID=22537  
REFID=22814  
REFID=22443  
REFID=22444  
REFID=22807  
REFID=22808

NODE=M146

NODE=M146

NODE=M146M

NODE=M146M

NODE=M146M;LINKAGE=B  
NODE=M146M;LINKAGE=A  
NODE=M146M;LINKAGE=C

NODE=M146W

NODE=M146W

NODE=M146W;LINKAGE=A  
NODE=M146W;LINKAGE=B  
NODE=M146W;LINKAGE=C

K<sub>2</sub>(1820) DECAY MODES

NODE=M146215;NODE=M146

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1$ $K\pi\pi$        |                                |
| $\Gamma_2$ $K_2^*(1430)\pi$ | seen                           |
| $\Gamma_3$ $K^*(892)\pi$    | seen                           |
| $\Gamma_4$ $K f_2(1270)$    | seen                           |
| $\Gamma_5$ $K\omega$        | seen                           |
| $\Gamma_6$ $K\phi$          | seen                           |

DESIG=5  
DESIG=1;OUR EVAL;→ UNCHECKED ←  
DESIG=2;OUR EVAL;→ UNCHECKED ←  
DESIG=3;OUR EVAL;→ UNCHECKED ←  
DESIG=6;OUR EVAL;→ UNCHECKED ←  
DESIG=7

K<sub>2</sub>(1820) BRANCHING RATIOS

NODE=M146220

| $\Gamma(K_2^*(1430)\pi)/\Gamma(K\pi\pi)$ | $\Gamma_2/\Gamma_1$      |
|------------------------------------------|--------------------------|
| VALUE                                    | DOCUMENT ID TECN COMMENT |

NODE=M146R1  
NODE=M146R1

• • • We do not use the following data for averages, fits, limits, etc. • • •  
~ 0.77 DAUM 81C CNTR 63K<sup>-</sup> p →  $\bar{K}2\pi p$

| $\Gamma(K^*(892)\pi)/\Gamma(K\pi\pi)$ | $\Gamma_3/\Gamma_1$      |
|---------------------------------------|--------------------------|
| VALUE                                 | DOCUMENT ID TECN COMMENT |

NODE=M146R2  
NODE=M146R2

• • • We do not use the following data for averages, fits, limits, etc. • • •  
~ 0.05 DAUM 81C CNTR 63K<sup>-</sup> p →  $\bar{K}2\pi p$

| $\Gamma(K f_2(1270))/\Gamma(K\pi\pi)$ | $\Gamma_4/\Gamma_1$      |
|---------------------------------------|--------------------------|
| VALUE                                 | DOCUMENT ID TECN COMMENT |

NODE=M146R3  
NODE=M146R3

• • • We do not use the following data for averages, fits, limits, etc. • • •  
~ 0.18 DAUM 81C CNTR 63K<sup>-</sup> p →  $\bar{K}2\pi p$

| $\Gamma(K\phi)/\Gamma_{\text{total}}$ | $\Gamma_6/\Gamma$             |
|---------------------------------------|-------------------------------|
| VALUE                                 | EVTS DOCUMENT ID TECN COMMENT |

NODE=M146R00  
NODE=M146R00

seen 4289 <sup>7</sup> AAIJ 17C LHCB B<sup>+</sup> → J/ψ φ K<sup>+</sup>  
<sup>7</sup> From an amplitude analysis of the decay B<sup>+</sup> → J/ψ φ K<sup>+</sup> with a significance of 3.0 σ.

NODE=M146R00;LINKAGE=A

K<sub>2</sub>(1820) REFERENCES

NODE=M146

|       |     |                |                           |                           |
|-------|-----|----------------|---------------------------|---------------------------|
| AAIJ  | 17C | PRL 118 022003 | R. Aaij <i>et al.</i>     | (LHCb Collab.)            |
| Also  |     | PR D95 012002  | R. Aaij <i>et al.</i>     | (LHCb Collab.)            |
| PDG   | 04  | PL B592 1      | S. Eidelman <i>et al.</i> | (PDG Collab.)             |
| ASTON | 93  | PL B308 186    | D. Aston <i>et al.</i>    | (SLAC, NAGO, CINC, INUS)  |
| DAUM  | 81C | NP B187 1      | C. Daum <i>et al.</i>     | (AMST, CERN, CRAC, MPIM+) |

REFID=57657  
REFID=57636  
REFID=49653  
REFID=43597  
REFID=22548

**$K(1830)$** 

$$I(J^P) = \frac{1}{2}(0^-)$$

OMITTED FROM SUMMARY TABLE

Seen in partial-wave analysis of  $K\phi$  system. Needs confirmation. **$K(1830)$  MASS**

| VALUE (MeV)                | EVTs | DOCUMENT ID       | TECN | CHG  | COMMENT                           |
|----------------------------|------|-------------------|------|------|-----------------------------------|
| $1874 \pm 43^{+59}_{-115}$ | 4289 | <sup>1</sup> AAIJ | 17C  | LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

~ 1830

ARMSTRONG 83 OMEG -  $18.5 K^- p \rightarrow 3K p$ <sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of  $3.5 \sigma$ . **$K(1830)$  WIDTH**

| VALUE (MeV)                | EVTs | DOCUMENT ID       | TECN | CHG  | COMMENT                           |
|----------------------------|------|-------------------|------|------|-----------------------------------|
| $168 \pm 90^{+280}_{-104}$ | 4289 | <sup>2</sup> AAIJ | 17C  | LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

~ 250

ARMSTRONG 83 OMEG -  $18.5 K^- p \rightarrow 3K p$ <sup>2</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of  $3.5 \sigma$ . **$K(1830)$  DECAY MODES**

Mode

 $\Gamma_1 K\phi$  **$K(1830)$  REFERENCES**

|           |     |                |                              |                        |
|-----------|-----|----------------|------------------------------|------------------------|
| AAIJ      | 17C | PRL 118 022003 | R. Aaij <i>et al.</i>        | (LHCb Collab.)         |
| Also      |     | PR D95 012002  | R. Aaij <i>et al.</i>        | (LHCb Collab.)         |
| ARMSTRONG | 83  | NP B221 1      | T.A. Armstrong <i>et al.</i> | (BARI, BIRM, CERN+) JP |

 **$K_0^*(1950)$** 

$$I(J^P) = \frac{1}{2}(0^+)$$

OMITTED FROM SUMMARY TABLE

Seen in partial-wave analysis of the  $K^- \pi^+$  system. Needs confirmation. **$K_0^*(1950)$  MASS**

| VALUE (MeV)          | DOCUMENT ID            | TECN | CHG  | COMMENT                              |
|----------------------|------------------------|------|------|--------------------------------------|
| $1945 \pm 10 \pm 20$ | <sup>1</sup> ASTON     | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$ |
| $1917 \pm 12$        | <sup>2</sup> ZHOU      | 06   | RVUE | $K p \rightarrow K^- \pi^+ n$        |
| $1820 \pm 40$        | <sup>3</sup> ANISOVICH | 97C  | RVUE | 11 $K^- p \rightarrow K^- \pi^+ n$   |

<sup>1</sup> We take the central value of the two solutions and the larger error given.<sup>2</sup> S-matrix pole. Using ASTON 88 and assuming  $K_0^*(700)$ ,  $K_0^*(1430)$ .<sup>3</sup> T-matrix pole. Reanalysis of ASTON 88 data. **$K_0^*(1950)$  WIDTH**

| VALUE (MeV)         | DOCUMENT ID            | TECN | CHG  | COMMENT                              |
|---------------------|------------------------|------|------|--------------------------------------|
| $201 \pm 34 \pm 79$ | <sup>4</sup> ASTON     | 88   | LASS | 0 11 $K^- p \rightarrow K^- \pi^+ n$ |
| $145 \pm 38$        | <sup>5</sup> ZHOU      | 06   | RVUE | $K p \rightarrow K^- \pi^+ n$        |
| $250 \pm 100$       | <sup>6</sup> ANISOVICH | 97C  | RVUE | 11 $K^- p \rightarrow K^- \pi^+ n$   |

<sup>4</sup> We take the central value of the two solutions and the larger error given.<sup>5</sup> S-matrix pole. Using ASTON 88 and assuming  $K_0^*(700)$ ,  $K_0^*(1430)$ .<sup>6</sup> T-matrix pole. Reanalysis of ASTON 88 data.

NODE=M088

NODE=M088

NODE=M088M

NODE=M088M

NODE=M088M;LINKAGE=A

NODE=M088W

NODE=M088W

NODE=M088W;LINKAGE=A

NODE=M088215;NODE=M088

DESIG=1

NODE=M088

REFID=57657  
REFID=57636  
REFID=22801

NODE=M134

NODE=M134

NODE=M134M

NODE=M134M

NODE=M134M;LINKAGE=A

NODE=M134M;LINKAGE=ZU

NODE=M134M;LINKAGE=A1

NODE=M134W

NODE=M134W

NODE=M134W;LINKAGE=A

NODE=M134W;LINKAGE=ZU

NODE=M134W;LINKAGE=A1

**$K_0^*(1950)$  DECAY MODES**

NODE=M134215;NODE=M134

| Mode                       | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------|--------------------------------|
| $\Gamma_1 \quad K^- \pi^+$ | (52±14) %                      |

DESIG=1

**$K_0^*(1950)$  BRANCHING RATIOS**

NODE=M134220

| $\Gamma(K^- \pi^+)/\Gamma_{\text{total}}$                                               |                    |      |      |         | $\Gamma_1/\Gamma$                  |
|-----------------------------------------------------------------------------------------|--------------------|------|------|---------|------------------------------------|
| VALUE                                                                                   | DOCUMENT ID        | TECN | CHG  | COMMENT |                                    |
| <b>0.52±0.08±0.12</b>                                                                   | <sup>7</sup> ASTON | 88   | LASS | 0       | 11 $K^- p \rightarrow K^- \pi^+ n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •           |                    |      |      |         |                                    |
| ~ 0.60                                                                                  | <sup>8</sup> ZHOU  | 06   | RVUE |         | $K p \rightarrow K^- \pi^+ n$      |
| <sup>7</sup> We take the central value of the two solutions and the larger error given. |                    |      |      |         |                                    |
| <sup>8</sup> S-matrix pole. Using ASTON 88 and assuming $K_0^*(700)$ , $K_0^*(1430)$ .  |                    |      |      |         |                                    |

NODE=M134R1  
NODE=M134R1

NODE=M134R1;LINKAGE=A  
NODE=M134R1;LINKAGE=ZU

**$K_0^*(1950)$  REFERENCES**

NODE=M134

|           |     |             |                                                 |
|-----------|-----|-------------|-------------------------------------------------|
| ZHOU      | 06  | NP A775 212 | Z.Y. Zhou, H.Q. Zheng                           |
| ANISOVICH | 97C | PL B413 137 | A.V. Anisovich, A.V. Sarantsev                  |
| ASTON     | 88  | NP B296 493 | D. Aston <i>et al.</i> (SLAC, NAGO, CINC, INUS) |

REFID=51198  
REFID=45815  
REFID=40262

NODE=M104

|                                     |                             |
|-------------------------------------|-----------------------------|
| <div><math>K_2^*(1980)</math></div> | $I(J^P) = \frac{1}{2}(2^+)$ |
| Needs confirmation.                 |                             |

NODE=M104

**$K_2^*(1980)$  MASS**

NODE=M104M

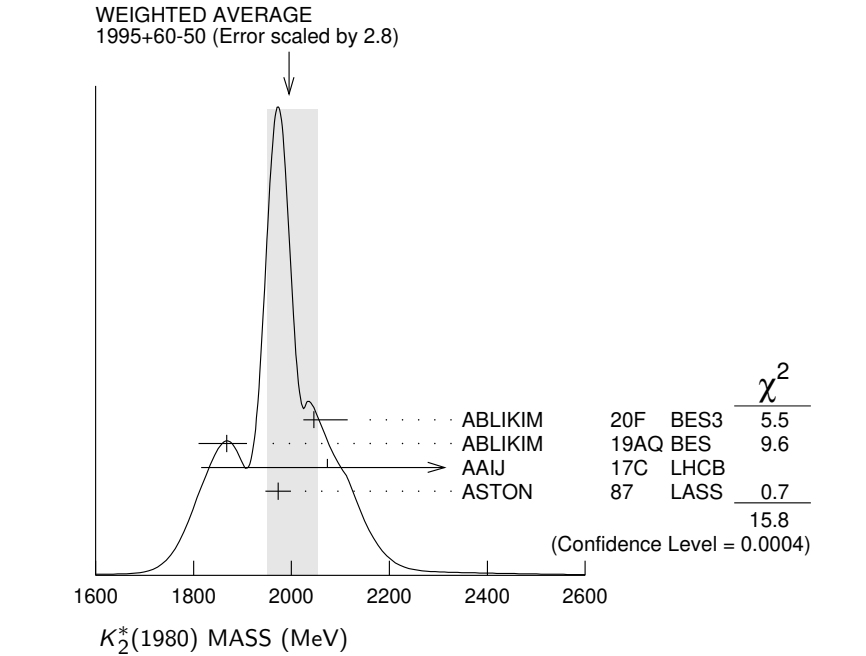
| VALUE (MeV)                                                                                                                                                       | EVTS | DOCUMENT ID          | TECN | CHG    | COMMENT                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|------|--------|------------------------------------------------|
| <b>1995<sup>+60</sup><sub>-50</sub> OUR AVERAGE</b> Error includes scale factor of 2.8. See the ideogram below.                                                   |      |                      |      |        |                                                |
| [1943 ± 50 MeV OUR 2020 AVERAGE Scale factor = 2.2]                                                                                                               |      |                      |      |        |                                                |
| 2046 <sup>+17</sup> <sub>-16</sub> <sup>+67</sup> <sub>-15</sub>                                                                                                  | 1.8k | <sup>1</sup> ABLIKIM | 20F  | BES3   | $\psi(2S) \rightarrow K^+ K^- \eta$            |
| 1868 ± 8 <sup>+40</sup> <sub>-57</sub>                                                                                                                            | 183k | ABLIKIM              | 19AQ | BES ±  | $J/\psi \rightarrow K^+ K^- \pi^0$             |
| 2073 ± 94 <sup>+245</sup> <sub>-240</sub>                                                                                                                         | 4289 | <sup>2</sup> AAIJ    | 17C  | LHCB   | $B^+ \rightarrow J/\psi \phi K^+$              |
| 1973 ± 8 ± 25                                                                                                                                                     |      | ASTON                | 87   | LASS 0 | 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                     |      |                      |      |        |                                                |
| 2020 ± 20                                                                                                                                                         |      | TIKHOMIROV           | 03   | SPEC   | 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| 1978 ± 40                                                                                                                                                         | 241  | BIRD                 | 89   | LASS - | 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$       |
| <sup>1</sup> Seen in $\psi(2S)$ decay with branching ratio $\psi(2S) \rightarrow K^\pm X \rightarrow K^+ K^- \eta = (7.0 \pm 0.5^{+3.7}_{-0.6}) \times 10^{-6}$ . |      |                      |      |        |                                                |
| <sup>2</sup> From an amplitude analysis of the decay $B^+ \rightarrow J/\psi \phi K^+$ with a significance of 5.4 $\sigma$ .                                      |      |                      |      |        |                                                |

NODE=M104M

NEW

NODE=M104M;LINKAGE=C

NODE=M104M;LINKAGE=B



**$K_2^*(1980)$  WIDTH**

| VALUE (MeV)                                                                   | EVTs                 | DOCUMENT ID                                                 | TECN | CHG           | COMMENT                                                  |
|-------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------|------|---------------|----------------------------------------------------------|
| <b><math>349^{+50}_{-30}</math> OUR AVERAGE</b>                               |                      | Error includes scale factor of 1.3. See the ideogram below. |      |               |                                                          |
| $[307^{+50}_{-31}$ MeV OUR 2020 AVERAGE Scale factor = 1.2]                   |                      |                                                             |      |               |                                                          |
| $408^{+38}_{-34}$                                                             | $72^{+44}_{-44}$     | 1.8k                                                        | 1    | ABLIKIM       | 20F BES3 $\psi(2S) \rightarrow K^+ K^- \eta$             |
| $272 \pm 24$                                                                  | $50^{+15}_{-15}$     | 183k                                                        |      | ABLIKIM       | 19AQBES $\pm$ $J/\psi \rightarrow K^+ K^- \pi^0$         |
| $678 \pm 311$                                                                 | $1153^{+559}_{-559}$ | 4289                                                        | 2    | AAIJ          | 17C LHCB $B^+ \rightarrow J/\psi \phi K^+$               |
| $373 \pm 33$                                                                  | 60                   |                                                             |      | ASTON         | 87 LASS 0 $11 K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |                                                             |      |               |                                                          |
| $180 \pm 70$                                                                  |                      |                                                             |      | TIKHOMIROV 03 | SPEC $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$      |
| $398 \pm 47$                                                                  | 241                  | BIRD                                                        | 89   | LASS -        | 11 $K^- p \rightarrow \bar{K}^0 \pi^- p$                 |

<sup>1</sup> Seen in  $\psi(2S)$  decay with branching ratio  $\psi(2S) \rightarrow K^\pm X \rightarrow K^+ K^- \eta = (7.0 \pm 0.5^{+3.7}_{-0.6}) \times 10^{-6}$ .

<sup>2</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of  $5.4 \sigma$ .

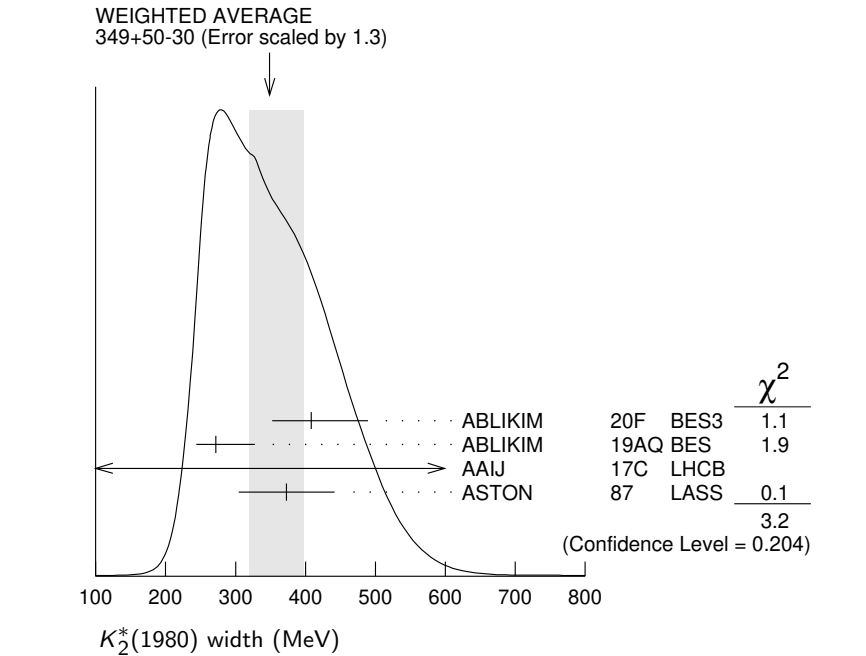
NODE=M104W

NODE=M104W

NEW

NODE=M104W;LINKAGE=C

NODE=M104W;LINKAGE=B



**$K_2^*(1980)$  DECAY MODES**

NODE=M104215;NODE=M104

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1$ $K^*(892)\pi$ | possibly seen                  |
| $\Gamma_2$ $K\rho$       | possibly seen                  |
| $\Gamma_3$ $K f_2(1270)$ | possibly seen                  |
| $\Gamma_4$ $K\phi$       | seen                           |
| $\Gamma_5$ $K\eta$       | seen                           |

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=6

 **$K_2^*(1980)$  BRANCHING RATIOS**

NODE=M104220

 **$\Gamma(K^*(892)\pi)/\Gamma_{\text{total}}$**   **$\Gamma_1/\Gamma$** 

NODE=M104R01

NODE=M104R01

| VALUE                | DOCUMENT ID | TECN | COMMENT                                       |
|----------------------|-------------|------|-----------------------------------------------|
| <b>possibly seen</b> | GULER       | 11   | BELL $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$ |

 **$\Gamma(K\rho)/\Gamma_{\text{total}}$**   **$\Gamma_2/\Gamma$** 

NODE=M104R02

NODE=M104R02

| VALUE                | DOCUMENT ID | TECN | COMMENT                                       |
|----------------------|-------------|------|-----------------------------------------------|
| <b>possibly seen</b> | GULER       | 11   | BELL $B^+ \rightarrow J/\psi K^+ \pi^+ \pi^-$ |

 **$\Gamma(K\rho)/\Gamma(K^*(892)\pi)$**   **$\Gamma_2/\Gamma_1$** 

NODE=M104R1

NODE=M104R1

| VALUE                                      | DOCUMENT ID | TECN | CHG  | COMMENT                                          |
|--------------------------------------------|-------------|------|------|--------------------------------------------------|
| <b><math>1.49 \pm 0.24 \pm 0.09</math></b> | ASTON       | 87   | LASS | 0 11 $K^- p \rightarrow \bar{K}^0 \pi^+ \pi^- n$ |

 **$\Gamma(K f_2(1270))/\Gamma_{\text{total}}$**   **$\Gamma_3/\Gamma$** 

NODE=M104R3

NODE=M104R3

| VALUE                | DOCUMENT ID   | TECN | COMMENT                                        |
|----------------------|---------------|------|------------------------------------------------|
| <b>possibly seen</b> | TIKHOMIROV 03 | SPEC | $40.0 \pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |

 **$\Gamma(K\phi)/\Gamma_{\text{total}}$**   **$\Gamma_4/\Gamma$** 

NODE=M104R00

NODE=M104R00

| VALUE       | EVTS | DOCUMENT ID       | TECN | COMMENT                                |
|-------------|------|-------------------|------|----------------------------------------|
| <b>seen</b> | 4289 | <sup>1</sup> AAIJ | 17C  | LHCB $B^+ \rightarrow J/\psi \phi K^+$ |

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of 5.4  $\sigma$ .

NODE=M104R00;LINKAGE=A

 **$\Gamma(K\eta)/\Gamma_{\text{total}}$**   **$\Gamma_5/\Gamma$** 

NODE=M104R03

NODE=M104R03

| VALUE       | EVTS | DOCUMENT ID          | TECN | COMMENT                                  |
|-------------|------|----------------------|------|------------------------------------------|
| <b>seen</b> | 1.8k | <sup>1</sup> ABLIKIM | 20F  | BES3 $\psi(2S) \rightarrow K^+ K^- \eta$ |
| <b>seen</b> | 116k | <sup>2</sup> CHEN    | 20A  | BELL $D^0 \rightarrow K^- \pi^+ \eta$    |

<sup>1</sup> Seen decaying to  $K\eta$  in an amplitude analysis of  $\psi(2S) \rightarrow K^+ K^- \eta$ .<sup>2</sup> From an amplitude analysis of the decay  $D^0 \rightarrow K^- \pi^+ \eta$  with a significance of 17  $\sigma$ .

NODE=M104R03;LINKAGE=A

NODE=M104R03;LINKAGE=B

 **$K_2^*(1980)$  REFERENCES**

NODE=M104

|            |      |                             |                               |                          |
|------------|------|-----------------------------|-------------------------------|--------------------------|
| ABLIKIM    | 20F  | PR D101 032008              | M. Ablikim <i>et al.</i>      | (BESIII Collab.)         |
| CHEN       | 20A  | PR D102 012002              | Y.Q. Chen <i>et al.</i>       | (BELLE Collab.)          |
| ABLIKIM    | 19AQ | PR D100 032004              | M. Ablikim <i>et al.</i>      | (BESIII Collab.)         |
| AAIJ       | 17C  | PRL 118 022003              | R. Aaij <i>et al.</i>         | (LHCb Collab.)           |
| Also       |      | PR D95 012002               | R. Aaij <i>et al.</i>         | (LHCb Collab.)           |
| GULER      | 11   | PR D83 032005               | H. Guler <i>et al.</i>        | (BELLE Collab.)          |
| TIKHOMIROV | 03   | PAN 66 828                  | G.D. Tikhomirov <i>et al.</i> |                          |
|            |      | Translated from YAF 66 860. |                               |                          |
| BIRD       | 89   | SLAC-332                    | P.F. Bird                     | (SLAC)                   |
| ASTON      | 87   | NP B292 693                 | D. Aston <i>et al.</i>        | (SLAC, NAGO, CINC, INUS) |

REFID=60256

REFID=60333

REFID=59909

REFID=57657

REFID=57636

REFID=53668

REFID=49423

REFID=41002

REFID=40234

$K_4^*(2045)$ 

$$I(J^P) = \frac{1}{2}(4^+)$$

NODE=M035

 $K_4^*(2045)$  MASS

NODE=M035M

| VALUE (MeV)                                                                                                                                                                                       | EVTS                            | DOCUMENT ID                         | TECN                   | CHG      | COMMENT                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------|------------------------|----------|------------------------------------------|
| <b>2048<sup>+8</sup><sub>-9</sub></b>                                                                                                                                                             | <b>OUR AVERAGE</b>              | Error includes scale factor of 1.1. |                        |          |                                          |
| 2090 <sup>±</sup>                                                                                                                                                                                 | 9 <sup>+11</sup> <sub>-29</sub> | 183k                                | ABLIKIM                | 19AQ BES | ± $J/\psi \rightarrow K^+ K^- \pi^0$     |
| 2062 <sup>±</sup>                                                                                                                                                                                 | 14 <sup>±</sup> 13              |                                     | <sup>1</sup> ASTON     | 86 LASS  | 0 $11 K^- p \rightarrow K^- \pi^+ n$     |
| 2039 <sup>±</sup>                                                                                                                                                                                 | 10                              | 400                                 | <sup>2,3</sup> CLELAND | 82 SPEC  | ± $50 K^+ p \rightarrow K_S^0 \pi^\pm p$ |
| 2070 <sup>+100</sup> <sub>-40</sub>                                                                                                                                                               |                                 |                                     | <sup>4</sup> ASTON     | 81C LASS | 0 $11 K^- p \rightarrow K^- \pi^+ n$     |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                     |                                 |                                     |                        |          |                                          |
| 2079 <sup>±</sup>                                                                                                                                                                                 | 7                               | 431                                 | TORRES                 | 86 MPSF  | 400 $pA \rightarrow 4KX$                 |
| 2088 <sup>±</sup>                                                                                                                                                                                 | 20                              | 650                                 | BAUBILLIER             | 82 HBC   | — $8.25 K^- p \rightarrow K_S^0 \pi^- p$ |
| 2115 <sup>±</sup>                                                                                                                                                                                 | 46                              | 488                                 | CARMONY                | 77 HBC   | 0 $9 K^+ d \rightarrow K^+ \pi^+ s X$    |
| <sup>1</sup> From a fit to all moments.<br><sup>2</sup> From a fit to 8 moments.<br><sup>3</sup> Number of events evaluated by us.<br><sup>4</sup> From energy-independent partial-wave analysis. |                                 |                                     |                        |          |                                          |

NODE=M035M

NODE=M035M;LINKAGE=E  
 NODE=M035M;LINKAGE=B  
 NODE=M035M;LINKAGE=W  
 NODE=M035M;LINKAGE=D

 $K_4^*(2045)$  WIDTH

NODE=M035W

| VALUE (MeV)                                                                                                                                                                                       | EVTS                             | DOCUMENT ID | TECN                   | CHG      | COMMENT                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------|------------------------|----------|------------------------------------------|
| <b>199<sup>+27</sup><sub>-19</sub></b>                                                                                                                                                            | <b>OUR AVERAGE</b>               |             |                        |          |                                          |
| 201 <sup>±</sup>                                                                                                                                                                                  | 19 <sup>+57</sup> <sub>-17</sub> | 183k        | ABLIKIM                | 19AQ BES | ± $J/\psi \rightarrow K^+ K^- \pi^0$     |
| 221 <sup>±</sup>                                                                                                                                                                                  | 48 <sup>±</sup> 27               |             | <sup>5</sup> ASTON     | 86 LASS  | 0 $11 K^- p \rightarrow K^- \pi^+ n$     |
| 189 <sup>±</sup>                                                                                                                                                                                  | 35                               | 400         | <sup>6,7</sup> CLELAND | 82 SPEC  | ± $50 K^+ p \rightarrow K_S^0 \pi^\pm p$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                     |                                  |             |                        |          |                                          |
| 61 <sup>±</sup>                                                                                                                                                                                   | 58                               | 431         | TORRES                 | 86 MPSF  | 400 $pA \rightarrow 4KX$                 |
| 170 <sup>+100</sup> <sub>-50</sub>                                                                                                                                                                |                                  | 650         | BAUBILLIER             | 82 HBC   | — $8.25 K^- p \rightarrow K_S^0 \pi^- p$ |
| 240 <sup>+500</sup> <sub>-100</sub>                                                                                                                                                               |                                  |             | <sup>8</sup> ASTON     | 81C LASS | 0 $11 K^- p \rightarrow K^- \pi^+ n$     |
| 300 <sup>±</sup> 200                                                                                                                                                                              |                                  |             | CARMONY                | 77 HBC   | 0 $9 K^+ d \rightarrow K^+ \pi^+ s X$    |
| <sup>5</sup> From a fit to all moments.<br><sup>6</sup> From a fit to 8 moments.<br><sup>7</sup> Number of events evaluated by us.<br><sup>8</sup> From energy-independent partial-wave analysis. |                                  |             |                        |          |                                          |

NODE=M035W

NODE=M035W;LINKAGE=E  
 NODE=M035W;LINKAGE=B  
 NODE=M035W;LINKAGE=W  
 NODE=M035W;LINKAGE=D

 $K_4^*(2045)$  DECAY MODES

NODE=M035215;NODE=M035

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------|--------------------------------|
| $\Gamma_1$ $K\pi$              | (9.9 $\pm$ 1.2) %              |
| $\Gamma_2$ $K^*(892)\pi\pi$    | (9 $\pm$ 5 ) %                 |
| $\Gamma_3$ $K^*(892)\pi\pi\pi$ | (7 $\pm$ 5 ) %                 |
| $\Gamma_4$ $\rho K\pi$         | (5.7 $\pm$ 3.2) %              |
| $\Gamma_5$ $\omega K\pi$       | (5.0 $\pm$ 3.0) %              |
| $\Gamma_6$ $\phi K\pi$         | (2.8 $\pm$ 1.4) %              |
| $\Gamma_7$ $\phi K^*(892)$     | (1.4 $\pm$ 0.7) %              |

DESIG=1  
 DESIG=2  
 DESIG=5  
 DESIG=3  
 DESIG=4  
 DESIG=6  
 DESIG=7

 $K_4^*(2045)$  BRANCHING RATIOS

NODE=M035220

| $\Gamma(K\pi)/\Gamma_{\text{total}}$  |             |      |      |         |                                      | $\Gamma_1/\Gamma$   |
|---------------------------------------|-------------|------|------|---------|--------------------------------------|---------------------|
| VALUE                                 | DOCUMENT ID | TECN | CHG  | COMMENT |                                      |                     |
| <b>0.099±0.012</b>                    | ASTON       | 88   | LASS | 0       | 11 $K^-p \rightarrow K^- \pi^+ n$    |                     |
| $\Gamma(K^*(892)\pi\pi)/\Gamma(K\pi)$ |             |      |      |         |                                      | $\Gamma_2/\Gamma_1$ |
| VALUE                                 | DOCUMENT ID | TECN | CHG  | COMMENT |                                      |                     |
| <b>0.89±0.53</b>                      | BAUBILLIER  | 82   | HBC  | —       | 8.25 $K^-p \rightarrow p K_S^0 3\pi$ |                     |

NODE=M035R1  
 NODE=M035R1

NODE=M035R2  
 NODE=M035R2

$\Gamma(K^*(892)\pi\pi\pi)/\Gamma(K\pi)$ 

| VALUE            | DOCUMENT ID   | TECN | CHG | COMMENT                               |
|------------------|---------------|------|-----|---------------------------------------|
| <b>0.75±0.49</b> | BAUBILLIER 82 | HBC  | —   | 8.25 $K^- p \rightarrow p K_S^0 3\pi$ |

 $\Gamma_3/\Gamma_1$ 

NODE=M035R5  
 NODE=M035R5

 $\Gamma(\rho K\pi)/\Gamma(K\pi)$ 

| VALUE            | DOCUMENT ID   | TECN | CHG | COMMENT                               |
|------------------|---------------|------|-----|---------------------------------------|
| <b>0.58±0.32</b> | BAUBILLIER 82 | HBC  | —   | 8.25 $K^- p \rightarrow p K_S^0 3\pi$ |

 $\Gamma_4/\Gamma_1$ 

NODE=M035R3  
 NODE=M035R3

 $\Gamma(\omega K\pi)/\Gamma(K\pi)$ 

| VALUE            | DOCUMENT ID   | TECN | CHG | COMMENT                               |
|------------------|---------------|------|-----|---------------------------------------|
| <b>0.50±0.30</b> | BAUBILLIER 82 | HBC  | —   | 8.25 $K^- p \rightarrow p K_S^0 3\pi$ |

 $\Gamma_5/\Gamma_1$ 

NODE=M035R4  
 NODE=M035R4

 $\Gamma(\phi K\pi)/\Gamma_{\text{total}}$ 

| VALUE              | DOCUMENT ID            | TECN | CHG          | COMMENT |
|--------------------|------------------------|------|--------------|---------|
| <b>0.028±0.014</b> | <sup>9</sup> TORRES 86 | MPSF | 400 pA → 4KX |         |

 $\Gamma_6/\Gamma$ 

NODE=M035R6  
 NODE=M035R6

 $\Gamma(\phi K^*(892))/\Gamma_{\text{total}}$ 

| VALUE              | DOCUMENT ID            | TECN | CHG          | COMMENT |
|--------------------|------------------------|------|--------------|---------|
| <b>0.014±0.007</b> | <sup>9</sup> TORRES 86 | MPSF | 400 pA → 4KX |         |

 $\Gamma_7/\Gamma$ 

NODE=M035R7  
 NODE=M035R7

<sup>9</sup> Error determination is model dependent.

NODE=M035R;LINKAGE=A

 $K_4^*(2045)$  REFERENCES

|                             |                             |                          |
|-----------------------------|-----------------------------|--------------------------|
| ABLIKIM 19AQ PR D100 032004 | M. Ablikim <i>et al.</i>    | (BESIII Collab.)         |
| ASTON 88 NP B296 493        | D. Aston <i>et al.</i>      | (SLAC, NAGO, CINC, INUS) |
| ASTON 86 PL B180 308        | D. Aston <i>et al.</i>      | (SLAC, NAGO, CINC, INUS) |
| TORRES 86 PR D34 707        | S. Torres <i>et al.</i>     | (VPI, ARIZ, FNAL, FSU+)  |
| BAUBILLIER 82 PL 118B 447   | M. Baubillier <i>et al.</i> | (BIRM, CERN, GLAS+)      |
| CLELAND 82 NP B208 189      | W.E. Cleland <i>et al.</i>  | (DURH, GEVA, LAUS+)      |
| ASTON 81C PL 106B 235       | D. Aston <i>et al.</i>      | (SLAC, CARL, OTTA) JP    |
| CARMONY 77 PR D16 1251      | D.D. Carmony <i>et al.</i>  | (PURD, UCD, IUPU)        |

NODE=M035

REFID=59909  
 REFID=40262  
 REFID=22462  
 REFID=22845  
 REFID=22842  
 REFID=22455  
 REFID=22821  
 REFID=22811

 $K_2(2250)$ 

$$I(J^P) = \frac{1}{2}(2^-)$$

OMITTED FROM SUMMARY TABLE

This entry contains various peaks in strange meson systems reported in the 2150–2260 MeV region, as well as enhancements seen in the antihyperon-nucleon system, either in the mass spectra or in the  $J^P = 2^-$  wave.

NODE=M040

NODE=M040

 $K_2(2250)$  MASS

| <u>VALUE (MeV)</u>                                                            | <u>EVTS</u> | <u>DOCUMENT ID</u>         | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u>                                 |
|-------------------------------------------------------------------------------|-------------|----------------------------|-------------|------------|------------------------------------------------|
| <b>2247±17 OUR AVERAGE</b>                                                    |             |                            |             |            |                                                |
| 2200±40                                                                       |             | <sup>1</sup> ARMSTRONG 83c | OMEG        | —          | 18 $K^- p \rightarrow \Lambda \bar{p} X$       |
| 2235±50                                                                       |             | <sup>1</sup> BAUBILLIER 81 | HBC         | —          | 8 $K^- p \rightarrow \Lambda \bar{p} X$        |
| 2260±20                                                                       |             | <sup>1</sup> CLELAND 81    | SPEC        | ±          | 50 $K^+ p \rightarrow \Lambda \bar{p} X$       |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |                            |             |            |                                                |
| 2280±20                                                                       |             | TIKHOMIROV 03              | SPEC        |            | 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |
| 2147± 4                                                                       | 37          | CHLIAPNIK... 79            | HBC         | +          | 32 $K^+ p \rightarrow \bar{\Lambda} p X$       |
| 2240±20                                                                       | 20          | LISSAUER 70                | HBC         |            | 9 $K^+ p$                                      |

<sup>1</sup>  $J^P = 2^-$  from moments analysis.

NODE=M040M

NODE=M040M

NODE=M040M;LINKAGE=Q

 $K_2(2250)$  WIDTH

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                         | TECN | CHG | COMMENT                                        |                                          |
|-------------------------------------------------------------------------------|------|-------------------------------------|------|-----|------------------------------------------------|------------------------------------------|
| <b>180±30 OUR AVERAGE</b>                                                     |      | Error includes scale factor of 1.4. |      |     |                                                |                                          |
| 150±30                                                                        |      | <sup>2</sup> ARMSTRONG 83c          | OMEG | —   | 18 $K^- p \rightarrow \Lambda \bar{p} X$       |                                          |
| 210±30                                                                        |      | <sup>2</sup> CLELAND 81             | SPEC | ±   | 50 $K^+ p \rightarrow \Lambda \bar{p} X$       |                                          |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                                     |      |     |                                                |                                          |
| 180±60                                                                        |      | TIKHOMIROV 03                       | SPEC |     | 40.0 $\pi^- C \rightarrow K_S^0 K_S^0 K_L^0 X$ |                                          |
| ~ 200                                                                         |      | <sup>2</sup> BAUBILLIER 81          | HBC  | —   | 8 $K^- p \rightarrow \Lambda \bar{p} X$        |                                          |
| ~ 40                                                                          | 37   | CHLIAPNIK...                        | 79   | HBC | +                                              | 32 $K^+ p \rightarrow \bar{\Lambda} p X$ |
| 80±20                                                                         | 20   | LISSAUER 70                         | HBC  |     | 9 $K^+ p$                                      |                                          |

<sup>2</sup>  $J^P = 2^-$  from moments analysis.

NODE=M040W

NODE=M040W

NODE=M040W;LINKAGE=Q



**$K_2(2250)$  DECAY MODES**

NODE=M040215;NODE=M040

| Mode       |                     |
|------------|---------------------|
| $\Gamma_1$ | $K\pi\pi$           |
| $\Gamma_2$ | $Kf_2(1270)$        |
| $\Gamma_3$ | $K^*(892)f_0(980)$  |
| $\Gamma_4$ | $\rho\bar{\Lambda}$ |

DESIG=1  
DESIG=3  
DESIG=4  
DESIG=2

 **$K_2(2250)$  REFERENCES**

|                 |                             |                                |                        |
|-----------------|-----------------------------|--------------------------------|------------------------|
| TIKHOMIROV 03   | PAN 66 828                  | G.D. Tikhomirov <i>et al.</i>  |                        |
|                 | Translated from YAF 66 860. |                                |                        |
| ARMSTRONG 83C   | NP B227 365                 | T.A. Armstrong <i>et al.</i>   | (BARI, BIRM, CERN+)    |
| BAUBILLIER 81   | NP B183 1                   | M. Baubillier <i>et al.</i>    | (BIRM, CERN, GLAS+) JP |
| CLELAND 81      | NP B184 1                   | W.E. Cleland <i>et al.</i>     | (PITT, GEVA, LAUS+) JP |
| CHLIAPNIK... 79 | NP B158 253                 | P.V. Chliapnikov <i>et al.</i> | (CERN, BELG, MONS)     |
| LISSAUER 70     | NP B18 491                  | D. Lissauer <i>et al.</i>      | (LBL)                  |

NODE=M040

REFID=49423

REFID=22852  
REFID=22850  
REFID=22851  
REFID=22849  
REFID=22847

NODE=M090

 **$K_3(2320)$** 

$$I(J^P) = \frac{1}{2}(3^+)$$

OMITTED FROM SUMMARY TABLE

Seen in the  $J^P = 3^+$  wave of the antihyperon-nucleon system.  
Needs confirmation.

NODE=M090

 **$K_3(2320)$  MASS**

NODE=M090M

| VALUE (MeV)                                     | DOCUMENT ID                | TECN | CHG | COMMENT                               |
|-------------------------------------------------|----------------------------|------|-----|---------------------------------------|
| <b>2324±24 OUR AVERAGE</b>                      |                            |      |     |                                       |
| 2330±40                                         | <sup>1</sup> ARMSTRONG 83C | OMEG | —   | 18 $K^-p \rightarrow \Lambda\bar{p}X$ |
| 2320±30                                         | <sup>1</sup> CLELAND 81    | SPEC | ±   | 50 $K^+p \rightarrow \Lambda\bar{p}X$ |
| <sup>1</sup> $J^P = 3^+$ from moments analysis. |                            |      |     |                                       |

NODE=M090M

NODE=M090M;LINKAGE=P

 **$K_3(2320)$  WIDTH**

NODE=M090W

| VALUE (MeV)                                                                   | DOCUMENT ID                | TECN | CHG | COMMENT                               |
|-------------------------------------------------------------------------------|----------------------------|------|-----|---------------------------------------|
| <b>150±30</b>                                                                 | <sup>2</sup> ARMSTRONG 83C | OMEG | —   | 18 $K^-p \rightarrow \Lambda\bar{p}X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                            |      |     |                                       |
| ~ 250                                                                         | <sup>2</sup> CLELAND 81    | SPEC | ±   | 50 $K^+p \rightarrow \Lambda\bar{p}X$ |
| <sup>2</sup> $J^P = 3^+$ from moments analysis.                               |                            |      |     |                                       |

NODE=M090W

NODE=M090W;LINKAGE=P

 **$K_3(2320)$  DECAY MODES**

NODE=M090215;NODE=M090

| Mode       |                     |
|------------|---------------------|
| $\Gamma_1$ | $\rho\bar{\Lambda}$ |

DESIG=1

 **$K_3(2320)$  REFERENCES**

|               |             |                              |                     |
|---------------|-------------|------------------------------|---------------------|
| ARMSTRONG 83C | NP B227 365 | T.A. Armstrong <i>et al.</i> | (BARI, BIRM, CERN+) |
| CLELAND 81    | NP B184 1   | W.E. Cleland <i>et al.</i>   | (PITT, GEVA, LAUS+) |

NODE=M090

REFID=22852  
REFID=22851

**$K_5^*(2380)$** 

$$I(J^P) = \frac{1}{2}(5^-)$$

OMITTED FROM SUMMARY TABLE

Needs confirmation.

 **$K_5^*(2380)$  MASS**

| <u>VALUE (MeV)</u>                     | <u>DOCUMENT ID</u> |    | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u>                     |
|----------------------------------------|--------------------|----|-------------|------------|------------------------------------|
| <b><math>2382 \pm 14 \pm 19</math></b> | <sup>1</sup> ASTON | 86 | LASS        | 0          | 11 $K^- p \rightarrow K^- \pi^+ n$ |

<sup>1</sup> From a fit to all the moments. **$K_5^*(2380)$  WIDTH**

| <u>VALUE (MeV)</u> | <u>DOCUMENT ID</u> |    | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u>                    |
|--------------------|--------------------|----|-------------|------------|-----------------------------------|
| <b>178±37±32</b>   | <sup>2</sup> ASTON | 86 | LASS        | 0          | 11 $K^-p \rightarrow K^- \pi^+ n$ |

<sup>2</sup> From a fit to all the moments. **$K_5^*(2380)$  DECAY MODES**

| Mode               | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------|--------------------------------|
| $\Gamma_1$ $K \pi$ | (6.1 $\pm$ 1.2) %              |

 **$K_5^*(2380)$  BRANCHING RATIOS**

| $\Gamma(K\pi)/\Gamma_{\text{total}}$ |             |      |      |         | $\Gamma_1/\Gamma$                  |
|--------------------------------------|-------------|------|------|---------|------------------------------------|
| VALUE                                | DOCUMENT ID | TECN | CHG  | COMMENT |                                    |
| <b><math>0.061 \pm 0.012</math></b>  | ASTON       | 88   | LASS | 0       | 11 $K^- p \rightarrow K^- \pi^+ n$ |

 **$K_5^*(2380)$  REFERENCES**

|       |    |             |                        |                          |
|-------|----|-------------|------------------------|--------------------------|
| ASTON | 88 | NP B296 493 | D. Aston <i>et al.</i> | (SLAC, NAGO, CINC, INUS) |
| ASTON | 86 | PL B180 308 | D. Aston <i>et al.</i> | (SLAC, NAGO, CINC, INUS) |

 **$K_4(2500)$** 

$$I(J^P) = \frac{1}{2}(4^-)$$

OMITTED FROM SUMMARY TABLE

Needs confirmation.

 **$K_4(2500)$  MASS**

| VALUE (MeV)                     | DOCUMENT ID          |    | TECN | CHG   | COMMENT                                |
|---------------------------------|----------------------|----|------|-------|----------------------------------------|
| <b><math>2490 \pm 20</math></b> | <sup>1</sup> CLELAND | 81 | SPEC | $\pm$ | 50 $K^+ p \rightarrow \Lambda \bar{p}$ |

<sup>1</sup>  $J^P = 4^-$  from moments analysis. **$K_4(2500)$  WIDTH**

| <u>VALUE (MeV)</u>                                                            | <u>DOCUMENT ID</u>   | <u>TECN</u> | <u>CHG</u> | <u>COMMENT</u>                               |
|-------------------------------------------------------------------------------|----------------------|-------------|------------|----------------------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                      |             |            |                                              |
| $\sim 250$                                                                    | <sup>2</sup> CLELAND | 81          | SPEC       | $\pm$ 50 $K^+ p \rightarrow \Lambda \bar{p}$ |

<sup>2</sup>  $J^P = 4^-$  from moments analysis. **$K_4(2500)$  DECAY MODES**

| Mode                         |  |
|------------------------------|--|
| $\Gamma_1$ $p \bar{\Lambda}$ |  |

 **$K_4(2500)$  REFERENCES**

|         |    |           |                            |                     |
|---------|----|-----------|----------------------------|---------------------|
| CLELAND | 81 | NP B184 1 | W.E. Cleland <i>et al.</i> | (PITT, GEVA, LAUS+) |
|---------|----|-----------|----------------------------|---------------------|

NODE=M098

NODE=M098

NODE=M098M

NODE=M098M

NODE=M098M;LINKAGE=E

NODE=M098W

NODE=M098W

NODE=M098W;LINKAGE=E

NODE=M098215;NODE=M098

DESIG=1

NODE=M098220

NODE=M098R1  
NODE=M098R1

NODE=M098

REFID=40262  
REFID=22462

NODE=M091

NODE=M091

NODE=M091M

NODE=M091M

NODE=M091M;LINKAGE=R

NODE=M091W

NODE=M091W

NODE=M091W;LINKAGE=R

NODE=M091215;NODE=M091

DESIG=1

NODE=M091

REFID=22851

**$K(3100)$** 

$$I^G(J^{PC}) = ?^?(?^{??})$$

NODE=M129

## OMITTED FROM SUMMARY TABLE

Narrow peak observed in several ( $\Lambda\bar{p}$  + pions) and ( $\bar{\Lambda}p$  + pions) states in  $\Sigma^-$  Be reactions by BOURQUIN 86 and in  $np$  and  $nA$  reactions by ALEEV 93. Not seen by BOEHNLEIN 91. If due to strong decays, this state has exotic quantum numbers ( $B=0, Q=+1, S=-1$  for  $\Lambda\bar{p}\pi^+\pi^+$  and  $I \geq 3/2$  for  $\Lambda\bar{p}\pi^-\pi^-$ ). Needs confirmation.

NODE=M129

 **$K(3100)$  MASS**

NODE=M129205

VALUE (MeV)

DOCUMENT ID

 **$\approx 3100$  OUR ESTIMATE**

NODE=M129M

→ UNCHECKED ←

**3-BODY DECAYS**

NODE=M129M1

NODE=M129M1

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

 **$3054 \pm 11$  OUR AVERAGE** $3060 \pm 7 \pm 20$ <sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+$  $3056 \pm 7 \pm 20$ <sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^-$  $3055 \pm 8 \pm 20$ <sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^-$  $3045 \pm 8 \pm 20$ <sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^+$ 

OCCUR=2

OCCUR=3

OCCUR=4

**4-BODY DECAYS**

NODE=M129M2

NODE=M129M2

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

 **$3059 \pm 11$  OUR AVERAGE** $3067 \pm 6 \pm 20$ <sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^+$  $3060 \pm 8 \pm 20$ <sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^-$  $3055 \pm 7 \pm 20$ <sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^-\pi^-$  $3052 \pm 8 \pm 20$ <sup>1</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^-\pi^+$ 

OCCUR=2

OCCUR=3

OCCUR=4

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $3105 \pm 30$ BOURQUIN 86 SPEC  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^+$  $3115 \pm 30$ BOURQUIN 86 SPEC  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^-$ 

OCCUR=2

**5-BODY DECAYS**

NODE=M129M3

NODE=M129M3

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $3095 \pm 30$ BOURQUIN 86 SPEC  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^+\pi^-$ <sup>1</sup> Supersedes ALEEV 90.

NODE=M129M;LINKAGE=A

 **$K(3100)$  WIDTH**

NODE=M129210

**3-BODY DECAYS**

NODE=M129W1

NODE=M129W1

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $42 \pm 16$ <sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+$  $36 \pm 15$ <sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^-$  $50 \pm 18$ <sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^-$  $30 \pm 15$ <sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^+$ 

OCCUR=2

OCCUR=3

OCCUR=4

**4-BODY DECAYS**

NODE=M129W2

NODE=M129W2

VALUE (MeV)

CL%

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $22 \pm 8$ <sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^+$  $28 \pm 12$ <sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^-$  $32 \pm 15$ <sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^-\pi^-$  $30 \pm 15$ <sup>2</sup> ALEEV 93 BIS2  $K(3100) \rightarrow \bar{\Lambda}p\pi^-\pi^+$ 

OCCUR=2

OCCUR=3

OCCUR=4

&lt;30

90

BOURQUIN 86 SPEC  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^+$ 

&lt;80

90

BOURQUIN 86 SPEC  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^-$ 

OCCUR=2

**5-BODY DECAYS**

NODE=M129W3

NODE=M129W3

VALUE (MeV)

CL%

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt;30

90

BOURQUIN 86 SPEC  $K(3100) \rightarrow \Lambda\bar{p}\pi^+\pi^+\pi^-$ <sup>2</sup> Supersedes ALEEV 90.

NODE=M129W;LINKAGE=A

**K(3100) DECAY MODES**

NODE=M129215;NODE=M129

| Mode       |                                                           |
|------------|-----------------------------------------------------------|
| $\Gamma_1$ | $K(3100)^0 \rightarrow \Lambda \bar{p} \pi^+$             |
| $\Gamma_2$ | $K(3100)^{-} \rightarrow \Lambda \bar{p} \pi^-$           |
| $\Gamma_3$ | $K(3100)^- \rightarrow \Lambda \bar{p} \pi^+ \pi^-$       |
| $\Gamma_4$ | $K(3100)^+ \rightarrow \Lambda \bar{p} \pi^+ \pi^+$       |
| $\Gamma_5$ | $K(3100)^0 \rightarrow \Lambda \bar{p} \pi^+ \pi^+ \pi^-$ |
| $\Gamma_6$ | $K(3100)^0 \rightarrow \Sigma(1385)^+ \bar{p}$            |

DESIG=1

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=6

| $\Gamma(\Sigma(1385)^+ \bar{p})/\Gamma(\Lambda \bar{p} \pi^+)$ |     |             |      |         | $\Gamma_6/\Gamma_1$                            |
|----------------------------------------------------------------|-----|-------------|------|---------|------------------------------------------------|
| VALUE                                                          | CL% | DOCUMENT ID | TECN | COMMENT |                                                |
| <0.04                                                          | 90  | ALEEV       | 93   | BIS2    | $K(3100)^0 \rightarrow \Sigma(1385)^+ \bar{p}$ |

NODE=M129R1

NODE=M129R1

**K(3100) REFERENCES**

|           |    |                             |                             |                     |
|-----------|----|-----------------------------|-----------------------------|---------------------|
| ALEEV     | 93 | PAN 56 1358                 | A.N. Aleev <i>et al.</i>    | (BIS-2 Collab.)     |
|           |    | Translated from YAF 56 100. |                             |                     |
| BOEHNLEIN | 91 | NPBPS B21 174               | A. Boehnlein <i>et al.</i>  | (FLOR, BNL, IND+)   |
| ALEEV     | 90 | ZPHY C47 533                | A.N. Aleev <i>et al.</i>    | (BIS-2 Collab.)     |
| BOURQUIN  | 86 | PL B172 113                 | M.H. Bourquin <i>et al.</i> | (GEVA, RAL, HEIDP+) |

NODE=M129

REFID=43668

REFID=41743

REFID=42173

REFID=22928

# CHARMED MESONS ( $C = \pm 1$ )

 $D^+ = c\bar{d}, D^0 = c\bar{u}, \bar{D}^0 = \bar{c}u, D^- = \bar{c}d,$  similarly for  $D^{*}$ 's

NODE=MXXX035

NODE=MXXX035

NODE=M061

 **$D^*(2007)^0$** 
 $I(J^P) = \frac{1}{2}(1^-)$   
 $I, J, P$  need confirmation.
 $J$  consistent with 1, value 0 ruled out (NGUYEN 77).

NODE=M061

 **$D^*(2007)^0$  MASS**

NODE=M061M

The fit includes  $D^\pm, D^0, D_s^\pm, D^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ ,  
and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M061M

| <u>VALUE (MeV)</u>                                                                                                                                    | <u>DOCUMENT ID</u>                  | <u>TECN</u> | <u>COMMENT</u>                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------------|-------------------------------|
| <b>2006.85±0.05 OUR FIT</b>                                                                                                                           | Error includes scale factor of 1.1. |             |                               |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●                                                                         |                                     |             |                               |
| 2006 ±1.5                                                                                                                                             | <sup>1</sup> GOLDHABER 77           | MRK1        | e <sup>+</sup> e <sup>-</sup> |
| <sup>1</sup> From simultaneous fit to D <sup>*</sup> (2010) <sup>+</sup> , D <sup>*</sup> (2007) <sup>0</sup> , D <sup>+</sup> , and D <sup>0</sup> . |                                     |             |                               |

NODE=M061M

NODE=M061M;LINKAGE=G

 **$m_{D^*(2007)^0} - m_{D^0}$** 

NODE=M061DM

The fit includes  $D^\pm, D^0, D_s^\pm, D^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ ,  
and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M061DM

| VALUE (MeV)                                                                   | EVTS                                | DOCUMENT ID               | TECN | COMMENT                        |
|-------------------------------------------------------------------------------|-------------------------------------|---------------------------|------|--------------------------------|
| <b>142.014±0.030 OUR FIT</b>                                                  | Error includes scale factor of 1.5. |                           |      |                                |
| <b>142.016±0.030 OUR AVERAGE</b>                                              | Error includes scale factor of 1.5. |                           |      |                                |
| 142.007±0.015±0.014                                                           | 10k                                 | <sup>2</sup> TOMARADZE 15 | CLEO | $e^+ e^- \rightarrow$ hadrons  |
| 142.2 ±0.3 ±0.2                                                               | 145                                 | ALBRECHT 95F              | ARG  | $e^+ e^- \rightarrow$ hadrons  |
| 142.12 ±0.05 ±0.05                                                            | 1176                                | BORTOLETTO92B             | CLE2 | $e^+ e^- \rightarrow$ hadrons  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |                           |      |                                |
| 142.2 ±2.0                                                                    |                                     | SADROZINSKI 80            | CBAL | $D^{*0} \rightarrow D^0 \pi^0$ |
| 142.7 ±1.7                                                                    |                                     | <sup>3</sup> GOLDHABER 77 | MRK1 | $e^+ e^-$                      |

NODE=M061DM

<sup>2</sup> Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration . This value comes from the average of the results for two decay modes,  $D^0 \rightarrow K^- \pi^+$  and  $D^0 \rightarrow K^- \pi^+ \pi^- \pi^+$ .

<sup>3</sup> From simultaneous fit to  $D^*(2010)^+$ ,  $D^*(2007)^0$ ,  $D^+$ , and  $D^0$ .

### $D^*(2007)^0$ WIDTH

| VALUE (MeV)    | CL% | DOCUMENT ID         | TECN    | COMMENT                        |
|----------------|-----|---------------------|---------|--------------------------------|
| <b>&lt;2.1</b> | 90  | <sup>4</sup> ABACHI | 88B HRS | $D^{*0} \rightarrow D^+ \pi^-$ |

<sup>4</sup> Assuming  $m_{D^{*0}} = 2007.2 \pm 2.1 \text{ MeV}/c^2$ .

### $D^*(2007)^0$ DECAY MODES

$\bar{D}^*(2007)^0$  modes are charge conjugates of modes below.

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1 \quad D^0 \pi^0$  | $(64.7 \pm 0.9) \%$            |
| $\Gamma_2 \quad D^0 \gamma$ | $(35.3 \pm 0.9) \%$            |

### CONSTRAINED FIT INFORMATION

An overall fit to 2 branching ratios uses 5 measurements and one constraint to determine 2 parameters. The overall fit has a  $\chi^2 = 2.5$  for 4 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

$$\begin{array}{c|c} x_2 & -100 \\ \hline & x_1 \end{array}$$

### $D^*(2007)^0$ BRANCHING RATIOS

$\Gamma(D^0 \pi^0) / \Gamma(D^0 \gamma)$   $\Gamma_1 / \Gamma_2$

| VALUE                                         | EVTS                                | DOCUMENT ID | TECN     | COMMENT                                            |
|-----------------------------------------------|-------------------------------------|-------------|----------|----------------------------------------------------|
| <b><math>1.83 \pm 0.07</math> OUR FIT</b>     | Error includes scale factor of 1.1. |             |          |                                                    |
| <b><math>1.85 \pm 0.07</math> OUR AVERAGE</b> |                                     |             |          |                                                    |
| $1.90 \pm 0.07 \pm 0.05$                      | 4.9k                                | ABLIKIM     | 15B BES3 | $10.6 \text{ } e^+ e^- \rightarrow \text{hadrons}$ |
| $1.74 \pm 0.02 \pm 0.13$                      |                                     | AUBERT,BE   | 05G BABR | $10.6 \text{ } e^+ e^- \rightarrow \text{hadrons}$ |

$\Gamma(D^0 \pi^0) / \Gamma_{\text{total}}$   $\Gamma_1 / \Gamma$

| <u>VALUE</u>                                                                  | <u>EVTS</u> | <u>DOCUMENT ID</u>     | <u>TECN</u> | <u>COMMENT</u>                               |
|-------------------------------------------------------------------------------|-------------|------------------------|-------------|----------------------------------------------|
| <b>0.647±0.009 OUR FIT</b>                                                    |             |                        |             |                                              |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |             |                        |             |                                              |
| 0.655±0.008±0.005                                                             | 3.2k        | <sup>5</sup> ABLIKIM   | 15B BES3    | e <sup>+</sup> e <sup>-</sup> → hadrons      |
| 0.635±0.003±0.017                                                             | 69k         | <sup>5</sup> AUBERT,BE | 05G BABR    | 10.6 e <sup>+</sup> e <sup>-</sup> → hadrons |
| 0.596±0.035±0.028                                                             | 858         | <sup>6</sup> ALBRECHT  | 95F ARG     | e <sup>+</sup> e <sup>-</sup> → hadrons      |
| 0.636±0.023±0.033                                                             | 1097        | <sup>6</sup> BUTLER    | 92 CLE2     | e <sup>+</sup> e <sup>-</sup> → hadrons      |

$\Gamma(D^0 \gamma) / \Gamma_{\text{total}}$   $\Gamma_2 / \Gamma$

| VALUE                                                                         | EVTS | DOCUMENT ID            | TECN     | COMMENT                                            |
|-------------------------------------------------------------------------------|------|------------------------|----------|----------------------------------------------------|
| <b><math>0.353 \pm 0.009</math> OUR FIT</b>                                   |      |                        |          |                                                    |
| <b><math>0.381 \pm 0.029</math> OUR AVERAGE</b>                               |      |                        |          |                                                    |
| $0.404 \pm 0.035 \pm 0.028$                                                   | 456  | <sup>6</sup> ALBRECHT  | 95F ARG  | $e^+ e^- \rightarrow \text{hadrons}$               |
| $0.364 \pm 0.023 \pm 0.033$                                                   | 621  | <sup>6</sup> BUTLER    | 92 CLE2  | $e^+ e^- \rightarrow \text{hadrons}$               |
| $0.37 \pm 0.08 \pm 0.08$                                                      |      | ADLER                  | 88D MRK3 | $e^+ e^-$                                          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |          |                                                    |
| $0.345 \pm 0.008 \pm 0.005$                                                   | 1.8k | <sup>5</sup> ABLIKIM   | 15B BES3 | $e^+ e^- \rightarrow \text{hadrons}$               |
| $0.365 \pm 0.003 \pm 0.017$                                                   | 68k  | <sup>5</sup> AUBERT,BE | 05G BABR | $10.6 \text{ } e^+ e^- \rightarrow \text{hadrons}$ |
| $0.47 \pm 0.23$                                                               |      | LOW                    | 87 HRS   | $29 \text{ GeV } e^+ e^-$                          |
| $0.53 \pm 0.13$                                                               |      | BARTEL                 | 85G JADE | $e^+ e^-$ , hadrons                                |
| $0.47 \pm 0.12$                                                               |      | COLES                  | 82 MRK2  | $e^+ e^-$                                          |
| $0.45 \pm 0.15$                                                               |      | GOLDHABER              | 77 MRK1  | $e^+ e^-$                                          |

NODE=M061DM;LINKAGE=A

NODE=M061DM;LINKAGE=G

NODE=M061W

NODE=M061W

NODE=M061W;LINKAGE=A

NODE=M061220;NODE=M061

NODE=M061

DESIG=1

DESIG=2

NODE=M061225

NODE=M061R3  
NODE=M061R3

NODE=M061R2  
NODE=M061R2

NODE=M061R1  
NODE=M061R1

<sup>5</sup> Derived from the ratio  $\Gamma(D^0\pi^0) / \Gamma(D^0\gamma)$  assuming that the branching fractions of  $D^{*0} \rightarrow D^0\pi^0$  and  $D^{*0} \rightarrow D^0\gamma$  decays sum to 100%

<sup>6</sup> The BUTLER 92 and ALBRECHT 95F branching ratios are not independent, they have been constrained by the authors to sum to 100%.

NODE=M061R;LINKAGE=AU

NODE=M061R;LINKAGE=A

### $D^*(2007)^0$ REFERENCES

|             |     |                   |                                  |                         |
|-------------|-----|-------------------|----------------------------------|-------------------------|
| ABLIKIM     | 15B | PR D91 031101     | M. Ablikim <i>et al.</i>         | (BESIII Collab.)        |
| TOMARADZE   | 15  | PR D91 011102     | A. Tomaradze <i>et al.</i>       | (NWES)                  |
| AUBERT, BE  | 05G | PR D72 091101     | B. Aubert <i>et al.</i>          | (BABAR Collab.)         |
| ALBRECHT    | 95F | ZPHY C66 63       | H. Albrecht <i>et al.</i>        | (ARGUS Collab.)         |
| BORTOLETTO  | 92B | PRL 69 2046       | D. Bortoletto <i>et al.</i>      | (CLEO Collab.)          |
| BUTLER      | 92  | PRL 69 2041       | F. Butler <i>et al.</i>          | (CLEO Collab.)          |
| ABACHI      | 88B | PL B212 533       | S. Abachi <i>et al.</i>          | (ANL, IND, MICH, PURD+) |
| ADLER       | 88D | PL B208 152       | J. Adler <i>et al.</i>           | (Mark III Collab.)      |
| LOW         | 87  | PL B183 232       | E.H. Low <i>et al.</i>           | (HRS Collab.)           |
| BARTEL      | 85G | PL 161B 197       | W. Bartel <i>et al.</i>          | (JADE Collab.)          |
| COLES       | 82  | PR D26 2190       | M.W. Coles <i>et al.</i>         | (LBL, SLAC)             |
| SADROZINSKI | 80  | Madison Conf. 681 | H.F.W. Sadrozinski <i>et al.</i> | (PRIN, CIT+)            |
| GOLDHABER   | 77  | PL 69B 503        | G. Goldhaber <i>et al.</i>       | (Mark I Collab.)        |
| NGUYEN      | 77  | PRL 39 262        | H.K. Nguyen <i>et al.</i>        | (LBL, SLAC) J           |

NODE=M061

REFID=56375  
REFID=57142  
REFID=50942  
REFID=44374  
REFID=43116  
REFID=43170  
REFID=40584  
REFID=40579  
REFID=40017  
REFID=22880  
REFID=22866  
REFID=22877  
REFID=11434  
REFID=11543

NODE=M062

$D^*(2010)^\pm$

$I(J^P) = \frac{1}{2}(1^-)$   
 $I, J, P$  need confirmation.

### $D^*(2010)^\pm$ MASS

The fit includes  $D^\pm, D^0, D_s^\pm, D^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M062M

NODE=M062M

| VALUE (MeV) | DOCUMENT ID | TECN | CHG | COMMENT |
|-------------|-------------|------|-----|---------|
|-------------|-------------|------|-----|---------|

#### 2010.26 ± 0.05 OUR FIT

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |                           |      |   |          |
|--------------|---------------------------|------|---|----------|
| 2008 ± 3     | <sup>1</sup> GOLDHABER 77 | MRK1 | ± | $e^+e^-$ |
| 2008.6 ± 1.0 | <sup>2</sup> PERUZZI 77   | LGW  | ± | $e^+e^-$ |

<sup>1</sup> From simultaneous fit to  $D^*(2010)^+, D^*(2007)^0, D^+,$  and  $D^0$ ; not independent of FELDMAN 77B mass difference below.

<sup>2</sup> PERUZZI 77 mass not independent of FELDMAN 77B mass difference below and PERUZZI 77  $D^0$  mass value.

NODE=M062M

NODE=M062M;LINKAGE=G

NODE=M062M;LINKAGE=P

### $m_{D^*(2010)^+} - m_{D^+}$

The fit includes  $D^\pm, D^0, D_s^\pm, D^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M062MD

NODE=M062MD

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

#### 140.603 ± 0.015 OUR FIT

#### 140.602 ± 0.014 OUR AVERAGE

|                            |      |               |      |                                   |
|----------------------------|------|---------------|------|-----------------------------------|
| 140.6010 ± 0.0068 ± 0.0129 | 151k | LEES          | 17F  | BABR $e^+e^- \rightarrow$ hadrons |
| 140.64 ± 0.08 ± 0.06       | 620  | BORTOLETTO92B | CLE2 | $e^+e^- \rightarrow$ hadrons      |

NODE=M062MD

### $m_{D^*(2010)^+} - m_{D^0}$

The fit includes  $D^\pm, D^0, D_s^\pm, D^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M062DM

NODE=M062DM

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

#### 145.4257 ± 0.0017 OUR FIT

#### 145.4258 ± 0.0020 OUR AVERAGE Error includes scale factor of 1.2.

|                            |        |                          |      |                                                                         |
|----------------------------|--------|--------------------------|------|-------------------------------------------------------------------------|
| 145.4259 ± 0.0004 ± 0.0017 | 312.8k | LEES                     | 13X  | BABR $D^{*\pm} \rightarrow D^0\pi^\pm \rightarrow (K\pi, K3\pi)\pi^\pm$ |
| 145.412 ± 0.002 ± 0.012    |        | ANASTASSOV 02            | CLE2 | $D^{*\pm} \rightarrow D^0\pi^\pm \rightarrow (K\pi)\pi^\pm$             |
| 145.54 ± 0.08              | 611    | <sup>3</sup> ADINOLFI 99 | BEAT | $D^{*\pm} \rightarrow D^0\pi^\pm$                                       |
| 145.45 ± 0.02              |        | <sup>3</sup> BREITWEG 99 | ZEUS | $D^{*\pm} \rightarrow D^0\pi^\pm \rightarrow (K\pi)\pi^\pm$             |

NODE=M062DM

OCCUR=3

|        |       |       |                        |     |      |                                                                   |         |
|--------|-------|-------|------------------------|-----|------|-------------------------------------------------------------------|---------|
| 145.42 | ±0.05 |       | <sup>3</sup> BREITWEG  | 99  | ZEUS | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K^- 3\pi) \pi^\pm$ | OCCUR=2 |
| 145.5  | ±0.15 | 103   | <sup>4</sup> ADLOFF    | 97B | H1   | $D^{*\pm} \rightarrow D^0 \pi^\pm$                                |         |
| 145.44 | ±0.08 | 152   | <sup>4</sup> BREITWEG  | 97  | ZEUS | $D^{*\pm} \rightarrow D^0 \pi^\pm$                                |         |
| 145.42 | ±0.11 | 199   | <sup>4</sup> BREITWEG  | 97  | ZEUS | $D^{*\pm} \rightarrow D^0 \pi^\pm, D^0 \rightarrow K^- 3\pi$      | OCCUR=2 |
| 145.4  | ±0.2  | 48    | <sup>4</sup> DERRICK   | 95  | ZEUS | $D^{*\pm} \rightarrow D^0 \pi^\pm, D^0 \rightarrow K^- \pi^+$     |         |
| 145.39 | ±0.06 | ±0.03 | BARLAG                 | 92B | ACCM | $\pi^- 230 \text{ GeV}$                                           |         |
| 145.5  | ±0.2  | 115   | <sup>4</sup> ALEXANDER | 91B | OPAL | $D^{*\pm} \rightarrow D^0 \pi^\pm$                                |         |
| 145.30 | ±0.06 |       | <sup>4</sup> DECAMP    | 91J | ALEP | $D^{*\pm} \rightarrow D^0 \pi^\pm$                                |         |
| 145.40 | ±0.05 | ±0.10 | ABACHI                 | 88B | HRS  | $D^{*\pm} \rightarrow D^0 \pi^\pm$                                |         |
| 145.46 | ±0.07 | ±0.03 | ALBRECHT               | 85F | ARG  | $D^{*\pm} \rightarrow D^0 \pi^+$                                  |         |
| 145.5  | ±0.3  | 28    | BAILEY                 | 83  | SPEC | $D^{*\pm} \rightarrow D^0 \pi^\pm$                                | OCCUR=2 |
| 145.5  | ±0.3  | 60    | FITCH                  | 81  | SPEC | $\pi^- A$                                                         |         |
| 145.3  | ±0.5  | 30    | FELDMAN                | 77B | MRK1 | $D^{*+} \rightarrow D^0 \pi^+$                                    |         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                        |        |                       |     |      |                                                                           |         |
|------------------------|--------|-----------------------|-----|------|---------------------------------------------------------------------------|---------|
| 145.4256±0.0006±0.0017 | 138.5k | LEES                  | 13X | BABR | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K^- \pi^+) \pi^\pm$        | OCCUR=2 |
| 145.4266±0.0005±0.0019 | 174.3k | LEES                  | 13X | BABR | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K^- 2\pi^+ \pi^-) \pi^\pm$ |         |
| 145.44 ±0.09           | 122    | <sup>4</sup> BREITWEG | 97B | ZEUS | $D^{*\pm} \rightarrow D^0 \pi^\pm, D^0 \rightarrow K^- \pi^+$             | OCCUR=3 |
| 145.8 ±1.5             | 16     | AHLEN                 | 83  | HRS  | $D^{*+} \rightarrow D^0 \pi^+$                                            |         |
| 145.1 ±1.8             | 12     | BAILEY                | 83  | SPEC | $D^{*\pm} \rightarrow D^0 \pi^\pm$                                        |         |
| 145.1 ±0.5             | 14     | BAILEY                | 83  | SPEC | $D^{*\pm} \rightarrow D^0 \pi^\pm$                                        |         |
| 145.5 ±0.5             | 14     | YELTON                | 82  | MRK2 | $29 e^+ e^- \rightarrow K^- \pi^+$                                        |         |
| ~ 145.5                |        | AVERY                 | 80  | SPEC | $\gamma A$                                                                |         |
| 145.2 ±0.6             | 2      | BLIETSCHAU            | 79  | BEBC | $\nu p$                                                                   |         |

<sup>3</sup> Statistical errors only.

<sup>4</sup> Systematic error not evaluated.

NODE=M062DM;LINKAGE=AV

NODE=M062DM;LINKAGE=A

### $m_{D^*(2010)^+} - m_{D^*(2007)^0}$

NODE=M062EM

VALUE (MeV) DOCUMENT ID TECN COMMENT

NODE=M062EM

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |                      |    |     |           |  |
|---------|----------------------|----|-----|-----------|--|
| 2.6±1.8 | <sup>5</sup> PERUZZI | 77 | LGW | $e^+ e^-$ |  |
|---------|----------------------|----|-----|-----------|--|

<sup>5</sup> Not independent of FELDMAN 77B mass difference above, PERUZZI 77  $D^0$  mass, and GOLDHABER 77  $D^*(2007)^0$  mass.

NODE=M062EM;LINKAGE=P

### $D^*(2010)^\pm$ WIDTH

NODE=M062W

VALUE (keV) CL% EVTS DOCUMENT ID TECN COMMENT

NODE=M062W

#### 83.4±1.8 OUR AVERAGE

|              |        |                         |     |      |                                                                        |         |
|--------------|--------|-------------------------|-----|------|------------------------------------------------------------------------|---------|
| 83.3±1.2±1.4 | 312.8k | <sup>6</sup> LEES       | 13X | BABR | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K \pi, K 3\pi) \pi^\pm$ | OCCUR=3 |
| 96 ±4 ±22    |        | <sup>6</sup> ANASTASSOV | 02  | CLE2 | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K \pi) \pi^\pm$         |         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |        |                   |        |      |                                                                           |                         |
|---------------|--------|-------------------|--------|------|---------------------------------------------------------------------------|-------------------------|
| 83.4±1.7± 1.5 | 138.5k | <sup>6</sup> LEES | 13X    | BABR | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K^- \pi^+) \pi^\pm$        |                         |
| 83.2±1.5± 2.6 | 174.3k | <sup>6</sup> LEES | 13X    | BABR | $D^{*\pm} \rightarrow D^0 \pi^\pm \rightarrow (K^- 2\pi^+ \pi^-) \pi^\pm$ | OCCUR=2                 |
| <131          | 90     | 110               | BARLAG | 92B  | ACCM                                                                      | $\pi^- 230 \text{ GeV}$ |

<sup>6</sup> Ignoring the electromagnetic contribution from  $D^{*\pm} \rightarrow D^\pm \gamma$ .

NODE=M062W;LINKAGE=LE

### $D^*(2010)^\pm$ DECAY MODES

NODE=M062225;NODE=M062

$D^*(2010)^-$  modes are charge conjugates of the modes below.

NODE=M062

| Mode                    | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------|--------------------------------|
| $\Gamma_1$ $D^0 \pi^+$  | (67.7±0.5) %                   |
| $\Gamma_2$ $D^+ \pi^0$  | (30.7±0.5) %                   |
| $\Gamma_3$ $D^+ \gamma$ | (1.6±0.4) %                    |

DESIG=1

DESIG=3

DESIG=2

## CONSTRAINED FIT INFORMATION

An overall fit to 3 branching ratios uses 6 measurements and one constraint to determine 3 parameters. The overall fit has a  $\chi^2 = 0.3$  for 4 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|       |       |       |
|-------|-------|-------|
| $x_2$ | -62   |       |
| $x_3$ | -43   | -44   |
|       | $x_1$ | $x_2$ |

### $D^*(2010)^+$ BRANCHING RATIOS

NODE=M062230

| $\Gamma(D^0 \pi^+) / \Gamma_{\text{total}}$                                   |       |             |      |         |                               | $\Gamma_1 / \Gamma$ |
|-------------------------------------------------------------------------------|-------|-------------|------|---------|-------------------------------|---------------------|
| VALUE                                                                         |       | DOCUMENT ID | TECN | COMMENT |                               |                     |
| <b>0.677 <math>\pm</math> 0.005 OUR FIT</b>                                   |       |             |      |         |                               |                     |
| <b>0.677 <math>\pm</math> 0.006 OUR AVERAGE</b>                               |       |             |      |         |                               |                     |
| 0.6759 $\pm$ 0.0029 $\pm$ 0.0064                                              | 7,8,9 | BARTELT     | 98   | CLE2    | $e^+ e^-$                     |                     |
| 0.688 $\pm$ 0.024 $\pm$ 0.013                                                 |       | ALBRECHT    | 95F  | ARG     | $e^+ e^- \rightarrow$ hadrons |                     |
| 0.681 $\pm$ 0.010 $\pm$ 0.013                                                 | 7     | BUTLER      | 92   | CLE2    | $e^+ e^- \rightarrow$ hadrons |                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |             |      |         |                               |                     |
| 0.57 $\pm$ 0.04 $\pm$ 0.04                                                    |       | ADLER       | 88D  | MRK3    | $e^+ e^-$                     |                     |
| 0.44 $\pm$ 0.10                                                               |       | COLES       | 82   | MRK2    | $e^+ e^-$                     |                     |
| 0.6 $\pm$ 0.15                                                                | 9     | GOLDHABER   | 77   | MRK1    | $e^+ e^-$                     |                     |

NODE=M062R1  
NODE=M062R1

| $\Gamma(D^+ \pi^0) / \Gamma_{\text{total}}$                                   |       |             |      |         |                               | $\Gamma_2 / \Gamma$ |
|-------------------------------------------------------------------------------|-------|-------------|------|---------|-------------------------------|---------------------|
| VALUE                                                                         | EVTS  | DOCUMENT ID | TECN | COMMENT |                               |                     |
| <b>0.307 <math>\pm</math> 0.005 OUR FIT</b>                                   |       |             |      |         |                               |                     |
| <b>0.3073 <math>\pm</math> 0.0013 <math>\pm</math> 0.0062</b>                 |       |             |      |         |                               |                     |
|                                                                               | 7,8,9 | BARTELT     | 98   | CLE2    | $e^+ e^-$                     |                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |             |      |         |                               |                     |
| 0.312 $\pm$ 0.011 $\pm$ 0.008                                                 | 1404  | ALBRECHT    | 95F  | ARG     | $e^+ e^- \rightarrow$ hadrons |                     |
| 0.308 $\pm$ 0.004 $\pm$ 0.008                                                 | 410   | 7 BUTLER    | 92   | CLE2    | $e^+ e^- \rightarrow$ hadrons |                     |
| 0.26 $\pm$ 0.02 $\pm$ 0.02                                                    |       | ADLER       | 88D  | MRK3    | $e^+ e^-$                     |                     |
| 0.34 $\pm$ 0.07                                                               |       | COLES       | 82   | MRK2    | $e^+ e^-$                     |                     |

NODE=M062R3  
NODE=M062R3

| $\Gamma(D^+\gamma)/\Gamma_{\text{total}}$                                     |     |      |             |      |         | $\Gamma_3/\Gamma$               |
|-------------------------------------------------------------------------------|-----|------|-------------|------|---------|---------------------------------|
| VALUE                                                                         | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |                                 |
| <b>0.016 ±0.004 OUR FIT</b>                                                   |     |      |             |      |         |                                 |
| <b>0.016 ±0.005 OUR AVERAGE</b>                                               |     |      |             |      |         |                                 |
| 0.0168±0.0042±0.0029                                                          |     |      | 7,8 BARTELT | 98   | CLE2    | $e^+e^-$                        |
| 0.011 ±0.014 ±0.016                                                           |     | 12   | 7 BUTLER    | 92   | CLE2    | $e^+e^- \rightarrow$<br>hadrons |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |             |      |         |                                 |
| <0.052                                                                        |     | 90   | ALBRECHT    | 95F  | ARG     | $e^+e^- \rightarrow$<br>hadrons |
| 0.17 ±0.05 ±0.05                                                              |     |      | ADLER       | 88D  | MRK3    | $e^+e^-$                        |
| 0.22 ±0.12                                                                    |     |      | 10 COLES    | 82   | MRK2    | $e^+e^-$                        |

NODE=M062R2  
NODE=M062R2

<sup>7</sup> The branching ratios are not independent, they have been constrained by the authors to sum to 100%.

<sup>8</sup> Systematic error includes theoretical error on the prediction of the ratio of hadronic modes.

<sup>9</sup> Assuming that isospin is conserved in the decay.

<sup>10</sup> Not independent of  $\Gamma(D^0 \pi^+) / \Gamma_{\text{total}}$  and  $\Gamma(D^+ \pi^0) / \Gamma_{\text{total}}$  measurement.

NODE=M062R;LINKAGE=A

NODE=M062R;LINKAGE=B

NODE=M062R;LINKAGE=G

NODE=M062R;LINKAGE=C



**$D^*(2010)^\pm$  REFERENCES**

|            |     |                         |                             |                           |
|------------|-----|-------------------------|-----------------------------|---------------------------|
| LEES       | 17F | PRL 119 202003          | J.P. Lees <i>et al.</i>     | (BABAR Collab.)           |
| LEES       | 13X | PRL 111 111801          | J.P. Lees <i>et al.</i>     | (BABAR Collab.)           |
| Also       |     | PR D88 052003           | J.P. Lees <i>et al.</i>     | (BABAR Collab.)           |
| Also       |     | PR D88 079902 (errata.) | J.P. Lees <i>et al.</i>     | (BABAR Collab.)           |
| ANASTASSOV | 02  | PR D65 032003           | A. Anastassov <i>et al.</i> | (CLEO Collab.)            |
| ADINOLFI   | 99  | NP B547 3               | M. Adinolfi <i>et al.</i>   | (Beatrice Collab.)        |
| BREITWEG   | 99  | EPJ C6 67               | J. Breitweg <i>et al.</i>   | (ZEUS Collab.)            |
| BARTELT    | 98  | PRL 80 3919             | J. Bartelt <i>et al.</i>    | (CLEO Collab.)            |
| ADLOFF     | 97B | ZPHY C72 593            | C. Adloff <i>et al.</i>     | (H1 Collab.)              |
| BREITWEG   | 97  | PL B401 192             | J. Breitweg <i>et al.</i>   | (ZEUS Collab.)            |
| BREITWEG   | 97B | PL B407 402             | J. Breitweg <i>et al.</i>   | (ZEUS Collab.)            |
| ALBRECHT   | 95F | ZPHY C66 63             | H. Albrecht <i>et al.</i>   | (ARGUS Collab.)           |
| DERRICK    | 95  | PL B349 225             | M. Derrick <i>et al.</i>    | (ZEUS Collab.)            |
| BARLAG     | 92B | PL B278 480             | S. Barlag <i>et al.</i>     | (ACCMOR Collab.)          |
| BORTOLETTO | 92B | PRL 69 2046             | D. Bortoletto <i>et al.</i> | (CLEO Collab.)            |
| BUTLER     | 92  | PRL 69 2041             | F. Butler <i>et al.</i>     | (CLEO Collab.)            |
| ALEXANDER  | 91B | PL B262 341             | G. Alexander <i>et al.</i>  | (OPAL Collab.)            |
| DECAMP     | 91J | PL B266 218             | D. Decamp <i>et al.</i>     | (ALEPH Collab.)           |
| ABACHI     | 88B | PL B212 533             | S. Abachi <i>et al.</i>     | (ANL, IND, MICH, PURD+)   |
| ADLER      | 88D | PL B208 152             | J. Adler <i>et al.</i>      | (Mark III Collab.)        |
| ALBRECHT   | 85F | PL 150B 235             | H. Albrecht <i>et al.</i>   | (ARGUS Collab.)           |
| AHLEN      | 83  | PRL 51 1147             | S.P. Ahlen <i>et al.</i>    | (ANL, IND, LBL+)          |
| BAILEY     | 83  | PL 132B 230             | R. Bailey <i>et al.</i>     | (AMST, BRIS, CERN, CRAC+) |
| COLES      | 82  | PR D26 2190             | M.W. Coles <i>et al.</i>    | (LBL, SLAC)               |
| YELTON     | 82  | PRL 49 430              | J.M. Yelton <i>et al.</i>   | (SLAC, LBL, UCB+)         |
| FITCH      | 81  | PRL 46 761              | V.L. Fitch <i>et al.</i>    | (PRIN, SACL, TORI+)       |
| AVERY      | 80  | PRL 44 1309             | P. Avery <i>et al.</i>      | (ILL, FNAL, COLU)         |
| BLIETSCHAU | 79  | PL 86B 108              | J. Blietschau <i>et al.</i> | (AACH3, BONN, CERN+)      |
| FELDMAN    | 77B | PRL 38 1313             | G.J. Feldman <i>et al.</i>  | (Mark I Collab.)          |
| GOLDHABER  | 77  | PL 69B 503              | G. Goldhaber <i>et al.</i>  | (Mark I Collab.)          |
| PERUZZI    | 77  | PRL 39 1301             | I. Peruzzi <i>et al.</i>    | (LGW Collab.)             |

NODE=M062

REFID=58277  
REFID=55564  
REFID=55547  
REFID=55695  
REFID=48550  
REFID=46925  
REFID=46604  
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REFID=11435

$$D_0^*(2300)^0$$

$$I(J^P) = \frac{1}{2}(0^+)$$

was  $D_0^*(2400)^0$   
 $J^P = 0^+$  assignment favored (ABE 04D).

NODE=M178

NODE=M178

 **$D_0^*(2300)^0$  MASS**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID       | TECN      | COMMENT                           |
|-------------------------------------------------------------------------------|------|-------------------|-----------|-----------------------------------|
| <b>2300±19 OUR AVERAGE</b>                                                    |      |                   |           |                                   |
| 2297± 8±20                                                                    | 3.4k | AUBERT            | 09AB BABR | $B^- \rightarrow D^+ \pi^- \pi^-$ |
| 2308±17±32                                                                    |      | ABE               | 04D BELL  | $B^- \rightarrow D^+ \pi^- \pi^-$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                   |           |                                   |
| 2407±21±35                                                                    | 9.8k | <sup>1</sup> LINK | 04A FOCS  | $\gamma A$                        |
| <sup>1</sup> Possibly the feed-down from another state.                       |      |                   |           |                                   |

NODE=M178M

NODE=M178M

NODE=M178M;LINKAGE=E

 **$D_0^*(2300)^0$  WIDTH**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID       | TECN      | COMMENT                           |
|-------------------------------------------------------------------------------|------|-------------------|-----------|-----------------------------------|
| <b>274±40 OUR AVERAGE</b>                                                     |      |                   |           |                                   |
| 273±12±48                                                                     | 3.4k | AUBERT            | 09AB BABR | $B^- \rightarrow D^+ \pi^- \pi^-$ |
| 276±21±63                                                                     |      | ABE               | 04D BELL  | $B^- \rightarrow D^+ \pi^- \pi^-$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                   |           |                                   |
| 240±55±59                                                                     | 9.8k | <sup>1</sup> LINK | 04A FOCS  | $\gamma A$                        |
| <sup>1</sup> Possibly the feed-down from another state.                       |      |                   |           |                                   |

NODE=M178W

NODE=M178W

NODE=M178W;LINKAGE=E

 **$D_0^*(2300)^0$  DECAY MODES**

| Mode                 | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------|--------------------------------|
| $\Gamma_1 D^+ \pi^-$ | seen                           |

NODE=M178215;NODE=M178

DESIG=1;OUR EVAL;→ UNCHECKED ←

 **$D_0^*(2300)^0$  REFERENCES**

|        |      |               |                         |                 |
|--------|------|---------------|-------------------------|-----------------|
| AUBERT | 09AB | PR D79 112004 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| ABE    | 04D  | PR D69 112002 | K. Abe <i>et al.</i>    | (BELLE Collab.) |
| LINK   | 04A  | PL B586 11    | J.M. Link <i>et al.</i> | (FOCUS Collab.) |

NODE=M178

REFID=52941  
REFID=50011  
REFID=49775

$D_0^*(2300)^\pm$ 

$$I(J^P) = \frac{1}{2}(0^+)$$

OMITTED FROM SUMMARY TABLE

was  $D_0^*(2400)^\pm$  $J, P$  need confirmation.

NODE=M179

NODE=M179

 $D_0^*(2300)^\pm$  MASS

NODE=M179M

NODE=M179M

| VALUE (MeV)                                                                                                                                                                     | EVTs  | DOCUMENT ID       | TECN      | COMMENT                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------|-----------|-----------------------------------------|
| <b>2349 ± 7 OUR AVERAGE</b>                                                                                                                                                     |       |                   |           |                                         |
| 2360 ± 15 ± 30                                                                                                                                                                  |       | <sup>1</sup> AAIJ | 15X LHCb  | $B^0 \rightarrow \bar{D}^0 K^+ \pi^-$   |
| 2349 ± 6 ± 4                                                                                                                                                                    |       | <sup>2</sup> AAIJ | 15Y LHCb  | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                   |       |                   |           |                                         |
| 2354 ± 7 ± 11                                                                                                                                                                   |       | <sup>3</sup> AAIJ | 15Y LHCb  | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| 2403 ± 14 ± 35                                                                                                                                                                  | 18.8k | <sup>4</sup> LINK | 04A FOCUS | $\gamma A$                              |
| <sup>1</sup> From the Dalitz plot analysis including various $K^*$ and $D^{**}$ mesons as well as broad structures in the $K\pi$ $S$ -wave and the $D\pi$ $S$ - and $P$ -waves. |       |                   |           |                                         |
| <sup>2</sup> Modeling the $\pi^+ \pi^-$ $S$ -wave with the Isobar formalism.                                                                                                    |       |                   |           |                                         |
| <sup>3</sup> Modeling the $\pi^+ \pi^-$ $S$ -wave with the K-matrix formalism.                                                                                                  |       |                   |           |                                         |
| <sup>4</sup> Possibly the feed-down from another state.                                                                                                                         |       |                   |           |                                         |

OCCUR=2

NODE=M179M;LINKAGE=A

NODE=M179M;LINKAGE=B

NODE=M179M;LINKAGE=C

NODE=M179M;LINKAGE=D

 $D_0^*(2300)^\pm$  WIDTH

NODE=M179W

NODE=M179W

| VALUE (MeV)                                                                                                                                                                     | EVTs  | DOCUMENT ID       | TECN      | COMMENT                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------|-----------|-----------------------------------------|
| <b>221 ± 18 OUR AVERAGE</b>                                                                                                                                                     |       |                   |           |                                         |
| 255 ± 26 ± 51                                                                                                                                                                   |       | <sup>1</sup> AAIJ | 15X LHCb  | $B^0 \rightarrow \bar{D}^0 K^+ \pi^-$   |
| 217 ± 13 ± 13                                                                                                                                                                   |       | <sup>2</sup> AAIJ | 15Y LHCb  | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                   |       |                   |           |                                         |
| 230 ± 15 ± 21                                                                                                                                                                   |       | <sup>3</sup> AAIJ | 15Y LHCb  | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| 283 ± 24 ± 34                                                                                                                                                                   | 18.8k | <sup>4</sup> LINK | 04A FOCUS | $\gamma A$                              |
| <sup>1</sup> From the Dalitz plot analysis including various $K^*$ and $D^{**}$ mesons as well as broad structures in the $K\pi$ $S$ -wave and the $D\pi$ $S$ - and $P$ -waves. |       |                   |           |                                         |
| <sup>2</sup> Modeling the $\pi^+ \pi^-$ $S$ -wave with the Isobar formalism.                                                                                                    |       |                   |           |                                         |
| <sup>3</sup> Modeling the $\pi^+ \pi^-$ $S$ -wave with the K-matrix formalism.                                                                                                  |       |                   |           |                                         |
| <sup>4</sup> Possibly the feed-down from another state.                                                                                                                         |       |                   |           |                                         |

OCCUR=2

NODE=M179W;LINKAGE=A

NODE=M179W;LINKAGE=B

NODE=M179W;LINKAGE=C

NODE=M179W;LINKAGE=D

 $D_0^*(2300)^\pm$  DECAY MODES

NODE=M179215;NODE=M179

| Mode                       | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------|--------------------------------|
| $\Gamma_1 \quad D^0 \pi^+$ | seen                           |

DESIG=1;OUR EVAL;→ UNCHECKED ←

 $D_0^*(2300)^\pm$  REFERENCES

NODE=M179

|      |     |               |                         |                 |
|------|-----|---------------|-------------------------|-----------------|
| AAIJ | 15X | PR D92 012012 | R. Aaij <i>et al.</i>   | (LHCb Collab.)  |
| AAIJ | 15Y | PR D92 032002 | R. Aaij <i>et al.</i>   | (LHCb Collab.)  |
| LINK | 04A | PL B586 11    | J.M. Link <i>et al.</i> | (FOCUS Collab.) |

REFID=56588

REFID=56609

REFID=49775

**$D_0^*(2300)$** 

$$I(J^P) = \frac{1}{2}(0^+)$$

was  $D_0^*(2400)$   
 $J^P = 0^+$  assignment favored (ABE 04D).

NODE=M252

NODE=M252

NODE=M252M

NODE=M252M

 **$D_0^*(2300)$  MASS**

| VALUE (MeV)                                                                   | EVTs  | DOCUMENT ID                                           | TECN      | CHG | COMMENT                                 |
|-------------------------------------------------------------------------------|-------|-------------------------------------------------------|-----------|-----|-----------------------------------------|
| <b>2343±10 OUR AVERAGE</b>                                                    | Error | includes scale factor of 1.5. See the ideogram below. |           |     |                                         |
| 2360±15±30                                                                    |       | <sup>1</sup> AAIJ                                     | 15X LHCB  | +   | $B^0 \rightarrow \bar{D}^0 K^+ \pi^-$   |
| 2349±6±4                                                                      |       | <sup>2</sup> AAIJ                                     | 15Y LHCB  | +   | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| 2297±8±20                                                                     | 3.4k  | AUBERT                                                | 09AB BABR | 0   | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| 2308±17±32                                                                    |       | ABE                                                   | 04D BELL  | 0   | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                                                       |           |     |                                         |
| 2354±7±11                                                                     |       | <sup>3</sup> AAIJ                                     | 15Y LHCB  | +   | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| 2403±14±35                                                                    | 18.8k | <sup>4</sup> LINK                                     | 04A FOCS  | +   | $\gamma A$                              |
| 2407±21±35                                                                    | 9.8k  | <sup>4</sup> LINK                                     | 04A FOCS  | 0   | $\gamma A$                              |

OCCUR=2

OCCUR=2

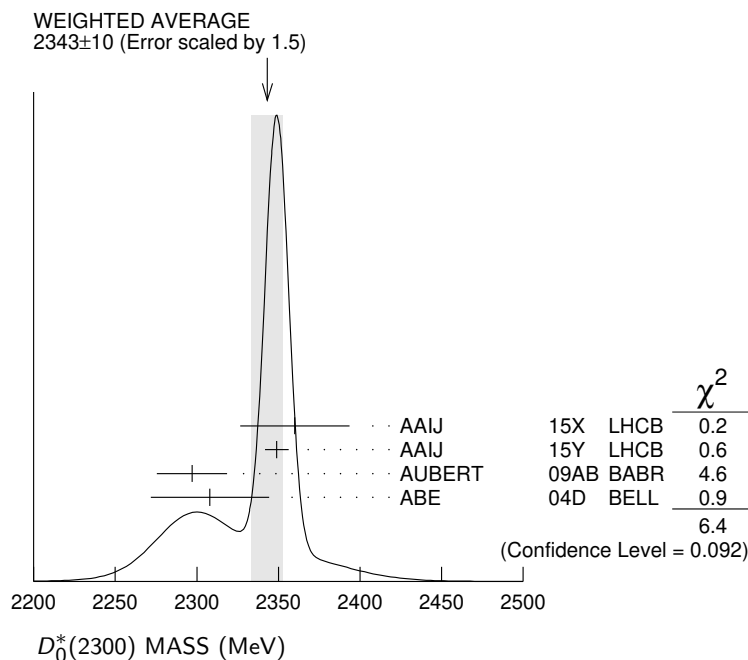
NODE=M252M;LINKAGE=A

NODE=M252M;LINKAGE=B

NODE=M252M;LINKAGE=C

NODE=M252M;LINKAGE=D

- <sup>1</sup> From the Dalitz plot analysis including various  $K^*$  and  $D^{**}$  mesons as well as broad structures in the  $K\pi$  S-wave and the  $D\pi$  S- and P-waves.  
<sup>2</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the Isobar formalism.  
<sup>3</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the K-matrix formalism.  
<sup>4</sup> Possibly the feed-down from another state.

 **$D_0^*(2300)$  WIDTH**

NODE=M252W

NODE=M252W

| VALUE (MeV)                                                                   | EVTs  | DOCUMENT ID       | TECN      | CHG | COMMENT                                 |
|-------------------------------------------------------------------------------|-------|-------------------|-----------|-----|-----------------------------------------|
| <b>229±16 OUR AVERAGE</b>                                                     |       |                   |           |     |                                         |
| 255±26±51                                                                     |       | <sup>1</sup> AAIJ | 15X LHCB  | +   | $B^0 \rightarrow \bar{D}^0 K^+ \pi^-$   |
| 217±13±13                                                                     |       | <sup>2</sup> AAIJ | 15Y LHCB  | +   | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| 273±12±48                                                                     | 3.4k  | AUBERT            | 09AB BABR | 0   | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| 276±21±63                                                                     |       | ABE               | 04D BELL  | 0   | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                   |           |     |                                         |
| 230±15±21                                                                     |       | <sup>3</sup> AAIJ | 15Y LHCB  | +   | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| 283±24±34                                                                     | 18.8k | <sup>4</sup> LINK | 04A FOCS  | +   | $\gamma A$                              |
| 240±55±59                                                                     | 9.8k  | <sup>4</sup> LINK | 04A FOCS  | 0   | $\gamma A$                              |

OCCUR=2

OCCUR=2

NODE=M252W;LINKAGE=A

NODE=M252W;LINKAGE=B

NODE=M252W;LINKAGE=C

NODE=M252W;LINKAGE=D

- <sup>1</sup> From the Dalitz plot analysis including various  $K^*$  and  $D^{**}$  mesons as well as broad structures in the  $K\pi$  S-wave and the  $D\pi$  S- and P-waves.  
<sup>2</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the Isobar formalism.  
<sup>3</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the K-matrix formalism.  
<sup>4</sup> Possibly the feed-down from another state.

**$D_0^*(2300)$  DECAY MODES**

NODE=M252215;NODE=M252

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1 \quad D\pi^\pm$ | seen                           |

DESIG=1

| $\Gamma(D\pi^\pm)/\Gamma_{\text{total}}$ |       |             |           |     | $\Gamma_1/\Gamma$                   |
|------------------------------------------|-------|-------------|-----------|-----|-------------------------------------|
| VALUE                                    | EVTS  | DOCUMENT ID | TECN      | CHG | COMMENT                             |
| seen                                     |       | AAIJ        | 15X LHCb  | +   | $D^*(2300)^+ \rightarrow D^0 \pi^+$ |
| seen                                     |       | AAIJ        | 15Y LHCb  | +   | $D^*(2300)^+ \rightarrow D^0 \pi^+$ |
| seen                                     | 3.4k  | AUBERT      | 09AB BABR | 0   | $D^*(2300)^0 \rightarrow D^+ \pi^-$ |
| <b>seen</b>                              |       | ABE         | 04D BELL  | 0   | $D^*(2300)^0 \rightarrow D^+ \pi^-$ |
| <b>seen</b>                              | 18.8k | LINK        | 04A FOCS  | +   | $D^*(2300)^+ \rightarrow D^0 \pi^+$ |

NODE=M252R01  
NODE=M252R01 **$D_0^*(2300)$  REFERENCES**

|        |      |               |                         |                 |
|--------|------|---------------|-------------------------|-----------------|
| AAIJ   | 15X  | PR D92 012012 | R. Aaij <i>et al.</i>   | (LHCb Collab.)  |
| AAIJ   | 15Y  | PR D92 032002 | R. Aaij <i>et al.</i>   | (LHCb Collab.)  |
| AUBERT | 09AB | PR D79 112004 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
| ABE    | 04D  | PR D69 112002 | K. Abe <i>et al.</i>    | (BELLE Collab.) |
| LINK   | 04A  | PL B586 11    | J.M. Link <i>et al.</i> | (FOCUS Collab.) |

NODE=M252

REFID=56588  
REFID=56609  
REFID=52941  
REFID=50011  
REFID=49775

$$D_1(2420)^0$$

$$I(J^P) = \frac{1}{2}(1^+)$$

NODE=M097

 **$D_1(2420)^0$  MASS**

NODE=M097M

The fit includes  $D^\pm$ ,  $D^0$ ,  $D_s^\pm$ ,  $D^{*\pm}$ ,  $D^{*0}$ ,  $D_s^{*\pm}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M097M

| VALUE (MeV)                                    | EVTS                                                        | DOCUMENT ID                                                | TECN | COMMENT |
|------------------------------------------------|-------------------------------------------------------------|------------------------------------------------------------|------|---------|
| <b><math>2421.8 \pm 0.6</math> OUR FIT</b>     | Error includes scale factor of 1.8.                         | [2420.8 $\pm$ 0.5 MeV OUR 2020 FIT Scale factor = 1.3]     |      |         |
| <b><math>2421.8 \pm 0.8</math> OUR AVERAGE</b> | Error includes scale factor of 2.2. See the ideogram below. | [2420.5 $\pm$ 0.6 MeV OUR 2020 AVERAGE Scale factor = 1.3] |      |         |

NODE=M097M

NEW

NEW

|                                                                               |                |                           |           |                                             |
|-------------------------------------------------------------------------------|----------------|---------------------------|-----------|---------------------------------------------|
| $2424.8 \pm 0.1 \pm 0.7$                                                      | 79k            | <sup>1</sup> AAII         | 20D LHCb  | $B^- \rightarrow D^{*+} \pi^- \pi^-$        |
| $2419.6 \pm 0.1 \pm 0.7$                                                      | 210k           | AAIJ                      | 13CC LHCb | $pp \rightarrow D^{*+} \pi^- X$             |
| $2423.1 \pm 1.5^{+0.4}_{-1.0}$                                                | 2.7k           | <sup>2</sup> ABRAMOWICZ13 | ZEUS      | $e^\pm p \rightarrow D^{(*)+} \pi^- X$      |
| $2420.1 \pm 0.1 \pm 0.8$                                                      | 103k           | DEL-AMO-SA..10P           | BABR      | $e^+ e^- \rightarrow D^{*+} \pi^- X$        |
| $2426 \pm 3 \pm 1$                                                            | 151            | ABE                       | 05A BELL  | $B^- \rightarrow D^0 \pi^+ \pi^- \pi^-$     |
| $2421.4 \pm 1.5 \pm 0.9$                                                      |                | <sup>3</sup> ABE          | 04D BELL  | $B^- \rightarrow D^{*+} \pi^- \pi^-$        |
| $2421 \pm \frac{1}{2} \pm 2$                                                  | 286            | AVERY                     | 94C CLE2  | $e^+ e^- \rightarrow D^{*+} \pi^- X$        |
| $2422 \pm 2 \pm 2$                                                            | 51             | FRABETTI                  | 94B E687  | $\gamma Be \rightarrow D^{*+} \pi^- X$      |
| $2428 \pm 3 \pm 2$                                                            | 279            | AVERY                     | 90 CLEO   | $e^+ e^- \rightarrow D^{*+} \pi^- X$        |
| $2414 \pm 2 \pm 5$                                                            | 171            | ALBRECHT                  | 89H ARG   | $e^+ e^- \rightarrow D^{*+} \pi^- X$        |
| $2428 \pm 8 \pm 5$                                                            | 171            | ANJOS                     | 89C TPS   | $\gamma N \rightarrow D^{*+} \pi^- X$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                |                           |           |                                             |
| $2420.5 \pm 2.1 \pm 0.9$                                                      | $3110 \pm 340$ | <sup>4</sup> CHEKANOV     | 09 ZEUS   | $e^\pm p \rightarrow D^{*+} \pi^- X$        |
| $2421.7 \pm 0.7 \pm 0.6$                                                      | 7.5k           | ABULENCIA                 | 06A CDF   | $1900 p \bar{p} \rightarrow D^{*+} \pi^- X$ |
| $2425 \pm 3$                                                                  | 235            | <sup>5</sup> ABREU        | 98M DLPH  | $e^+ e^-$                                   |

<sup>1</sup> From a full four-body amplitude analysis of the  $B^- \rightarrow D^{*+} \pi^- \pi^-$  decay.<sup>2</sup> From the combined fit of the  $M(D^+ \pi^-)$  and  $M(D^{*+} \pi^-)$  distributions. and  $A_{D_2}$  fixed to the theoretical prediction of  $-1$ .<sup>3</sup> Fit includes the contribution from  $D_1^*(2430)^0$ .<sup>4</sup> Calculated using the mass difference  $m(D_1^0) - m(D^{*+})_{PDG}$  reported below and  $m(D^{*+})_{PDG} = 2010.27 \pm 0.17$  MeV. The 0.17 MeV uncertainty of the PDG mass value should be added to the experimental uncertainty of 0.9 MeV.<sup>5</sup> No systematic error given.

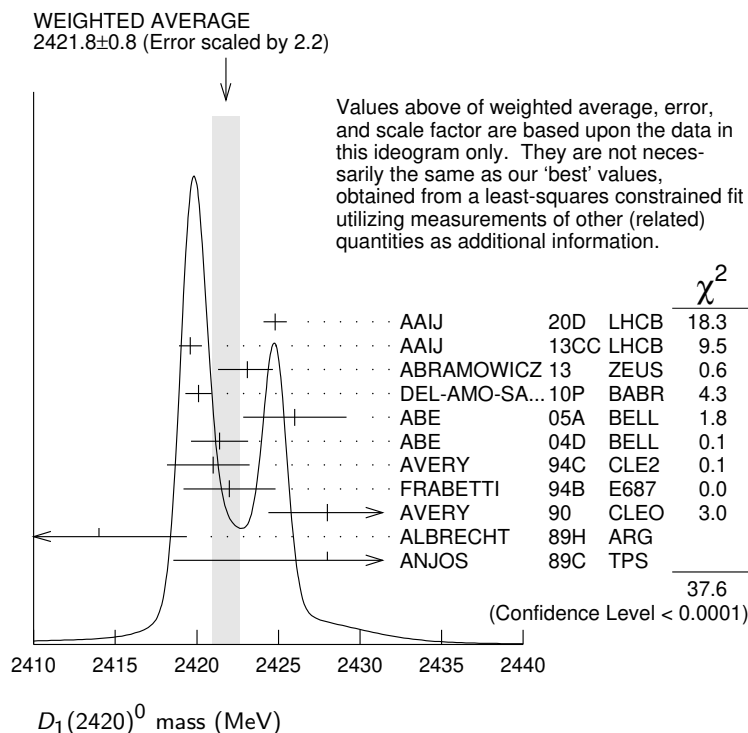
NODE=M097M;LINKAGE=B

NODE=M097M;LINKAGE=AR

NODE=M097M;LINKAGE=AB

NODE=M097M;LINKAGE=CH

NODE=M097M;LINKAGE=K



$$m_{D_1^0} - m_{D^{*+}}$$

NODE=M097DM

The fit includes  $D^\pm$ ,  $D^0$ ,  $D_s^\pm$ ,  $D^{*\pm}$ ,  $D^{*0}$ ,  $D_s^{*+}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M097DM

| VALUE (MeV)                  | EVTS                                                                                  | DOCUMENT ID | TECN    | COMMENT                                    |
|------------------------------|---------------------------------------------------------------------------------------|-------------|---------|--------------------------------------------|
| <b>411.5±0.6 OUR FIT</b>     | Error includes scale factor of 1.7. [410.6 ± 0.5 MeV OUR 2020 FIT Scale factor = 1.3] |             |         |                                            |
| <b>411.5±0.8 OUR AVERAGE</b> |                                                                                       |             |         |                                            |
| 410.2±2.1±0.9                | 3110 ± 340                                                                            | CHEKANOV    | 09 ZEUS | $e^\pm p \rightarrow D^{*+} \pi^- X$       |
| 411.7±0.7±0.4                | 7.5k                                                                                  | ABULENCIA   | 06A CDF | 1900 $p\bar{p} \rightarrow D^{*+} \pi^- X$ |

NODE=M097DM

NEW

### $D_1(2420)^0$ WIDTH

NODE=M097W

| VALUE (MeV)                                                                   | EVTS                                                                                                             | DOCUMENT ID               | TECN      | COMMENT                                    |
|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------|-----------|--------------------------------------------|
| <b>31.8± 2.2 OUR AVERAGE</b>                                                  | Error includes scale factor of 3.1. See the ideogram below. [31.7 ± 2.5 MeV OUR 2020 AVERAGE Scale factor = 3.5] |                           |           |                                            |
| 33.6± 0.3± 2.7                                                                | 79k                                                                                                              | <sup>1</sup> AAIJ         | 20D LHCB  | $B^- \rightarrow D^{*+} \pi^- \pi^-$       |
| 35.2± 0.4± 0.9                                                                | 210k                                                                                                             | AAIJ                      | 13CC LHCB | $pp \rightarrow D^{*+} \pi^- X$            |
| 38.8± 5.0 <sup>+1.9</sup> <sub>-5.4</sub>                                     | 2.7k                                                                                                             | <sup>2</sup> ABRAMOWICZ13 | ZEUS      | $e^\pm p \rightarrow D^{(*)+} \pi^- X$     |
| 31.4± 0.5± 1.3                                                                | 103k                                                                                                             | DEL-AMO-SA...10P          | BABR      | $e^+ e^- \rightarrow D^{*+} \pi^- X$       |
| 20.0± 1.7± 1.3                                                                | 7.5k                                                                                                             | ABULENCIA                 | 06A CDF   | 1900 $p\bar{p} \rightarrow D^{*+} \pi^- X$ |
| 24 ± 7 ± 8                                                                    | 151                                                                                                              | ABE                       | 05A BELL  | $B^- \rightarrow D^0 \pi^+ \pi^- \pi^-$    |
| 23.7± 2.7± 4.0                                                                |                                                                                                                  | <sup>3</sup> ABE          | 04D BELL  | $B^- \rightarrow D^{*+} \pi^- \pi^-$       |
| 20 <sup>+6</sup> <sub>-5</sub> ± 3                                            | 286                                                                                                              | AVERY                     | 94C CLE2  | $e^+ e^- \rightarrow D^{*+} \pi^- X$       |
| 15 ± 8 ± 4                                                                    | 51                                                                                                               | FRABETTI                  | 94B E687  | $\gamma Be \rightarrow D^{*+} \pi^- X$     |
| 23 <sup>+8</sup> <sub>-6</sub> <sup>+10</sup> <sub>-3</sub>                   | 279                                                                                                              | AVERY                     | 90 CLEO   | $e^+ e^- \rightarrow D^{*+} \pi^- X$       |
| 13 ± 6 <sup>+10</sup> <sub>-5</sub>                                           | 171                                                                                                              | ALBRECHT                  | 89H ARG   | $e^+ e^- \rightarrow D^{*+} \pi^- X$       |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                                                                                                                  |                           |           |                                            |
| 53.2± 7.2 <sup>+3.3</sup> <sub>-4.9</sub>                                     | 3110 ± 340                                                                                                       | CHEKANOV                  | 09 ZEUS   | $e^\pm p \rightarrow D^{*+} \pi^- X$       |
| 58 ± 14 ± 10                                                                  | 171                                                                                                              | ANJOS                     | 89C TPS   | $\gamma N \rightarrow D^{*+} \pi^- X$      |

NODE=M097W

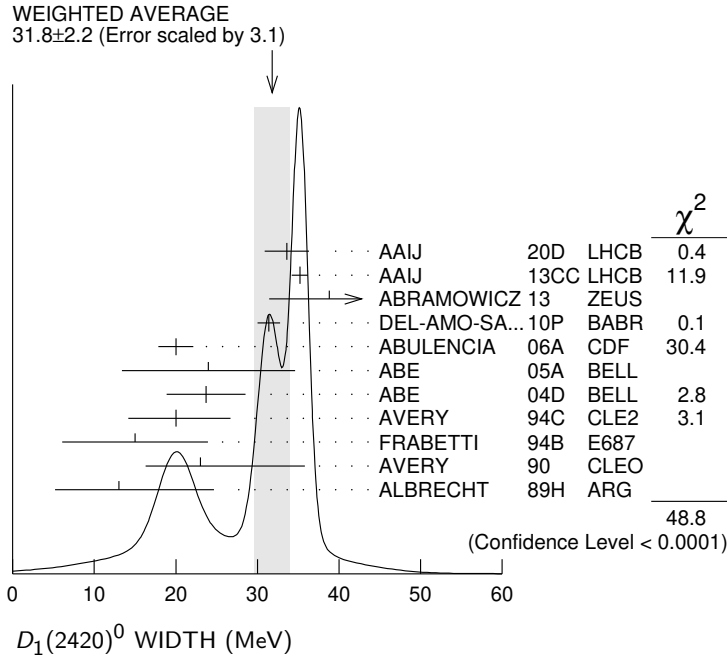
NEW

- <sup>1</sup> From a full four-body amplitude analysis of the  $B^- \rightarrow D^{*+} \pi^- \pi^-$  decay.  
<sup>2</sup> From the combined fit of the  $M(D^+ \pi^-)$  and  $M(D^{*+} \pi^-)$  distributions. and  $A_{D_2}$  fixed to the theoretical prediction of  $-1$ .  
<sup>3</sup> Fit includes the contribution from  $D_1^*(2430)^0$ .

NODE=M097W;LINKAGE=B

NODE=M097W;LINKAGE=AR

NODE=M097W;LINKAGE=AB



### $D_1(2420)^0$ DECAY MODES

NODE=M097215;NODE=M097

$\bar{D}_1(2420)^0$  modes are charge conjugates of modes below.

NODE=M097

| Mode                              | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------------|--------------------------------|
| $\Gamma_1$ $D^{*+}(2010) \pi^-$   | seen                           |
| $\Gamma_2$ $D^0 \pi^+ \pi^-$      | seen                           |
| $\Gamma_3$ $D^0 \rho^0$           |                                |
| $\Gamma_4$ $D^0 f_0(500)$         |                                |
| $\Gamma_5$ $D_0^{*+}(2300) \pi^-$ |                                |
| $\Gamma_6$ $D^+ \pi^-$            | not seen                       |
| $\Gamma_7$ $D^{*0} \pi^+ \pi^-$   | not seen                       |

DESIG=1

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4

DESIG=5

DESIG=6

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=7;OUR EST;→ UNCHECKED ←

### $D_1(2420)^0$ BRANCHING RATIOS

NODE=M097220

| $\Gamma(D^{*+}(2010) \pi^-)/\Gamma_{\text{total}}$ |             | $\Gamma_1/\Gamma$ |                                           |
|----------------------------------------------------|-------------|-------------------|-------------------------------------------|
| VALUE                                              | DOCUMENT ID | TECN              | COMMENT                                   |
| seen                                               | ACKERSTAFF  | 97W               | OPAL $e^+ e^- \rightarrow D^{*+} \pi^- X$ |
| seen                                               | AVERY       | 90                | CLEO $e^+ e^- \rightarrow D^{*+} \pi^- X$ |
| seen                                               | ALBRECHT    | 89H               | ARG $e^+ e^- \rightarrow D^{*+} \pi^- X$  |
| seen                                               | ANJOS       | 89C               | TPS $\gamma N \rightarrow D^{*+} \pi^- X$ |

| $\Gamma(D^+ \pi^-)/\Gamma(D^{*+}(2010) \pi^-)$ |     | $\Gamma_6/\Gamma_1$ |                                   |
|------------------------------------------------|-----|---------------------|-----------------------------------|
| VALUE                                          | CL% | DOCUMENT ID         | TECN                              |
| <0.24                                          | 90  | AVERY               | 90                                |
|                                                |     | CLEO                | $e^+ e^- \rightarrow D^+ \pi^- X$ |

NODE=M097R1

NODE=M097R1

NODE=M097R2

NODE=M097R2

### $D_1(2420)^0$ POLARIZATION AMPLITUDE $A_{D_1}$

NODE=M097PAH

A polarization amplitude  $A_{D_1}$  is a parameter that depends on the initial polarization of the  $D_1$  and is sensitive to a possible S-wave contribution to its decay. For  $D_1$  decays the helicity angle,  $\theta_h$ , distribution varies like  $1 + A_{D_1} \cos^2 \theta_h$ , where  $\theta_h$  is the angle in the  $D^*$  rest frame between the two pions emitted by the  $D_1 \rightarrow D^* \pi$  and the  $D^* \rightarrow D \pi$ .

NODE=M097PAH

Unpolarized  $D_1$  decaying purely via  $D$ -wave is predicted to give  $A_{D_1} = 3$ .

| VALUE                                                                         | EVTs | DOCUMENT ID               | TECN      | COMMENT                                 |
|-------------------------------------------------------------------------------|------|---------------------------|-----------|-----------------------------------------|
| <b>5.73±0.25 OUR AVERAGE</b>                                                  |      |                           |           |                                         |
| 7.8 $^{+6.7}_{-2.7}$ $^{+4.6}_{-1.8}$                                         | 2.7k | <sup>1</sup> ABRAMOWICZ13 | ZEUS      | $e^\pm p \rightarrow D^{(*)+} \pi^- X$  |
| 5.72±0.25                                                                     | 103k | DEL-AMO-SA..10P           | BABR      | $e^+ e^- \rightarrow D^{*+} \pi^- X$    |
| 5.9 $^{+3.0}_{-1.7}$ $^{+2.4}_{-1.0}$                                         |      | CHEKANOV 09               | ZEUS      | $e^\pm p \rightarrow D^{*+} \pi^- X$    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                           |           |                                         |
| 3.30±0.48                                                                     | 210k | <sup>2</sup> AAIJ         | 13CC LHCb | $pp \rightarrow D^{*+} \pi^- X$         |
| 3.8 $\pm 0.6$ $\pm 0.8$                                                       |      | <sup>3</sup> AUBERT       | 09Y BABR  | $B^+ \rightarrow D_1^0 \ell^+ \nu_\ell$ |
| 2.74 $^{+1.40}_{-0.93}$                                                       |      | <sup>4</sup> AVERY        | 94C CLE2  | $e^+ e^- \rightarrow D^{*+} \pi^- X$    |

<sup>1</sup> From the combined fit of the  $M(D^+ \pi^-)$  and  $M(D^{*+} \pi^-)$  distributions. and  $A_{D_2}$  fixed to the theoretical prediction of  $-1$ . A pure  $D$ -wave not excluded although some  $\bar{S}$ -wave mixing possible.

<sup>2</sup> Systematic uncertainty not estimated. Resonance parameters fixed.

<sup>3</sup> Assuming  $\Gamma(\Upsilon(4S) \rightarrow B^+ B^-) / \Gamma(\Upsilon(4S) \rightarrow B^0 \bar{B}^0) = 1.065 \pm 0.026$  and equal partial widths and helicity angle distributions for charged and neutral  $D_1$  mesons.

<sup>4</sup> Systematic uncertainties not estimated.

NODE=M097PAH

NODE=M097PAH;LINKAGE=AR

NODE=M097PAH;LINKAGE=A  
NODE=M097PAH;LINKAGE=AU

NODE=M097PAH;LINKAGE=AV

## $D_1(2420)^0$ REFERENCES

|                   |      |                |                                  |                     |
|-------------------|------|----------------|----------------------------------|---------------------|
| AAIJ              | 20D  | PR D101 032005 | R. Aaij <i>et al.</i>            | (LHCb Collab.)      |
| AAIJ              | 13CC | JHEP 1309 145  | R. Aaij <i>et al.</i>            | (LHCb Collab.)      |
| ABRAMOWICZ 13     | NP   | B866 229       | H. Abramowicz <i>et al.</i>      | (ZEUS Collab.)      |
| DEL-AMO-SA... 10P | PR   | D82 111101     | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)     |
| AUBERT            | 09Y  | PRL 103 051803 | B. Aubert <i>et al.</i>          | (BABAR Collab.)     |
| CHEKANOV          | 09   | EPJ C60 25     | S. Chekanov <i>et al.</i>        | (ZEUS Collab.)      |
| ABULENCIA         | 06A  | PR D73 051104  | A. Abulencia <i>et al.</i>       | (CDF Collab.)       |
| ABE               | 05A  | PRL 94 221805  | K. Abe <i>et al.</i>             | (BELLE Collab.)     |
| ABE               | 04D  | PR D69 112002  | K. Abe <i>et al.</i>             | (BELLE Collab.)     |
| ABREU             | 98M  | PL B426 231    | P. Abreu <i>et al.</i>           | (DELPHI Collab.)    |
| ACKERSTAFF        | 97W  | ZPHY C76 425   | K. Akerstaff <i>et al.</i>       | (OPAL Collab.)      |
| AVERY             | 94C  | PL B331 236    | P. Avery <i>et al.</i>           | (CLEO Collab.)      |
| FRABETTI          | 94B  | PRL 72 324     | P.L. Frabetti <i>et al.</i>      | (FNAL E687 Collab.) |
| AVERY             | 90   | PR D41 774     | P. Avery, D. Besson              | (CLEO Collab.)      |
| ALBRECHT          | 89H  | PL B232 398    | H. Albrecht <i>et al.</i>        | (ARGUS Collab.) JP  |
| ANJOS             | 89C  | PRL 62 1717    | J.C. Anjos <i>et al.</i>         | (FNAL E691 Collab.) |

NODE=M097

REFID=60253  
REFID=55581  
REFID=54743  
REFID=53534  
REFID=52929  
REFID=52733  
REFID=51054  
REFID=50755  
REFID=50011  
REFID=46315  
REFID=45788  
REFID=44096  
REFID=43687  
REFID=41013  
REFID=41001  
REFID=40737

$D_1(2420)^\pm$

$I(J^P) = \frac{1}{2}(?)$   
 $I$  needs confirmation.

OMITTED FROM SUMMARY TABLE

Seen in  $D^*(2007)^0 \pi^+$ .  $J^P = 0^+$  ruled out.

NODE=M120

NODE=M120

## $D_1(2420)^\pm$ MASS

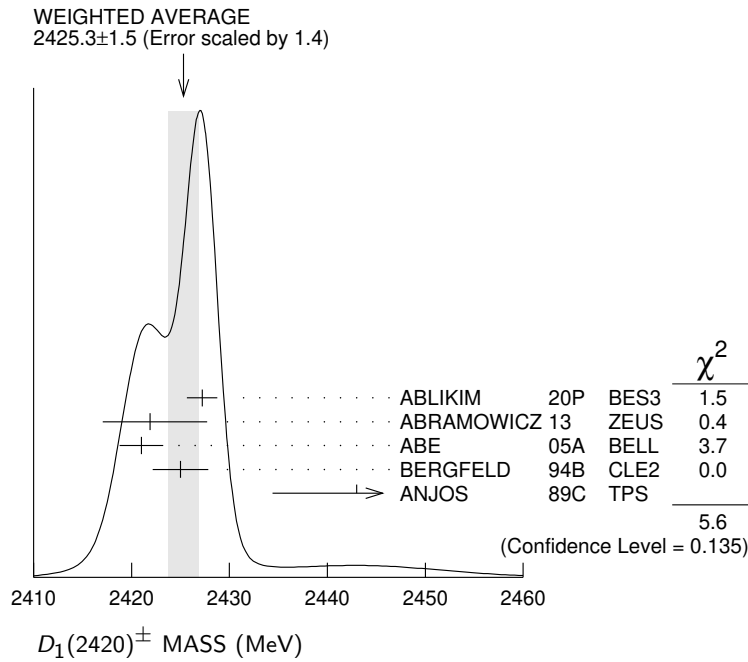
| VALUE (MeV)                                                                                                                                         | EVTs | DOCUMENT ID               | TECN | COMMENT                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------------|------|-----------------------------------------------|
| <b>2425.3±1.5 OUR AVERAGE</b> Error includes scale factor of 1.4. See the ideogram below.<br>[2423.2 ± 2.4 MeV OUR 2020 AVERAGE Scale factor = 1.5] |      |                           |      |                                               |
| 2427.2±1.0±1.2                                                                                                                                      | 4207 | ABLIKIM 20P               | BES3 | $e^+ e^- \rightarrow D^+ D^- \pi^+ \pi^-$     |
| 2421.9±4.7 $^{+3.4}_{-1.2}$                                                                                                                         | 759  | <sup>1</sup> ABRAMOWICZ13 | ZEUS | $e^\pm p \rightarrow D^{(*)0} \pi^+ X$        |
| 2421 $\pm 2$ $\pm 1$                                                                                                                                | 124  | ABE 05A                   | BELL | $\bar{B}^0 \rightarrow D^+ \pi^+ \pi^- \pi^-$ |
| 2425 $\pm 2$ $\pm 2$                                                                                                                                | 146  | BERGFELD 94B              | CLE2 | $e^+ e^- \rightarrow D^{*0} \pi^+ X$          |
| 2443 $\pm 7$ $\pm 5$                                                                                                                                | 190  | ANJOS 89C                 | TPS  | $\gamma N \rightarrow D^0 \pi^+ X^0$          |

<sup>1</sup> From the fit of the  $M(D^0 \pi^+)$  distribution. The widths of the  $D_1^+$  and  $D_2^{*+}$  are fixed to 25 MeV and 37 MeV, and  $A_{D_1}$  and  $A_{D_2}$  are fixed to the theoretical predictions of 3 and  $-1$ , respectively.

NODE=M120M

NODE=M120M  
NEW

NODE=M120M;LINKAGE=AB



$$m_{D_1^*(2420)^\pm} - m_{D_1^*(2420)^0}$$

NODE=M120DM

| VALUE (MeV)         | DOCUMENT ID | TECN     | COMMENT                             |
|---------------------|-------------|----------|-------------------------------------|
| $4^{+2}_{-3} \pm 3$ | BERGFELD    | 94B CLE2 | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M120DM

### $D_1(2420)^\pm$ WIDTH

NODE=M120W

| VALUE (MeV)                   | EVTS | DOCUMENT ID | TECN     | COMMENT                                    |
|-------------------------------|------|-------------|----------|--------------------------------------------|
| <b>23.7± 2.9 OUR AVERAGE</b>  |      |             |          |                                            |
| [25 ± 6 MeV OUR 2020 AVERAGE] |      |             |          |                                            |
| 23.2± 2.3±2.3                 | 4207 | ABLIKIM     | 20P BES3 | $e^+e^- \rightarrow D^+D^-\pi^+\pi^-$      |
| 21 ± 5 ±8                     | 124  | ABE         | 05A BELL | $\bar{B}^0 \rightarrow D^+\pi^+\pi^-\pi^-$ |
| 26 $^{+8}_{-7}$ ±4            | 146  | BERGFELD    | 94B CLE2 | $e^+e^- \rightarrow D^{*0}\pi^+\chi$       |
| 41 ±19 ±8                     | 190  | ANJOS       | 89C TPS  | $\gamma N \rightarrow D^0\pi^+\chi^0$      |

NODE=M120W

NEW

### $D_1(2420)^\pm$ DECAY MODES

NODE=M120215;NODE=M120

$D_1^*(2420)^-$  modes are charge conjugates of modes below.

NODE=M120

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1$ $D^*(2007)^0\pi^+$   | seen                           |
| $\Gamma_2$ $D^+\pi^+\pi^-$      | seen                           |
| $\Gamma_3$ $D^+\rho^0$          |                                |
| $\Gamma_4$ $D^+f_0(500)$        |                                |
| $\Gamma_5$ $D_0^*(2300)^0\pi^+$ |                                |
| $\Gamma_6$ $D^0\pi^+$           | not seen                       |
| $\Gamma_7$ $D^{*+}\pi^+\pi^-$   | not seen                       |

DESIG=1

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4

DESIG=5

DESIG=6

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=7;OUR EST;→ UNCHECKED ←

### $D_1(2420)^\pm$ BRANCHING RATIOS

NODE=M120220

| $\Gamma(D^*(2007)^0\pi^+)/\Gamma_{\text{total}}$ | DOCUMENT ID | TECN    | COMMENT                               | $\Gamma_1/\Gamma$ |
|--------------------------------------------------|-------------|---------|---------------------------------------|-------------------|
| seen                                             | ANJOS       | 89C TPS | $\gamma N \rightarrow D^0\pi^+\chi^0$ |                   |

NODE=M120R1

NODE=M120R1



$\Gamma(D^0\pi^+)/\Gamma(D^*(2007)^0\pi^+)$  $\Gamma_6/\Gamma_1$ 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------|-----|-------------|----------|-------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                                     |
| <0.18                                                                         | 90  | BERGFELD    | 94B CLE2 | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M120R2  
 NODE=M120R2

 $D_1(2420)^\pm$  POLARIZATION AMPLITUDE  $A_{D_1}$ 

NODE=M120PAH

A polarization amplitude  $A_{D_1}$  is a parameter that depends on the initial polarization of the  $D_1$  and is sensitive to a possible  $S$ -wave contribution to its decay. For  $D_1$  decays the helicity angle,  $\theta_h$ , distribution varies like  $1 + A_{D_1} \cos^2 \theta_h$ , where  $\theta_h$  is the angle in the  $D^*$  rest frame between the two pions emitted by the  $D_1 \rightarrow D^*\pi$  and the  $D^* \rightarrow D\pi$ .

NODE=M120PAH

Unpolarized  $D_1$  decaying purely via  $D$ -wave is predicted to give  $A_{D_1} = 3$ .

| VALUE                                                                                                                                                                                                                               | DOCUMENT ID         | TECN     | COMMENT                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|----------|-----------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                       |                     |          |                                         |
| $3.8 \pm 0.6 \pm 0.8$                                                                                                                                                                                                               | <sup>2</sup> AUBERT | 09Y BABR | $B^0 \rightarrow D_1^- \ell^+ \nu_\ell$ |
| <sup>2</sup> Assuming $\Gamma(\Upsilon(4S) \rightarrow B^+ B^-) / \Gamma(\Upsilon(4S) \rightarrow B^0 \bar{B}^0) = 1.065 \pm 0.026$ and equal partial widths and helicity angle distributions for charged and neutral $D_1$ mesons. |                     |          |                                         |

NODE=M120PAH

NODE=M120PAH;LINKAGE=AU

 $D_1(2420)^\pm$  REFERENCES

NODE=M120

|            |     |                |                             |                     |
|------------|-----|----------------|-----------------------------|---------------------|
| ABLIKIM    | 20P | PL B804 135395 | M. Ablikim <i>et al.</i>    | (BESIII Collab.)    |
| ABRAMOWICZ | 13  | NP B866 229    | H. Abramowicz <i>et al.</i> | (ZEUS Collab.)      |
| AUBERT     | 09Y | PRL 103 051803 | B. Aubert <i>et al.</i>     | (BABAR Collab.)     |
| ABE        | 05A | PRL 94 221805  | K. Abe <i>et al.</i>        | (BELLE Collab.)     |
| BERGFELD   | 94B | PL B340 194    | T. Bergfeld <i>et al.</i>   | (CLEO Collab.)      |
| ANJOS      | 89C | PRL 62 1717    | J.C. Anjos <i>et al.</i>    | (FNAL E691 Collab.) |

REFID=60395  
 REFID=54743  
 REFID=52929  
 REFID=50755  
 REFID=44099  
 REFID=40737

NODE=M180

 $D_1(2430)^0$ 

$$I(J^P) = \frac{1}{2}(1^+)$$

$J^P = 1^+$  determined by AAIJ 20D.

NODE=M180

 $D_1(2430)^0$  MASS

NODE=M180M

| VALUE (MeV)                                                                                              | EVTS | DOCUMENT ID         | TECN     | COMMENT                                     |
|----------------------------------------------------------------------------------------------------------|------|---------------------|----------|---------------------------------------------|
| <b>2412 ± 9 OUR AVERAGE</b><br>[2427 ± 40 MeV OUR 2020 AVERAGE]                                          |      |                     |          |                                             |
| $2411 \pm 3 \pm 9$                                                                                       | 79k  | <sup>1</sup> AAIJ   | 20D LHCb | $B^- \rightarrow D^{*+} \pi^- \pi^-$        |
| $2427 \pm 26 \pm 25$                                                                                     |      | ABE                 | 04D BELL | $B^- \rightarrow D^{*+} \pi^- \pi^-$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                            |      |                     |          |                                             |
| $2477 \pm 28$                                                                                            |      | <sup>2</sup> AUBERT | 06L BABR | $\bar{B}^0 \rightarrow D^{*+} \omega \pi^-$ |
| <sup>1</sup> From a full four-body amplitude analysis of the $B^- \rightarrow D^{*+} \pi^- \pi^-$ decay. |      |                     |          |                                             |
| <sup>2</sup> Systematic errors not estimated.                                                            |      |                     |          |                                             |

NODE=M180M  
 NEW

NODE=M180M;LINKAGE=A  
 NODE=M180M;LINKAGE=AU

 $D_1(2430)^0$  WIDTH

NODE=M180W

| VALUE (MeV)                                                                                              | EVTS | DOCUMENT ID         | TECN     | COMMENT                                     |
|----------------------------------------------------------------------------------------------------------|------|---------------------|----------|---------------------------------------------|
| <b>314 ± 29 OUR AVERAGE</b><br>[384 $^{+130}_{-110}$ MeV OUR 2020 AVERAGE]                               |      |                     |          |                                             |
| $309 \pm 9 \pm 28$                                                                                       | 79k  | <sup>1</sup> AAIJ   | 20D LHCb | $B^- \rightarrow D^{*+} \pi^- \pi^-$        |
| $384 \pm 107 \pm 74$                                                                                     |      | ABE                 | 04D BELL | $B^- \rightarrow D^{*+} \pi^- \pi^-$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                            |      |                     |          |                                             |
| $266 \pm 97$                                                                                             |      | <sup>2</sup> AUBERT | 06L BABR | $\bar{B}^0 \rightarrow D^{*+} \omega \pi^-$ |
| <sup>1</sup> From a full four-body amplitude analysis of the $B^- \rightarrow D^{*+} \pi^- \pi^-$ decay. |      |                     |          |                                             |
| <sup>2</sup> Systematic errors not estimated.                                                            |      |                     |          |                                             |

NODE=M180W  
 NEW

NODE=M180W;LINKAGE=A  
 NODE=M180W;LINKAGE=AU

 $D_1(2430)^0$  DECAY MODES

NODE=M180215;NODE=M180

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------|--------------------------------|
| $\Gamma_1$ $D^*(2010)^+ \pi^-$ | seen                           |

DESIG=1;OUR EVAL;→ UNCHECKED ←

**$D_1(2430)^0$  REFERENCES**

|        |     |                |                         |                   |
|--------|-----|----------------|-------------------------|-------------------|
| AAIJ   | 20D | PR D101 032005 | R. Aaij <i>et al.</i>   | (LHCb Collab.) JP |
| AUBERT | 06L | PR D74 012001  | B. Aubert <i>et al.</i> | (BABAR Collab.)   |
| ABE    | 04D | PR D69 112002  | K. Abe <i>et al.</i>    | (BELLE Collab.)   |

NODE=M180

REFID=60253  
REFID=51140  
REFID=50011

NODE=M119

 **$D_2^*(2460)^0$** 

$$I(J^P) = \frac{1}{2}(2^+)$$

$J^P = 2^+$  assignment strongly favored (ALBRECHT 89B, ALBRECHT 89H), natural parity confirmed by the helicity analysis (DEL-AMO-SANCHEZ 10P). AAIJ 13CC confirms  $J^P = 2^+$  and natural parity.

NODE=M119

 **$D_2^*(2460)^0$  MASS**

The fit includes  $D^\pm$ ,  $D^0$ ,  $D_s^\pm$ ,  $D^{*0}$ ,  $D_s^{*0}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M119M

NODE=M119M

| VALUE (MeV)                                      | EVTS | DOCUMENT ID | TECN | COMMENT                                                                                                                  |
|--------------------------------------------------|------|-------------|------|--------------------------------------------------------------------------------------------------------------------------|
| <b>2460.7 <math>\pm</math> 0.4 OUR FIT</b>       |      |             |      | Error includes scale factor of 2.9. [2460.7 $\pm$ 0.4 MeV OUR 2020 FIT Scale factor = 3.1]                               |
| <b>2460.58 <math>\pm</math> 0.34 OUR AVERAGE</b> |      |             |      | Error includes scale factor of 2.5. See the ideogram below. [2460.56 $\pm$ 0.35 MeV OUR 2020 AVERAGE Scale factor = 2.6] |

NODE=M119M

NEW

NEW

|                                   |      |                           |           |                                        |
|-----------------------------------|------|---------------------------|-----------|----------------------------------------|
| 2463.7 $\pm$ 0.4 $\pm$ 0.7        | 28k  | <sup>1</sup> AAIJ         | 16AH LHCb | $B^- \rightarrow D^+ \pi^- \pi^-$      |
| 2464.0 $\pm$ 1.4 $\pm$ 0.5        | 2k   | <sup>2</sup> AAIJ         | 15V LHCb  | $B^- \rightarrow D^+ K^- \pi^-$        |
| 2460.4 $\pm$ 0.4 $\pm$ 1.2        | 82k  | AAIJ                      | 13CC LHCb | $pp \rightarrow D^{*+} \pi^- X$        |
| 2460.4 $\pm$ 0.1 $\pm$ 0.1        | 675k | AAIJ                      | 13CC LHCb | $pp \rightarrow D^+ \pi^- X$           |
| 2462.5 $\pm$ 2.4 $^{+1.3}_{-1.1}$ | 2.3k | <sup>3</sup> ABRAMOWICZ13 | ZEUS      | $e^\pm p \rightarrow D^{(*)+} \pi^- X$ |
| 2462.2 $\pm$ 0.1 $\pm$ 0.8        | 243k | DEL-AMO-SA...10P          | BABR      | $e^+ e^- \rightarrow D^+ \pi^- X$      |
| 2460.4 $\pm$ 1.2 $\pm$ 2.2        | 3.4k | AUBERT                    | 09AB BABR | $B^- \rightarrow D^+ \pi^- \pi^-$      |
| 2461.6 $\pm$ 2.1 $\pm$ 3.3        |      | <sup>4</sup> ABE          | 04D BELL  | $B^- \rightarrow D^+ \pi^- \pi^-$      |
| 2464.5 $\pm$ 1.1 $\pm$ 1.9        | 5.8k | <sup>4</sup> LINK         | 04A FOCS  | $\gamma A$                             |
| 2465 $\pm$ 3 $\pm$ 3              | 486  | AVERY                     | 94C CLE2  | $e^+ e^- \rightarrow D^+ \pi^- X$      |
| 2453 $\pm$ 3 $\pm$ 2              | 128  | FRABETTI                  | 94B E687  | $\gamma Be \rightarrow D^+ \pi^- X$    |
| 2461 $\pm$ 3 $\pm$ 1              | 440  | AVERY                     | 90 CLEO   | $e^+ e^- \rightarrow D^{*+} \pi^- X$   |
| 2455 $\pm$ 3 $\pm$ 5              | 337  | ALBRECHT                  | 89B ARG   | $e^+ e^- \rightarrow D^+ \pi^- X$      |
| 2459 $\pm$ 3 $\pm$ 2              | 153  | ANJOS                     | 89C TPS   | $\gamma N \rightarrow D^+ \pi^- X$     |

OCCUR=2

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                   |      |                       |          |                                           |
|-----------------------------------|------|-----------------------|----------|-------------------------------------------|
| 2469.1 $\pm$ 3.7 $^{+1.2}_{-1.3}$ | 1.5k | <sup>5</sup> CHEKANOV | 09 ZEUS  | $e^\pm p \rightarrow D^{(*)+} \pi^- X$    |
| 2463.3 $\pm$ 0.6 $\pm$ 0.8        | 20k  | ABULENCIA             | 06A CDF  | $1900 p\bar{p} \rightarrow D^+ \pi^- X$   |
| 2461 $\pm$ 6                      | 126  | <sup>6</sup> ABREU    | 98M DLPH | $e^+ e^-$                                 |
| 2466 $\pm$ 7                      | 1    | ASRATYAN              | 95 BEBC  | $53,40 \nu(\bar{\nu}) \rightarrow pX, dX$ |

NODE=M119M;LINKAGE=B

NODE=M119M;LINKAGE=A

NODE=M119M;LINKAGE=AR

NODE=M119M;LINKAGE=LI

NODE=M119M;LINKAGE=CH

NODE=M119M;LINKAGE=K

<sup>1</sup> From the amplitude analysis in the model describing the  $D^+ \pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, and components corresponding to the  $D_2^*(2460)^0$ ,  $D_1^*(2680)^0$ ,  $D_3^*(2760)^0$ , and  $D_2^*(3000)^0$  resonances.

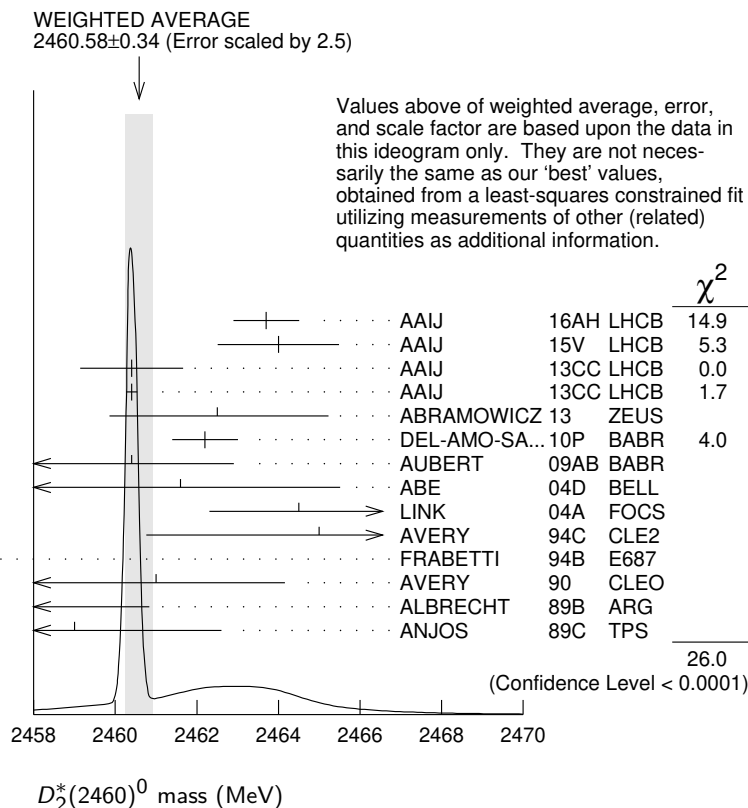
<sup>2</sup> From the amplitude analysis in the model describing the  $D^+ \pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, nonresonant spin-0 and spin-1 components as well as the  $D_0^*(2400)^0$ ,  $D_2^*(2460)^0$  and  $D_1^*(2760)^0$  resonances.

<sup>3</sup> From the combined fit of the  $M(D^+ \pi^-)$  and  $M(D^{*+} \pi^-)$  distributions. and  $A_{D_2}$  fixed to the theoretical prediction of  $-1$ .

<sup>4</sup> Fit includes the contribution from  $D_0^*(2400)^0$ .

<sup>5</sup> Calculated using the mass difference  $m(D_2^{*0}) - m(D^{*+})_{PDG}$  reported below and  $m(D^{*+})_{PDG} = 2010.27 \pm 0.17$  MeV. The 0.17 MeV uncertainty of the PDG mass value should be added to the experimental uncertainty of  $^{+1.2}_{-1.3}$  MeV.

<sup>6</sup> No systematic error given.



### $m_{D_2^{*0}} - m_{D^+}$

The fit includes  $D^\pm$ ,  $D^0$ ,  $D_s^\pm$ ,  $D^{*\pm}$ ,  $D^{*0}$ ,  $D_s^{*\pm}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M119DM

NODE=M119DM

| VALUE (MeV)              | EVTS                                | DOCUMENT ID                                       | TECN    | COMMENT                                 |
|--------------------------|-------------------------------------|---------------------------------------------------|---------|-----------------------------------------|
| <b>591.0±0.4 OUR FIT</b> | Error includes scale factor of 2.8. | [591.0 ± 0.4 MeV OUR 2020 FIT Scale factor = 2.9] |         |                                         |
| <b>593.9±0.6±0.5</b>     | 20k                                 | ABULENCIA                                         | 06A CDF | 1900 $p\bar{p} \rightarrow D^+ \pi^- X$ |

NODE=M119DM

NEW

### $m_{D_2^{*0}} - m_{D^{*+}}$

The fit includes  $D^\pm$ ,  $D^0$ ,  $D_s^\pm$ ,  $D^{*\pm}$ ,  $D^{*0}$ ,  $D_s^{*\pm}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M119DM2

NODE=M119DM2

| VALUE (MeV)                                    | EVTS                                | DOCUMENT ID                                       | TECN    | COMMENT                                |
|------------------------------------------------|-------------------------------------|---------------------------------------------------|---------|----------------------------------------|
| <b>450.4±0.4 OUR FIT</b>                       | Error includes scale factor of 2.8. | [450.4 ± 0.4 MeV OUR 2020 FIT Scale factor = 2.9] |         |                                        |
| <b>458.8±3.7<sup>+1.2</sup><sub>-1.3</sub></b> | 1560 ± 230                          | CHEKANOV                                          | 09 ZEUS | $e^\pm p \rightarrow D^{(*)+} \pi^- X$ |

NODE=M119DM2

NEW

### $D_2^*(2460)^0$ WIDTH

NODE=M119W

| VALUE (MeV)                               | EVTS                                                        | DOCUMENT ID                                          | TECN      | COMMENT                                 |
|-------------------------------------------|-------------------------------------------------------------|------------------------------------------------------|-----------|-----------------------------------------|
| <b>47.4± 1.0 OUR AVERAGE</b>              | Error includes scale factor of 1.7. See the ideogram below. | [47.5 ± 1.1 MeV OUR 2020 AVERAGE Scale factor = 1.8] |           |                                         |
| 47.0± 0.8± 1.0                            | 28k                                                         | <sup>7</sup> AAIJ                                    | 16AH LHCb | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| 43.8± 2.9± 1.8                            | 2k                                                          | <sup>8</sup> AAIJ                                    | 15V LHCb  | $B^- \rightarrow D^+ K^- \pi^-$         |
| 43.2± 1.2± 3.0                            | 82k                                                         | AAIJ                                                 | 13CC LHCb | $p\bar{p} \rightarrow D^{*+} \pi^- X$   |
| 45.6± 0.4± 1.1                            | 675k                                                        | AAIJ                                                 | 13CC LHCb | $p\bar{p} \rightarrow D^+ \pi^- X$      |
| 46.6± 8.1 <sup>+5.9</sup> <sub>-3.8</sub> | 2.3k                                                        | <sup>9</sup> ABRAMOWICZ13                            | ZEUS      | $e^\pm p \rightarrow D^{(*)+} \pi^- X$  |
| 50.5± 0.6± 0.7                            | 243k                                                        | DEL-AMO-SA..10P                                      | BABR      | $e^+ e^- \rightarrow D^+ \pi^- X$       |
| 41.8± 2.5± 2.9                            | 3.4k                                                        | AUBERT                                               | 09AB BABR | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| 49.2± 2.3± 1.3                            | 20k                                                         | ABULENCIA                                            | 06A CDF   | 1900 $p\bar{p} \rightarrow D^+ \pi^- X$ |

NODE=M119W

NEW

OCCUR=3

OCCUR=2

|                                         |      |          |          |                                      |
|-----------------------------------------|------|----------|----------|--------------------------------------|
| 45.6 ± 4.4 ± 6.7                        |      | 10 ABE   | 04D BELL | $B^- \rightarrow D^+ \pi^- \pi^-$    |
| 38.7 ± 5.3 ± 2.9                        | 5.8k | 10 LINK  | 04A FOCS | $\gamma A$                           |
| 28 $\pm \frac{8}{7} \pm 6$              | 486  | AVERY    | 94C CLE2 | $e^+ e^- \rightarrow D^+ \pi^- X$    |
| 25 ± 10 ± 5                             | 128  | FRABETTI | 94B E687 | $\gamma Be \rightarrow D^+ \pi^- X$  |
| 20 $\pm \frac{9}{12} \pm \frac{9}{10}$  | 440  | AVERY    | 90 CLEO  | $e^+ e^- \rightarrow D^{*+} \pi^- X$ |
| 15 $\pm \frac{13}{10} \pm \frac{5}{10}$ | 337  | ALBRECHT | 89B ARG  | $e^+ e^- \rightarrow D^+ \pi^- X$    |
| 20 ± 10 ± 5                             | 153  | ANJOS    | 89C TPS  | $\gamma N \rightarrow D^+ \pi^- X$   |

<sup>7</sup> From the amplitude analysis in the model describing the  $D^+ \pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, and components corresponding to the  $D_2^*(2460)^0$ ,  $D_1^*(2680)^0$ ,  $D_3^*(2760)^0$ , and  $D_2^*(3000)^0$  resonances.

<sup>8</sup> From the amplitude analysis in the model describing the  $D^+ \pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, nonresonant spin-0 and spin-1 components as well as the  $D_0^*(2400)^0$ ,  $D_2^*(2460)^0$  and  $D_1^*(2760)^0$  resonances.

<sup>9</sup> From the combined fit of the  $M(D^+ \pi^-)$  and  $M(D^{*+} \pi^-)$  distributions. and  $A_{D_2}$  fixed to the theoretical prediction of -1.

<sup>10</sup> Fit includes the contribution from  $D_0^*(2400)^0$ .

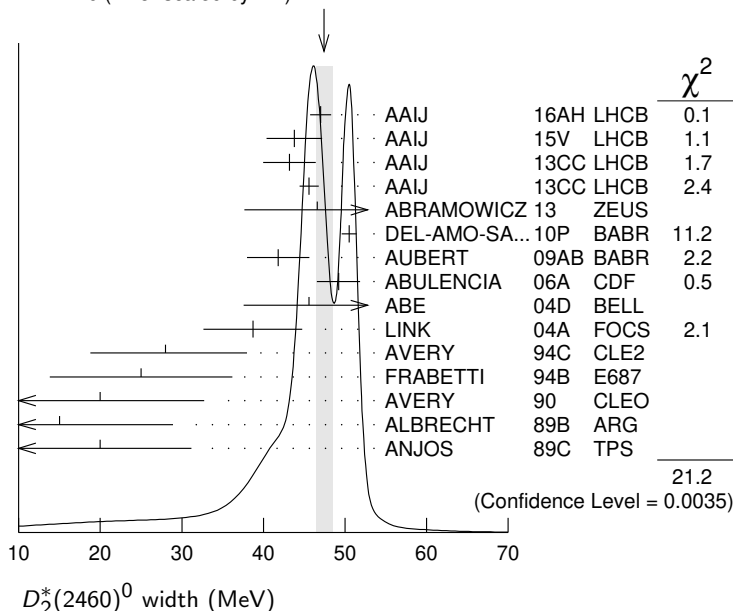
NODE=M119W;LINKAGE=D

NODE=M119W;LINKAGE=A

NODE=M119W;LINKAGE=AR

NODE=M119W;LINKAGE=LI

WEIGHTED AVERAGE  
47.4 ± 1.0 (Error scaled by 1.7)



## $D_2^*(2460)^0$ DECAY MODES

$\bar{D}_2^*(2460)^0$  modes are charge conjugates of modes below.

NODE=M119215;NODE=M119

NODE=M119

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1$ $D^+ \pi^-$          | seen                           |
| $\Gamma_2$ $D^*(2010)^+ \pi^-$  | seen                           |
| $\Gamma_3$ $D^0 \pi^+ \pi^-$    | not seen                       |
| $\Gamma_4$ $D^{*0} \pi^+ \pi^-$ | not seen                       |

CLUMP=A;DESIG=1

DESIG=2

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=4;OUR EST;→ UNCHECKED ←

## $D_2^*(2460)^0$ BRANCHING RATIOS

NODE=M119220

| $\Gamma(D^+ \pi^-)/\Gamma_{\text{total}}$ | VALUE | EVTS | DOCUMENT ID | TECN | COMMENT | $\Gamma_1/\Gamma$                  |
|-------------------------------------------|-------|------|-------------|------|---------|------------------------------------|
| seen                                      |       | 3.4k | AUBERT      | 09AB | BABR    | $B^- \rightarrow D^+ \pi^- \pi^-$  |
| seen                                      |       | 337  | ALBRECHT    | 89B  | ARG     | $e^+ e^- \rightarrow D^+ \pi^- X$  |
| seen                                      |       |      | ANJOS       | 89C  | TPS     | $\gamma N \rightarrow D^+ \pi^- X$ |

NODE=M119R1

NODE=M119R1

$\Gamma(D^*(2010)^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE | DOCUMENT ID    | TECN | COMMENT                            |
|-------|----------------|------|------------------------------------|
| seen  | ACKERSTAFF 97W | OPAL | $e^+e^- \rightarrow D^{*+}\pi^- X$ |
| seen  | AVERY 90       | CLEO | $e^+e^- \rightarrow D^{*+}\pi^- X$ |
| seen  | ALBRECHT 89H   | ARG  | $e^+e^- \rightarrow D^*\pi^- X$    |

NODE=M119R2  
 NODE=M119R2

 $\Gamma(D^+\pi^-)/\Gamma(D^*(2010)^+\pi^-)$  $\Gamma_1/\Gamma_2$ 

| VALUE                        | EVTS       | DOCUMENT ID      | TECN | COMMENT                               |
|------------------------------|------------|------------------|------|---------------------------------------|
| <b>1.54±0.15 OUR AVERAGE</b> |            |                  |      |                                       |
| 1.4 ±0.3 ±0.3                | 2.3k       | 11 ABRAMOWICZ13  | ZEUS | $e^\pm p \rightarrow D^{(*)+}\pi^- X$ |
| 1.47±0.03±0.16               | 379k       | DEL-AMO-SA...10P | BABR | $e^+e^- \rightarrow D^{(*)+}\pi^- X$  |
| 2.8 ±0.8 $^{+0.5}_{-0.6}$    | 1560 ± 230 | CHEKANOV 09      | ZEUS | $e^\pm p \rightarrow D^{(*)+}\pi^- X$ |
| 2.2 ±0.7 ±0.6                |            | AVERY 94C        | CLE2 | $e^+e^- \rightarrow D^{*+}\pi^- X$    |
| 2.3 ±0.8                     |            | AVERY 90         | CLEO | $e^+e^-$                              |
| 3.0 ±1.1 ±1.5                |            | ALBRECHT 89H     | ARG  | $e^+e^- \rightarrow D^*\pi^- X$       |

NODE=M119R3  
 NODE=M119R3

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                                                                                                               |  |         |      |                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------|--|---------|------|--------------------------------------|
| 1.9 ±0.5                                                                                                                                      |  | ABE 04D | BELL | $B^- \rightarrow D^{(*)+}\pi^-\pi^-$ |
| 11 From the combined fit of the $M(D^+\pi^-)$ and $M(D^{*+}\pi^-)$ distributions. and $A_{D_2}$ fixed to the theoretical prediction of $-1$ . |  |         |      |                                      |

NODE=M119R3;LINKAGE=AR

 $\Gamma(D^+\pi^-)/[\Gamma(D^+\pi^-) + \Gamma(D^*(2010)^+\pi^-)]$  $\Gamma_1/(\Gamma_1+\Gamma_2)$ 

| VALUE                                                                         | EVTS | DOCUMENT ID   | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|------|---------------|------|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |               |      |                                          |
| 0.62±0.03±0.02                                                                | 8414 | 12 AUBERT 09Y | BABR | $B^+ \rightarrow D_2^{*0}\ell^+\nu_\ell$ |

NODE=M119R01  
 NODE=M119R01

12 Assuming  $\Gamma(\Upsilon(4S) \rightarrow B^+B^-) / \Gamma(\Upsilon(4S) \rightarrow B^0\bar{B}^0) = 1.065 \pm 0.026$  and equal partial widths for charged and neutral  $D_2^*$  mesons.

NODE=M119R01;LINKAGE=AU

 $D_2^*(2460)^0$  POLARIZATION AMPLITUDE  $A_{D_2}$ 

NODE=M119PAM

A polarization amplitude  $A_{D_2}$  is a parameter that depends on the initial polarization of the  $D_2$ . For  $D_2$  decays the helicity angle,  $\theta_H$ , distribution varies like  $1 + A_{D_2} \cos^2(\theta_H)$ , where  $\theta_H$  is the angle in the  $D^*$  rest frame between the two pions emitted by the  $D_2 \rightarrow D^*\pi$  and  $D^* \rightarrow D\pi$ .

NODE=M119PAM

| VALUE                                                                         | EVTS | DOCUMENT ID      | TECN | COMMENT                               |
|-------------------------------------------------------------------------------|------|------------------|------|---------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                  |      |                                       |
| -1.16±0.35                                                                    | 2.3k | 13 ABRAMOWICZ13  | ZEUS | $e^\pm p \rightarrow D^{(*)+}\pi^- X$ |
| consistent with $-1$                                                          | 243k | DEL-AMO-SA...10P | BABR | $e^+e^- \rightarrow D^+\pi^- X$       |
| -0.74 $^{+0.49}_{-0.38}$                                                      |      | 14 AVERY 94C     | CLE2 | $e^+e^- \rightarrow D^{*+}\pi^- X$    |

NODE=M119PAM

13 From the combined fit of the  $M(D^+\pi^-)$  and  $M(D^{*+}\pi^-)$  distributions.  
 14 Systematic uncertainties not estimated.

NODE=M119PAM;LINKAGE=AB  
 NODE=M119PAM;LINKAGE=AV

 $D_2^*(2460)^0$  REFERENCES

NODE=M119

|                  |                         |                                  |                     |
|------------------|-------------------------|----------------------------------|---------------------|
| AAIJ 16AH        | PR D94 072001           | R. Aaij <i>et al.</i>            | (LHCb Collab.)      |
| AAIJ 15V         | PR D91 092002           | R. Aaij <i>et al.</i>            | (LHCb Collab.)      |
| Also             | PR D93 119901 (errata.) | R. Aaij <i>et al.</i>            | (LHCb Collab.)      |
| AAIJ 13CC        | JHEP 1309 145           | R. Aaij <i>et al.</i>            | (LHCb Collab.)      |
| ABRAMOWICZ 13    | NP B866 229             | H. Abramowicz <i>et al.</i>      | (ZEUS Collab.)      |
| DEL-AMO-SA...10P | PR D82 111101           | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)     |
| AUBERT 09AB      | PR D79 112004           | B. Aubert <i>et al.</i>          | (BABAR Collab.)     |
| AUBERT 09Y       | PRL 103 051803          | B. Aubert <i>et al.</i>          | (BABAR Collab.)     |
| CHEKANOV 09      | EPJ C60 25              | S. Chekanov <i>et al.</i>        | (ZEUS Collab.)      |
| ABULENCIA 06A    | PR D73 051104           | A. Abulencia <i>et al.</i>       | (CDF Collab.)       |
| ABE 04D          | PR D69 112002           | K. Abe <i>et al.</i>             | (BELLE Collab.)     |
| LINK 04A         | PL B586 11              | J.M. Link <i>et al.</i>          | (FOCUS Collab.)     |
| ABREU 98M        | PL B426 231             | P. Abreu <i>et al.</i>           | (DELPHI Collab.)    |
| ACKERSTAFF 97W   | ZPHY C76 425            | K. Ackerstaff <i>et al.</i>      | (OPAL Collab.)      |
| ASRATYAN 95      | ZPHY C68 43             | A.E. Asratyan <i>et al.</i>      | (BIRM, BELG, CERN+) |
| AVERY 94C        | PL B331 236             | P. Avery <i>et al.</i>           | (CLEO Collab.)      |
| FRABETTI 94B     | PRL 72 324              | P.L. Frabetti <i>et al.</i>      | (FNAL E687 Collab.) |
| AVERY 90         | PR D41 774              | P. Avery, D. Besson              | (CLEO Collab.)      |
| ALBRECHT 89B     | PL B221 422             | H. Albrecht <i>et al.</i>        | (ARGUS Collab.) JP  |
| ALBRECHT 89H     | PL B232 398             | H. Albrecht <i>et al.</i>        | (ARGUS Collab.) JP  |
| ANJOS 89C        | PRL 62 1717             | J.C. Anjos <i>et al.</i>         | (FNAL E691 Collab.) |

REFID=57518  
 REFID=56575  
 REFID=57289  
 REFID=55581  
 REFID=54743  
 REFID=53534  
 REFID=52941  
 REFID=52929  
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 REFID=51054  
 REFID=50011  
 REFID=49775  
 REFID=46315  
 REFID=45788  
 REFID=44439  
 REFID=44096  
 REFID=43687  
 REFID=41013  
 REFID=40736  
 REFID=41001  
 REFID=40737

**$D_2^*(2460)^\pm$** 

$$I(J^P) = \frac{1}{2}(2^+)$$

 $J^P = 2^+$  assignment strongly favored(ALBRECHT 89B).

NODE=M150

NODE=M150

NODE=M150M

NODE=M150M

 **$D_2^*(2460)^\pm$  MASS**

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID                                                 | TECN      | COMMENT                                    |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|-----------|--------------------------------------------|
| <b>2465.4±1.3 OUR AVERAGE</b>                                                 |      | Error includes scale factor of 3.1. See the ideogram below. |           |                                            |
| 2465.6±1.8±1.3                                                                |      | <sup>1</sup> AAIJ                                           | 15X LHCB  | $B^0 \rightarrow \bar{D}^0 K^+ \pi^-$      |
| 2468.6±0.6±0.3                                                                |      | <sup>2</sup> AAIJ                                           | 15Y LHCB  | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$    |
| 2463.1±0.2±0.6                                                                | 342k | AAIJ                                                        | 13CC LHCB | $p p \rightarrow D^0 \pi^+ X$              |
| 2460.6±4.4 <sup>+3.6</sup> <sub>-0.8</sub>                                    | 1371 | <sup>3</sup> ABRAMOWICZ13                                   | ZEUS      | $e^\pm p \rightarrow D^{(*)0} \pi^+ X$     |
| 2465.4±0.2±1.1                                                                | 111k | <sup>4</sup> DEL-AMO-SA...10P                               | BABR      | $e^+ e^- \rightarrow D^0 \pi^+ X$          |
| 2465.7±1.8 <sup>+1.4</sup> <sub>-4.8</sub>                                    | 2909 | KUZMIN                                                      | 07 BELL   | $e^+ e^- \rightarrow \text{hadrons}$       |
| 2463 ±3 ±3                                                                    | 310  | BERGFELD                                                    | 94B CLE2  | $e^+ e^- \rightarrow D^0 \pi^+ X$          |
| 2453 ±3 ±2                                                                    | 185  | FRABETTI                                                    | 94B E687  | $\gamma \text{Be} \rightarrow D^0 \pi^+ X$ |
| 2469 ±4 ±6                                                                    |      | ALBRECHT                                                    | 89F ARG   | $e^+ e^- \rightarrow D^0 \pi^+ X$          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                             |           |                                            |
| 2468.1±0.6±0.5                                                                |      | <sup>5</sup> AAIJ                                           | 15Y LHCB  | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$    |
| 2467.6±1.5±0.8                                                                | 3.5k | <sup>6</sup> LINK                                           | 04A FOCS  | $\gamma A$                                 |

<sup>1</sup> From the Dalitz plot analysis including various  $K^*$  and  $D^{**}$  mesons as well as broad structures in the  $K\pi$  S-wave and the  $D\pi$  S- and P-waves.<sup>2</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the Isobar formalism.<sup>3</sup> From the fit of the  $M(D^0 \pi^+)$  distribution. The widths of the  $D_1^+$  and  $D_2^{*+}$  are fixed to 25 MeV and 37 MeV, and  $A_{D_1}$  and  $A_{D_2}$  are fixed to the theoretical predictions of 3 and -1, respectively.<sup>4</sup> At a fixed width of 50.5 MeV.<sup>5</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the K-matrix formalism.<sup>6</sup> Fit includes the contribution from  $D_0^*(2400)^\pm$ . Not independent of the corresponding mass difference measurement,  $(m_{D_2^*(2460)^\pm} - (m_{D_2^*(2460)^0})$ .

OCCUR=2

NODE=M150M;LINKAGE=A

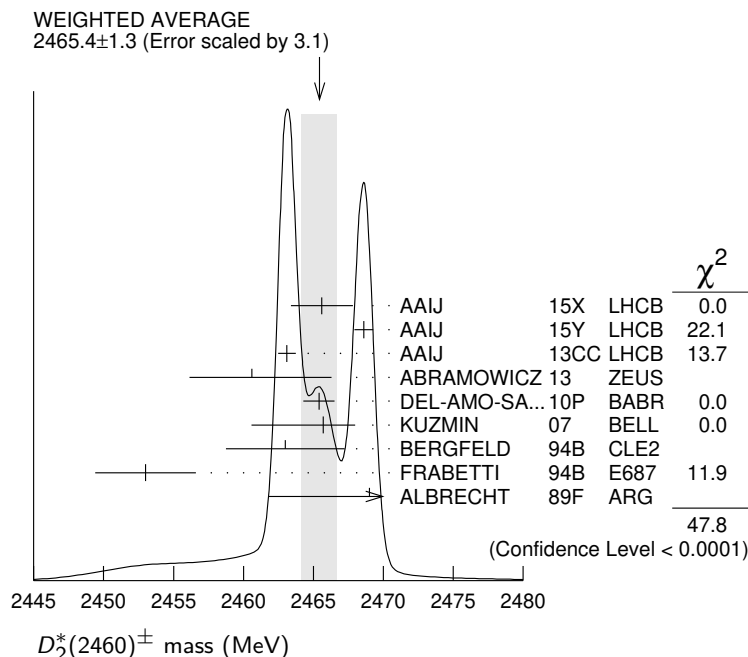
NODE=M150M;LINKAGE=B

NODE=M150M;LINKAGE=AB

NODE=M150M;LINKAGE=DE

NODE=M150M;LINKAGE=C

NODE=M150M;LINKAGE=LI



**$m_{D_2^*(2460)^\pm} - m_{D_2^*(2460)^0}$**

NODE=M150DM

NODE=M150DM

| VALUE (MeV)                | DOCUMENT ID | TECN     | COMMENT                               |
|----------------------------|-------------|----------|---------------------------------------|
| <b>2.4±1.7 OUR AVERAGE</b> |             |          |                                       |
| 3.1±1.9±0.9                | LINK        | 04A FOCS | $\gamma A$                            |
| - 2 ±4 ±4                  | BERGFELD    | 94B CLE2 | $e^+ e^- \rightarrow \text{hadrons}$  |
| 0 ±4                       | FRABETTI    | 94B E687 | $\gamma \text{Be} \rightarrow D\pi X$ |
| 14 ±5 ±8                   | ALBRECHT    | 89F ARG  | $e^+ e^- \rightarrow D^0 \pi^+ X$     |

**$D_2^*(2460)^\pm$  WIDTH**

NODE=M150W

| VALUE (MeV)                                                                                                                                                                     | EVTS | DOCUMENT ID       | TECN      | COMMENT                                    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------|--------------------------------------------|
| <b>46.7<math>\pm</math> 1.2 OUR AVERAGE</b>                                                                                                                                     |      |                   |           |                                            |
| 46.0 $\pm$ 3.4 $\pm$ 3.2                                                                                                                                                        |      | <sup>1</sup> AAIJ | 15X LHCb  | $B^0 \rightarrow \bar{D}^0 K^+ \pi^-$      |
| 47.3 $\pm$ 1.5 $\pm$ 0.7                                                                                                                                                        |      | <sup>2</sup> AAIJ | 15Y LHCb  | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$    |
| 48.6 $\pm$ 1.3 $\pm$ 1.9                                                                                                                                                        | 342k | AAIJ              | 13CC LHCb | $pp \rightarrow D^0 \pi^+ X$               |
| 49.7 $\pm$ 3.8 $\pm$ 6.4                                                                                                                                                        | 2909 | KUZMIN            | 07 BELL   | $e^+ e^- \rightarrow \text{hadrons}$       |
| 34.1 $\pm$ 6.5 $\pm$ 4.2                                                                                                                                                        | 3.5k | <sup>3</sup> LINK | 04A FOCS  | $\gamma A$                                 |
| 27 $^{+11}_{-8}$ $\pm$ 5                                                                                                                                                        | 310  | BERGFELD          | 94B CLE2  | $e^+ e^- \rightarrow D^0 \pi^+ X$          |
| 23 $\pm$ 9 $\pm$ 5                                                                                                                                                              | 185  | FRABETTI          | 94B E687  | $\gamma \text{Be} \rightarrow D^0 \pi^+ X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                   |      |                   |           |                                            |
| 46.0 $\pm$ 1.4 $\pm$ 1.8                                                                                                                                                        |      | <sup>4</sup> AAIJ | 15Y LHCb  | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$    |
| <sup>1</sup> From the Dalitz plot analysis including various $K^*$ and $D^{**}$ mesons as well as broad structures in the $K\pi$ $S$ -wave and the $D\pi$ $S$ - and $P$ -waves. |      |                   |           |                                            |
| <sup>2</sup> Modeling the $\pi^+ \pi^-$ $S$ -wave with the Isobar formalism.                                                                                                    |      |                   |           |                                            |
| <sup>3</sup> Fit includes the contribution from $D_0^*(2400)^\pm$ .                                                                                                             |      |                   |           |                                            |
| <sup>4</sup> Modeling the $\pi^+ \pi^-$ $S$ -wave with the K-matrix formalism.                                                                                                  |      |                   |           |                                            |

NODE=M150W

OCCUR=2

NODE=M150W;LINKAGE=A

NODE=M150W;LINKAGE=B

NODE=M150W;LINKAGE=LI

NODE=M150W;LINKAGE=C

 **$D_2^*(2460)^\pm$  DECAY MODES**

NODE=M150215;NODE=M150

 $D_2^*(2460)^-$  modes are charge conjugates of modes below.

NODE=M150

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1$ $D^0 \pi^+$          | seen                           |
| $\Gamma_2$ $D^{*0} \pi^+$       | seen                           |
| $\Gamma_3$ $D^+ \pi^+ \pi^-$    | not seen                       |
| $\Gamma_4$ $D^{*+} \pi^+ \pi^-$ | not seen                       |

DESIG=1

DESIG=2;OUR EST; $\rightarrow$  UNCHECKED  $\leftarrow$ DESIG=3;OUR EST; $\rightarrow$  UNCHECKED  $\leftarrow$ DESIG=4;OUR EST; $\rightarrow$  UNCHECKED  $\leftarrow$  **$D_2^*(2460)^\pm$  BRANCHING RATIOS**

NODE=M150220

| $\Gamma(D^0\pi^+)/\Gamma_{\text{total}}$ |             |      |         | $\Gamma_1/\Gamma$              |
|------------------------------------------|-------------|------|---------|--------------------------------|
| VALUE                                    | DOCUMENT ID | TECN | COMMENT |                                |
| seen                                     | ALBRECHT    | 89F  | ARG     | $e^+e^- \rightarrow D^0\pi^+X$ |

NODE=M150R1

NODE=M150R1

| $\Gamma(D^0\pi^+)/\Gamma(D^{*0}\pi^+)$ |      |             |      | $\Gamma_1/\Gamma_2$ |
|----------------------------------------|------|-------------|------|---------------------|
| VALUE                                  | EVTS | DOCUMENT ID | TECN | COMMENT             |
| <b>1.2±0.4 OUR AVERAGE</b>             |      |             |      |                     |

NODE=M150R2

NODE=M150R2

**1.2 $\pm$ 0.4 OUR AVERAGE**

|                                |      |                           |          |                                        |
|--------------------------------|------|---------------------------|----------|----------------------------------------|
| 1.1 $\pm$ 0.4 $^{+0.3}_{-0.2}$ | 1371 | <sup>1</sup> ABRAMOWICZ13 | ZEUS     | $e^\pm p \rightarrow D^{(*)0} \pi^+ X$ |
| 1.9 $\pm$ 1.1 $\pm$ 0.3        |      | BERGFELD                  | 94B CLE2 | $e^+ e^- \rightarrow \text{hadrons}$   |

<sup>1</sup> From the fit of the  $M(D^0 \pi^+)$  distribution. The widths of the  $D_1^+$  and  $D_2^{*+}$  are fixed to 25 MeV and 37 MeV, and  $A_{D_1}$  and  $A_{D_2}$  are fixed to the theoretical predictions of 3 and  $-1$ , respectively.

NODE=M150R2;LINKAGE=AB

| $\Gamma(D^0\pi^+)/[\Gamma(D^0\pi^+)+\Gamma(D^{*0}\pi^+)]$ |      |             |      | $\Gamma_1/(\Gamma_1+\Gamma_2)$ |
|-----------------------------------------------------------|------|-------------|------|--------------------------------|
| VALUE                                                     | EVTS | DOCUMENT ID | TECN | COMMENT                        |

NODE=M150R01

NODE=M150R01

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                            |      |                     |          |                                                  |
|----------------------------|------|---------------------|----------|--------------------------------------------------|
| 0.62 $\pm$ 0.03 $\pm$ 0.02 | 3361 | <sup>1</sup> AUBERT | 09Y BABR | $\bar{B}^0 \rightarrow D_2^{*+} \ell^- \nu_\ell$ |
|----------------------------|------|---------------------|----------|--------------------------------------------------|

<sup>1</sup> Assuming  $\Gamma(\Upsilon(4S) \rightarrow B^+ B^-) / \Gamma(\Upsilon(4S) \rightarrow B^0 \bar{B}^0) = 1.065 \pm 0.026$  and equal partial widths for charged and neutral  $D_2^*$  mesons.

NODE=M150R01;LINKAGE=AU

 **$D_2^*(2460)^\pm$  REFERENCES**

NODE=M150

|                   |      |                |                                  |                     |
|-------------------|------|----------------|----------------------------------|---------------------|
| AAIJ              | 15X  | PR D92 012012  | R. Aaij <i>et al.</i>            | (LHCb Collab.)      |
| AAIJ              | 15Y  | PR D92 032002  | R. Aaij <i>et al.</i>            | (LHCb Collab.)      |
| AAIJ              | 13CC | JHEP 1309 145  | R. Aaij <i>et al.</i>            | (LHCb Collab.)      |
| ABRAMOWICZ 13     | NP   | B866 229       | H. Abramowicz <i>et al.</i>      | (ZEUS Collab.)      |
| DEL-AMO-SA... 10P | PR   | D82 111101     | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)     |
| AUBERT            | 09Y  | PRL 103 051803 | B. Aubert <i>et al.</i>          | (BABAR Collab.)     |
| KUZMIN            | 07   | PR D76 012006  | A. Kuzmin <i>et al.</i>          | (BELLE Collab.)     |
| LINK              | 04A  | PL B586 11     | J.M. Link <i>et al.</i>          | (FOCUS Collab.)     |
| BERGFELD          | 94B  | PL B340 194    | T. Bergfeld <i>et al.</i>        | (CLEO Collab.)      |
| FRABETTI          | 94B  | PRL 72 324     | P.L. Frabetti <i>et al.</i>      | (FNAL E687 Collab.) |
| ALBRECHT          | 89B  | PL B221 422    | H. Albrecht <i>et al.</i>        | (ARGUS Collab.)     |
| ALBRECHT          | 89F  | PL B231 208    | H. Albrecht <i>et al.</i>        | (ARGUS Collab.)     |

REFID=56588

REFID=56609

REFID=55581

REFID=54743

REFID=53534

REFID=52929

REFID=51854

REFID=49775

REFID=44099

REFID=43687

REFID=40736

REFID=40931

**$D_0(2550)^0$** 

$$I(J^P) = \frac{1}{2}(0^-)$$

OMITTED FROM SUMMARY TABLE

 $J^P = 0^-$  determined by AAIJ 20D.

NODE=M198

NODE=M198

NODE=M198M

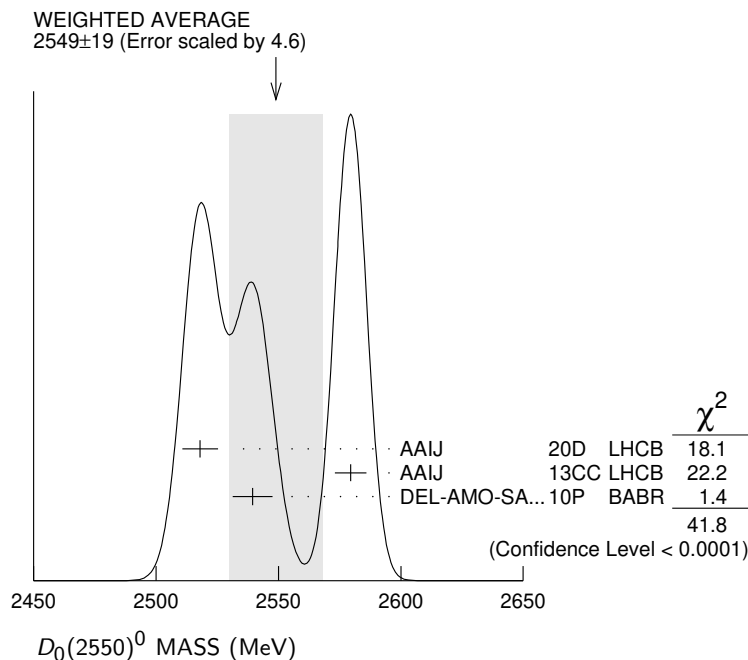
NODE=M198M

NEW

NODE=M198M;LINKAGE=A

 **$D_0(2550)^0$  MASS**

| VALUE (MeV)                  | EVTs | DOCUMENT ID                                                                                                        | TECN      | COMMENT                              |
|------------------------------|------|--------------------------------------------------------------------------------------------------------------------|-----------|--------------------------------------|
| <b>2549 ± 19 OUR AVERAGE</b> |      | Error includes scale factor of 4.6. See the ideogram below.<br>[2564 ± 20 MeV OUR 2020 AVERAGE Scale factor = 3.9] |           |                                      |
| 2518 ± 2 ± 7                 | 79k  | <sup>1</sup> AAIJ                                                                                                  | 20D LHCb  | $B^- \rightarrow D^{*+} \pi^- \pi^-$ |
| 2579.5 ± 3.4 ± 5.5           | 60k  | AAIJ                                                                                                               | 13CC LHCb | $pp \rightarrow D^{*+} \pi^- X$      |
| 2539.4 ± 4.5 ± 6.8           | 34k  | DEL-AMO-SA...10P                                                                                                   | BABR      | $e^+ e^- \rightarrow D^{*+} \pi^- X$ |

<sup>1</sup> From a full four-body amplitude analysis of the  $B^- \rightarrow D^{*+} \pi^- \pi^-$  decay. **$D_0(2550)^0$  WIDTH**

| VALUE (MeV)                 | EVTs | DOCUMENT ID                                                                                    | TECN      | COMMENT                              |
|-----------------------------|------|------------------------------------------------------------------------------------------------|-----------|--------------------------------------|
| <b>165 ± 24 OUR AVERAGE</b> |      | Error includes scale factor of 2.0. See the ideogram below.<br>[135 ± 17 MeV OUR 2020 AVERAGE] |           |                                      |
| 199 ± 5 ± 17                | 79k  | <sup>1</sup> AAIJ                                                                              | 20D LHCb  | $B^- \rightarrow D^{*+} \pi^- \pi^-$ |
| 177.5 ± 17.8 ± 46.0         | 60k  | AAIJ                                                                                           | 13CC LHCb | $pp \rightarrow D^{*+} \pi^- X$      |
| 130 ± 12 ± 13               | 34k  | DEL-AMO-SA...10P                                                                               | BABR      | $e^+ e^- \rightarrow D^{*+} \pi^- X$ |

<sup>1</sup> From a full four-body amplitude analysis of the  $B^- \rightarrow D^{*+} \pi^- \pi^-$  decay.

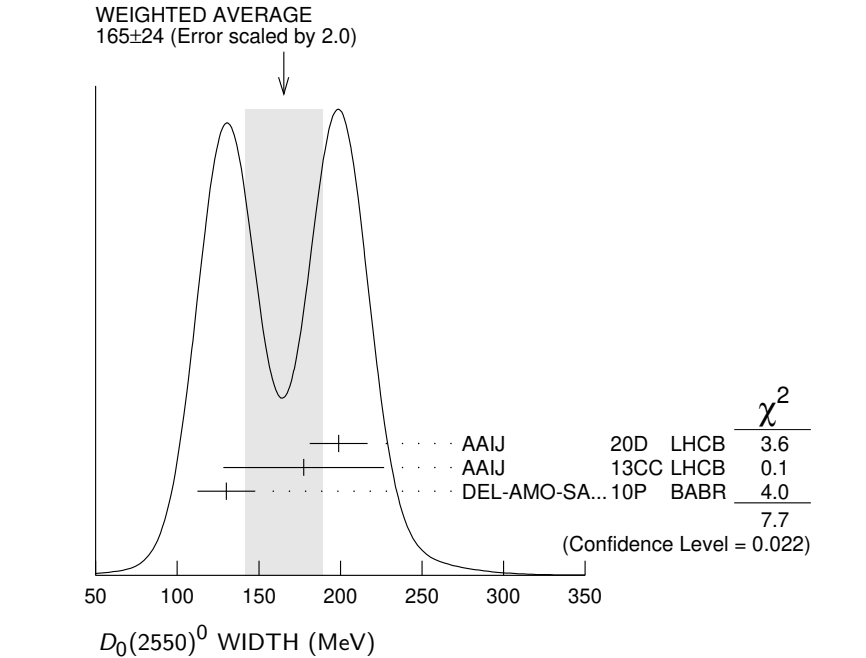
NODE=M198W

NODE=M198W

NEW

NODE=M198W;LINKAGE=A





**$D_0(2550)^0$  DECAY MODES**

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1$ $D^{*+}\pi^-$ | seen                           |

**$D_0(2550)^0$  POLARIZATION AMPLITUDE  $A_{D_J}$**

A polarization amplitude  $A_{D_J}$  is a parameter that depends on the initial polarization of the  $D_J$ . For  $D_J$  decays the helicity angle,  $\theta_H$ , distribution varies like  $1 + A_{D_J} \cos^2(\theta_H)$ , where  $\theta_H$  is the angle in the  $D_J$  rest frame between the two pions emitted in the  $D_J \rightarrow D^*\pi$  and  $D^* \rightarrow D\pi$  decays.

| VALUE                                                                         | EVTS | DOCUMENT ID       | TECN      | COMMENT                        |
|-------------------------------------------------------------------------------|------|-------------------|-----------|--------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                   |           |                                |
| $4.2 \pm 1.3$                                                                 | 60k  | <sup>1</sup> AAIJ | 13CC LHCb | $pp \rightarrow D^{*+}\pi^- X$ |
| <sup>1</sup> Systematic uncertainty not estimated.                            |      |                   |           |                                |

**$D_0(2550)^0$  REFERENCES**

|                   |        |                |                                  |                   |
|-------------------|--------|----------------|----------------------------------|-------------------|
| AAIJ              | 20D    | PR D101 032005 | R. Aaij <i>et al.</i>            | (LHCb Collab.) JP |
| AAIJ              | 13CC   | JHEP 1309 145  | R. Aaij <i>et al.</i>            | (LHCb Collab.)    |
| DEL-AMO-SA... 10P | PR D82 | 111101         | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)   |

NODE=M198215;NODE=M198

DESIG=1;OUR EVAL;→ UNCHECKED ←

NODE=M198PAM

NODE=M198PAM

NODE=M198PAM

NODE=M198PAM;LINKAGE=A

NODE=M198

REFID=60253  
REFID=55581  
REFID=53534

**$D_1^*(2600)^0$** 

$$I(J^P) = \frac{1}{2}(1^-)$$

OMITTED FROM SUMMARY TABLE

was  $D_J^*(2600)$  $J^P = 1^-$  determined by AAIJ 20D.

NODE=M199

NODE=M199

NODE=M199M

NODE=M199M

NEW

OCCUR=2

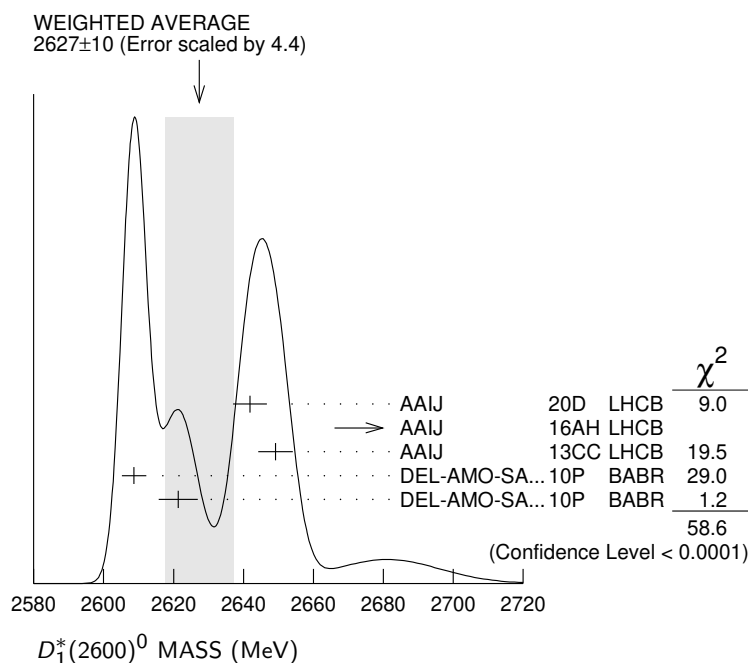
NODE=M199M;LINKAGE=B

NODE=M199M;LINKAGE=A

NODE=M199M;LINKAGE=DE

 **$D_1^*(2600)^0$  MASS**

| VALUE (MeV)                  | EVTS | DOCUMENT ID                                                                                                        | TECN | CHG  | COMMENT                              |
|------------------------------|------|--------------------------------------------------------------------------------------------------------------------|------|------|--------------------------------------|
| <b>2627 ± 10 OUR AVERAGE</b> |      | Error includes scale factor of 4.4. See the ideogram below.<br>[2623 ± 12 MeV OUR 2020 AVERAGE Scale factor = 4.8] |      |      |                                      |
| 2641.9 ± 1.8 ± 4.5           | 79k  | <sup>1</sup> AAIJ                                                                                                  | 20D  | LHCB | $B^- \rightarrow D^{*+} \pi^- \pi^-$ |
| 2681.1 ± 5.6 ± 14.0          | 28k  | <sup>2</sup> AAIJ                                                                                                  | 16AH | LHCB | $B^- \rightarrow D^+ \pi^- \pi^-$    |
| 2649.2 ± 3.5 ± 3.5           | 51k  | AAIJ                                                                                                               | 13CC | LHCB | $pp \rightarrow D^{*+} \pi^- X$      |
| 2608.7 ± 2.4 ± 2.5           | 26k  | DEL-AMO-SA...10P                                                                                                   | BABR | 0    | $e^+ e^- \rightarrow D^+ \pi^- X$    |
| 2621.3 ± 3.7 ± 4.2           | 13k  | <sup>3</sup> DEL-AMO-SA...10P                                                                                      | BABR | +    | $e^+ e^- \rightarrow D^0 \pi^+ X$    |

<sup>1</sup> From a full four-body amplitude analysis of the  $B^- \rightarrow D^{*+} \pi^- \pi^-$  decay.<sup>2</sup> From the amplitude analysis in the model describing the  $D^+ \pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, and components corresponding to the  $D_2^*(2460)^0$ ,  $D_1^*(2680)^0$ ,  $D_3^*(2760)^0$ , and  $D_2^*(3000)^0$  resonances.<sup>3</sup> At a fixed width of 93 MeV. **$D_1^*(2600)^0$  WIDTH**

| VALUE (MeV)                 | EVTS | DOCUMENT ID                                                                                                       | TECN | COMMENT                                   |
|-----------------------------|------|-------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------|
| <b>141 ± 23 OUR AVERAGE</b> |      | Error includes scale factor of 2.7. See the ideogram below.<br>[139 ± 31 MeV OUR 2020 AVERAGE Scale factor = 3.2] |      |                                           |
| 149 ± 4 ± 20                | 79k  | <sup>1</sup> AAIJ                                                                                                 | 20D  | LHCB $B^- \rightarrow D^{*+} \pi^- \pi^-$ |
| 186.7 ± 8.5 ± 11.9          | 28k  | <sup>2</sup> AAIJ                                                                                                 | 16AH | LHCB $B^- \rightarrow D^+ \pi^- \pi^-$    |
| 140.2 ± 17.1 ± 18.6         | 51k  | AAIJ                                                                                                              | 13CC | LHCB $pp \rightarrow D^{*+} \pi^- X$      |
| 93 ± 6 ± 13                 | 26k  | DEL-AMO-SA...10P                                                                                                  | BABR | $e^+ e^- \rightarrow D^+ \pi^- X$         |

<sup>1</sup> From a full four-body amplitude analysis of the  $B^- \rightarrow D^{*+} \pi^- \pi^-$  decay.<sup>2</sup> From the amplitude analysis in the model describing the  $D^+ \pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, and components corresponding to the  $D_2^*(2460)^0$ ,  $D_1^*(2680)^0$ ,  $D_3^*(2760)^0$ , and  $D_2^*(3000)^0$  resonances.

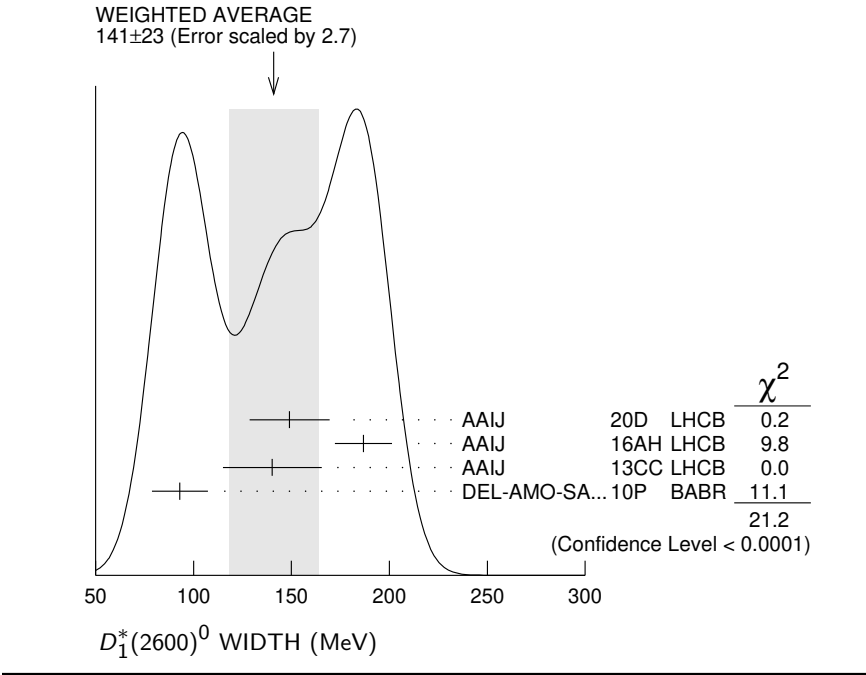
NODE=M199W

NODE=M199W

NEW

NODE=M199W;LINKAGE=B

NODE=M199W;LINKAGE=A



$D_1^*(2600)^0$  DECAY MODES

| Mode       |               | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------|---------------|--------------------------------|
| $\Gamma_1$ | $D\pi$        | seen                           |
| $\Gamma_2$ | $D^+\pi^-$    | seen                           |
| $\Gamma_3$ | $D^0\pi^\pm$  | seen                           |
| $\Gamma_4$ | $D^*\pi$      | seen                           |
| $\Gamma_5$ | $D^{*+}\pi^-$ | seen                           |

NODE=M199215;NODE=M199

DESIG=1;OUR EVAL;→ UNCHECKED ←  
DESIG=2;OUR EVAL;→ UNCHECKED ←  
DESIG=3;OUR EVAL;→ UNCHECKED ←  
DESIG=4;OUR EVAL;→ UNCHECKED ←  
DESIG=5;OUR EVAL;→ UNCHECKED ←

$D_1^*(2600)^0$  BRANCHING RATIOS

| $\Gamma(D^+\pi^-)/\Gamma(D^{*+}\pi^-)$ |      | $\Gamma_2/\Gamma_5$ |      |                                      |
|----------------------------------------|------|---------------------|------|--------------------------------------|
| VALUE                                  | EVTs | DOCUMENT ID         | TECN | COMMENT                              |
| <b>0.32±0.02±0.09</b>                  | 76k  | DEL-AMO-SA...10P    | BABR | $e^+e^- \rightarrow D^{(*)+}\pi^- X$ |

NODE=M199220

NODE=M199R01  
NODE=M199R01

$D_1^*(2600)^0$  REFERENCES

|                  |        |                |                                  |                   |
|------------------|--------|----------------|----------------------------------|-------------------|
| AAIJ             | 20D    | PR D101 032005 | R. Aaij <i>et al.</i>            | (LHCb Collab.) JP |
| AAIJ             | 16AH   | PR D94 072001  | R. Aaij <i>et al.</i>            | (LHCb Collab.)    |
| AAIJ             | 13CC   | JHEP 1309 145  | R. Aaij <i>et al.</i>            | (LHCb Collab.)    |
| DEL-AMO-SA...10P | PR D82 | 111101         | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)   |

NODE=M199

REFID=60253  
REFID=57518  
REFID=55581  
REFID=53534

$D^*(2640)^\pm$

$$I(J^P) = \frac{1}{2}(?)^?$$

OMITTED FROM SUMMARY TABLE  
Seen in Z decays by ABREU 98M. Not seen by ABBIENDI 01N and  
CHEKANOV 09. Needs confirmation.

NODE=M158

NODE=M158

**$D^*(2640)^\pm$  MASS**

NODE=M158M

NODE=M158M

| VALUE (MeV)         | EVTs    | DOCUMENT ID | TECN     | COMMENT                                |
|---------------------|---------|-------------|----------|----------------------------------------|
| <b>2637 ± 2 ± 6</b> | 66 ± 14 | ABREU       | 98M DLPH | $e^+e^- \rightarrow D^{*+}\pi^+\pi^-X$ |

**$D^*(2640)^\pm$  WIDTH**

NODE=M158W

NODE=M158W

| VALUE (MeV)   | CL% | DOCUMENT ID | TECN     | COMMENT                                |
|---------------|-----|-------------|----------|----------------------------------------|
| <b>&lt;15</b> | 95  | ABREU       | 98M DLPH | $e^+e^- \rightarrow D^{*+}\pi^+\pi^-X$ |

**$D^*(2640)^+$  DECAY MODES**

NODE=M158215;NODE=M158

NODE=M158

$D^*(2640)^-$  modes are charge conjugates of modes below.

| Mode                                   | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------------------|--------------------------------|
| $\Gamma_1 \quad D^*(2010)^+\pi^+\pi^-$ | seen                           |

DESIG=1;OUR EST;→ UNCHECKED ←

**$D^*(2640)^\pm$  REFERENCES**

NODE=M158

REFID=52733  
REFID=48296  
REFID=46315

|              |             |                           |                  |
|--------------|-------------|---------------------------|------------------|
| CHEKANOV 09  | EPJ C60 25  | S. Chekanov <i>et al.</i> | (ZEUS Collab.)   |
| ABBIENDI 01N | EPJ C20 445 | G. Abbiendi <i>et al.</i> | (OPAL Collab.)   |
| ABREU 98M    | PL B426 231 | P. Abreu <i>et al.</i>    | (DELPHI Collab.) |

NODE=M228

$D_2(2740)^0$

$$I(J^P) = \frac{1}{2}(2^-)$$

OMITTED FROM SUMMARY TABLE  
was  $D(2740)^0$   
 $J^P = 2^-$  determined by (AAIJ 20D).

NODE=M228

**$D_2(2740)^0$  MASS**

NODE=M228M

NODE=M228M  
NEW

| VALUE (MeV)                      | EVTs | DOCUMENT ID       | TECN      | COMMENT                            |
|----------------------------------|------|-------------------|-----------|------------------------------------|
| <b>2747 ± 6 OUR AVERAGE</b>      |      |                   |           |                                    |
| [2737 ± 12 MeV OUR 2020 AVERAGE] |      |                   |           |                                    |
| 2751 ± 3 ± 7                     | 79k  | <sup>1</sup> AAIJ | 20D LHCB  | $B^- \rightarrow D^{*+}\pi^-\pi^-$ |
| 2737.0 ± 3.5 ± 11.2              | 7.7k | AAIJ              | 13CC LHCB | $pp \rightarrow D^{*+}\pi^-X$      |

<sup>1</sup> From a full four-body amplitude analysis of the  $B^- \rightarrow D^{*+}\pi^-\pi^-$  decay.

NODE=M228M;LINKAGE=A

**$D_2(2740)^0$  WIDTH**

NODE=M228W

NODE=M228W  
NEW

| VALUE (MeV)                    | EVTs | DOCUMENT ID       | TECN      | COMMENT                            |
|--------------------------------|------|-------------------|-----------|------------------------------------|
| <b>88 ± 19 OUR AVERAGE</b>     |      |                   |           |                                    |
| [73 ± 28 MeV OUR 2020 AVERAGE] |      |                   |           |                                    |
| 102 ± 6 ± 26                   | 79k  | <sup>1</sup> AAIJ | 20D LHCB  | $B^- \rightarrow D^{*+}\pi^-\pi^-$ |
| 73.2 ± 13.4 ± 25.0             | 7.7k | AAIJ              | 13CC LHCB | $pp \rightarrow D^{*+}\pi^-X$      |

<sup>1</sup> From a full four-body amplitude analysis of the  $B^- \rightarrow D^{*+}\pi^-\pi^-$  decay.

NODE=M228W;LINKAGE=A

**$D_2(2740)^0$  DECAY MODES**

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad D^{*+} \pi^-$ | seen                           |

 **$D_2(2740)^0$  POLARIZATION AMPLITUDE  $A_{D_J}$** 

A polarization amplitude  $A_{D_J}$  is a parameter that depends on the initial polarization of the  $D_J$ . For  $D_J$  decays the helicity angle,  $\theta_H$ , distribution varies like  $1 + A_{D_J} \cos^2(\theta_H)$ , where  $\theta_H$  is the angle in the  $D_J$  rest frame between the two pions emitted in the  $D_J \rightarrow D^* \pi$  and  $D^* \rightarrow D \pi$  decays.

| VALUE                                                                         | EVTS | DOCUMENT ID       | TECN      | COMMENT                         |
|-------------------------------------------------------------------------------|------|-------------------|-----------|---------------------------------|
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                   |           |                                 |
| $3.1 \pm 2.2$                                                                 | 7.7k | <sup>1</sup> AAIJ | 13CC LHCb | $pp \rightarrow D^{*+} \pi^- X$ |
| <sup>1</sup> Systematic uncertainty not estimated.                            |      |                   |           |                                 |

 **$D_2(2740)^0$  REFERENCES**

|      |                    |                       |                   |
|------|--------------------|-----------------------|-------------------|
| AAIJ | 20D PR D101 032005 | R. Aaij <i>et al.</i> | (LHCb Collab.) JP |
| AAIJ | 13CC JHEP 1309 145 | R. Aaij <i>et al.</i> | (LHCb Collab.)    |

 **$D_3^*(2750)$** 

$$I(J^P) = \frac{1}{2}(3^-)$$

$J^P$  determined by AAIJ 15Y from the Dalitz plot analysis of  $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$  decays.

 **$D_3^*(2750)$  MASS**

| VALUE (MeV)                                                                                 | EVTS  | DOCUMENT ID                    | TECN        | CHG | COMMENT                                 |
|---------------------------------------------------------------------------------------------|-------|--------------------------------|-------------|-----|-----------------------------------------|
| <b>2763.1 ± 3.2 OUR AVERAGE</b> Error includes scale factor of 2.1. See the ideogram below. |       |                                |             |     |                                         |
| [2763.5 ± 3.4 MeV OUR 2020 AVERAGE Scale factor = 2.2]                                      |       |                                |             |     |                                         |
| 2753 ± 4 ± 6                                                                                | 79k   | <sup>1</sup> AAIJ              | 20D LHCb    |     | $B^- \rightarrow D^{*+} \pi^- \pi^-$    |
| 2775.5 ± 4.5 ± 6.5                                                                          | 28k   | <sup>2</sup> AAIJ              | 16AH LHCb   |     | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| 2798 ± 7 ± 7                                                                                |       | <sup>3</sup> AAIJ              | 15Y LHCb    |     | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| 2761.1 ± 5.1 ± 6.5                                                                          | 14k   | AAIJ                           | 13CC LHCb 0 |     | $pp \rightarrow D^{*+} \pi^- X$         |
| 2760.1 ± 1.1 ± 3.7                                                                          | 56k   | AAIJ                           | 13CC LHCb 0 |     | $pp \rightarrow D^+ \pi^- X$            |
| 2771.7 ± 1.7 ± 3.8                                                                          | 20k   | AAIJ                           | 13CC LHCb + |     | $pp \rightarrow D^0 \pi^+ X$            |
| 2752.4 ± 1.7 ± 2.7                                                                          | 23.5k | <sup>4</sup> DEL-AMO-SA..10P   | BABR 0      |     | $e^+ e^- \rightarrow D^{*+} \pi^- X$    |
| 2763.3 ± 2.3 ± 2.3                                                                          | 11.3k | <sup>4</sup> DEL-AMO-SA..10P   | BABR 0      |     | $e^+ e^- \rightarrow D^+ \pi^- X$       |
| 2769.7 ± 3.8 ± 1.5                                                                          | 5.7k  | <sup>4,5</sup> DEL-AMO-SA..10P | BABR +      |     | $e^+ e^- \rightarrow D^0 \pi^+ X$       |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●               |       |                                |             |     |                                         |
| 2802 ± 11 ± 10                                                                              |       | <sup>6</sup> AAIJ              | 15Y LHCb    |     | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |

<sup>1</sup> From a full four-body amplitude analysis of the  $B^- \rightarrow D^{*+} \pi^- \pi^-$  decay.

<sup>2</sup> From the amplitude analysis in the model describing the  $D^+ \pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, and components corresponding to the  $D_2^*(2460)^0$ ,  $D_1^*(2680)^0$ ,  $D_3^*(2760)^0$ , and  $D_2^*(3000)^0$  resonances.

<sup>3</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the Isobar formalism.

<sup>4</sup> The states observed in the  $D^* \pi$  and  $D \pi$  final states are not necessarily the same.

<sup>5</sup> At a fixed width of 60.9 MeV.

<sup>6</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the K-matrix formalism.

NODE=M228215;NODE=M228

DESIG=1;OUR EVAL;→ UNCHECKED ←

NODE=M228PAM

NODE=M228PAM

NODE=M228PAM

NODE=M228PAM;LINKAGE=A

NODE=M228

REFID=60253  
REFID=55581

NODE=M203

NODE=M203

NODE=M203M

NODE=M203M

NEW

OCCUR=2

OCCUR=3

OCCUR=2

OCCUR=3

OCCUR=2

NODE=M203M;LINKAGE=D

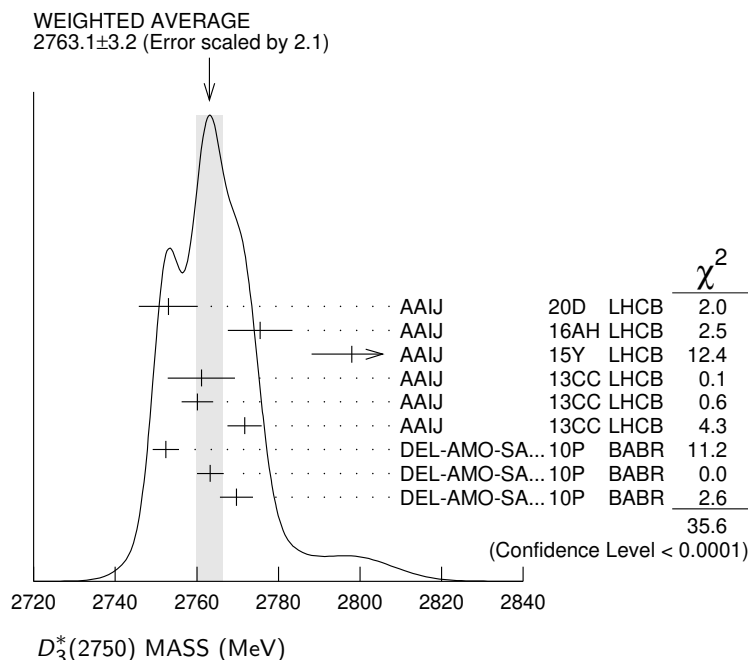
NODE=M203M;LINKAGE=C

NODE=M203M;LINKAGE=A

NODE=M203M;LINKAGE=DE

NODE=M203M;LINKAGE=DA

NODE=M203M;LINKAGE=B



### $D_3^*(2750)$ WIDTH

| VALUE (MeV)               | EVTS  | DOCUMENT ID                   | TECN        | CHG | COMMENT                                 |
|---------------------------|-------|-------------------------------|-------------|-----|-----------------------------------------|
| <b>66 ± 5 OUR AVERAGE</b> |       |                               |             |     |                                         |
| 66 ±10 ±14                | 79k   | <sup>1</sup> AAIJ             | 20D LHCb    |     | $B^- \rightarrow D^{*+} \pi^- \pi^-$    |
| 95.3 ± 9.6 ± 34.0         | 28k   | <sup>2</sup> AAIJ             | 16AH LHCb   |     | $B^- \rightarrow D^+ \pi^- \pi^-$       |
| 105 ±18 ±24               |       | <sup>3</sup> AAIJ             | 15Y LHCb    |     | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
| 74.4 ± 3.4 ± 37.0         | 14k   | AAIJ                          | 13CC LHCb 0 |     | $pp \rightarrow D^{*+} \pi^- X$         |
| 74.4 ± 3.4 ± 19.1         | 56k   | AAIJ                          | 13CC LHCb 0 |     | $pp \rightarrow D^+ \pi^- X$            |
| 66.7 ± 6.6 ± 10.5         | 20k   | AAIJ                          | 13CC LHCb + |     | $pp \rightarrow D^0 \pi^+ X$            |
| 71 ± 6 ± 11               | 23.5k | <sup>4</sup> DEL-AMO-SA...10P | BABR        |     | $e^+ e^- \rightarrow D^{*+} \pi^- X$    |
| 60.9 ± 5.1 ± 3.6          | 11.3k | <sup>4</sup> DEL-AMO-SA...10P | BABR        |     | $e^+ e^- \rightarrow D^+ \pi^- X$       |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |  |                   |          |  |                                         |
|-------------|--|-------------------|----------|--|-----------------------------------------|
| 154 ±27 ±16 |  | <sup>5</sup> AAIJ | 15Y LHCb |  | $B^0 \rightarrow \bar{D}^0 \pi^+ \pi^-$ |
|-------------|--|-------------------|----------|--|-----------------------------------------|

<sup>1</sup> From a full four-body amplitude analysis of the  $B^- \rightarrow D^{*+} \pi^- \pi^-$  decay.

<sup>2</sup> From the amplitude analysis in the model describing the  $D^+ \pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, and components corresponding to the  $D_2^*(2460)^0$ ,  $D_1^*(2680)^0$ ,  $D_3^*(2760)^0$ , and  $D_2^*(3000)^0$  resonances.

<sup>3</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the Isobar formalism.

<sup>4</sup> The states observed in the  $D^* \pi$  and  $D \pi$  final states are not necessarily the same.

<sup>5</sup> Modeling the  $\pi^+ \pi^-$  S-wave with the K-matrix formalism.

NODE=M203W

NODE=M203W

OCCUR=2

OCCUR=4

OCCUR=2

OCCUR=2

NODE=M203W;LINKAGE=D

NODE=M203W;LINKAGE=C

NODE=M203W;LINKAGE=A

NODE=M203W;LINKAGE=DE

NODE=M203W;LINKAGE=B

### $D_3^*(2750)$ DECAY MODES

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $D \pi$        | seen                           |
| $\Gamma_2$ $D^+ \pi^-$    | seen                           |
| $\Gamma_3$ $D^0 \pi^\pm$  | seen                           |
| $\Gamma_4$ $D^* \pi$      | seen                           |
| $\Gamma_5$ $D^{*+} \pi^-$ | seen                           |

NODE=M203215;NODE=M203

DESIG=1;OUR EVAL;→ UNCHECKED ←

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=3;OUR EVAL;→ UNCHECKED ←

DESIG=4;OUR EVAL;→ UNCHECKED ←

DESIG=5;OUR EVAL;→ UNCHECKED ←

### $D_3^*(2750)$ BRANCHING RATIOS

| $\Gamma(D^+ \pi^-)/\Gamma(D^{*+} \pi^-)$ |       |                               |      |                                        | $\Gamma_2/\Gamma_5$ |
|------------------------------------------|-------|-------------------------------|------|----------------------------------------|---------------------|
| VALUE                                    | EVTS  | DOCUMENT ID                   | TECN | COMMENT                                |                     |
| <b>0.42 ± 0.05 ± 0.11</b>                | 34.8k | <sup>1</sup> DEL-AMO-SA...10P | BABR | $e^+ e^- \rightarrow D^{(*)+} \pi^- X$ |                     |

NODE=M203220

NODE=M203R01

NODE=M203R01

<sup>1</sup> The states observed in the  $D^*\pi$  and  $D\pi$  final states are not necessarily the same.

### $D_3^*(2750)$ POLARIZATION AMPLITUDE $A_D$

A polarization amplitude  $A_D$  is a parameter that depends on the initial polarization of the  $D_3^*(2750)$ . For  $D_3^*(2750)$  decays the helicity angle,  $\theta_H$ , distribution varies like  $1 + A_D \cos(\theta_H)$ , where  $\theta_H$  is the angle in the  $D^*$  rest frame between the two pions emitted by the  $D_3^*(2750) \rightarrow D^*\pi$  and  $D^* \rightarrow D\pi$ .

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                  |       |                               |      |                                    |
|------------------|-------|-------------------------------|------|------------------------------------|
| $-0.33 \pm 0.28$ | 23.5k | <sup>1</sup> DEL-AMO-SA...10P | BABR | $e^+e^- \rightarrow D^{*+}\pi^- X$ |
|------------------|-------|-------------------------------|------|------------------------------------|

<sup>1</sup> Systematic uncertainties not estimated. The states observed in the  $D^*\pi$  and  $D\pi$  final states are not necessarily the same.

### $D_3^*(2750)$ REFERENCES

|                   |               |                |                                  |                   |
|-------------------|---------------|----------------|----------------------------------|-------------------|
| AAIJ              | 20D           | PR D101 032005 | R. Aaij <i>et al.</i>            | (LHCb Collab.)    |
| AAIJ              | 16AH          | PR D94 072001  | R. Aaij <i>et al.</i>            | (LHCb Collab.)    |
| AAIJ              | 15Y           | PR D92 032002  | R. Aaij <i>et al.</i>            | (LHCb Collab.) JP |
| AAIJ              | 13CC          | JHEP 1309 145  | R. Aaij <i>et al.</i>            | (LHCb Collab.)    |
| DEL-AMO-SA... 10P | PR D82 111101 |                | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)   |

$D_1^*(2760)^0$

$$I(J^P) = \frac{1}{2}(1^-)$$

OMITTED FROM SUMMARY TABLE

$J^P$  determined by AAIJ 15V from the Dalitz plot analysis of  $B^- \rightarrow D^+ K^- \pi^-$  decays.

### $D_1^*(2760)^0$ MASS

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

|                                        |    |                   |     |                                      |
|----------------------------------------|----|-------------------|-----|--------------------------------------|
| <b><math>2781 \pm 18 \pm 13</math></b> | 2k | <sup>1</sup> AAIJ | 15V | LHCB $B^- \rightarrow D^+ K^- \pi^-$ |
|----------------------------------------|----|-------------------|-----|--------------------------------------|

<sup>1</sup> From the amplitude analysis in the model describing the  $D^+\pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, nonresonant spin-0 and spin-1 components as well as the  $D_0^*(2400)^0$ ,  $D_2^*(2460)^0$  and  $D_1^*(2760)^0$  resonances.

### $D_1^*(2760)^0$ WIDTH

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

|                                       |    |                   |     |                                      |
|---------------------------------------|----|-------------------|-----|--------------------------------------|
| <b><math>177 \pm 32 \pm 21</math></b> | 2k | <sup>1</sup> AAIJ | 15V | LHCB $B^- \rightarrow D^+ K^- \pi^-$ |
|---------------------------------------|----|-------------------|-----|--------------------------------------|

<sup>1</sup> From the amplitude analysis in the model describing the  $D^+\pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, nonresonant spin-0 and spin-1 components as well as the  $D_0^*(2400)^0$ ,  $D_2^*(2460)^0$  and  $D_1^*(2760)^0$  resonances.

### $D_1^*(2760)^0$ DECAY MODES

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1 \quad D^+ K^-$ | seen                           |

### $D_1^*(2760)^0$ BRANCHING RATIOS

$\Gamma(D^+ K^-)/\Gamma_{\text{total}}$

$\Gamma_1/\Gamma$

| VALUE       | DOCUMENT ID       | TECN | COMMENT                              |
|-------------|-------------------|------|--------------------------------------|
| <b>seen</b> | <sup>1</sup> AAIJ | 15V  | LHCB $B^- \rightarrow D^+ K^- \pi^-$ |

<sup>1</sup> From the amplitude analysis in the model describing the  $D^+\pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, nonresonant spin-0 and spin-1 components as well as the  $D_0^*(2400)^0$ ,  $D_2^*(2460)^0$  and  $D_1^*(2760)^0$  resonances.

NODE=M203R01;LINKAGE=DE

NODE=M203PAM

NODE=M203PAM

NODE=M203PAM

NODE=M203PAM;LINKAGE=DE

NODE=M203

REFID=60253  
REFID=57518  
REFID=56609  
REFID=55581  
REFID=53534

NODE=M249

NODE=M249

NODE=M249M

NODE=M249M

NODE=M249M;LINKAGE=A

NODE=M249W

NODE=M249W

NODE=M249W;LINKAGE=A

NODE=M249215;NODE=M249

DESIG=1

NODE=M249225

NODE=M249R01  
NODE=M249R01  
OCCUR=2

NODE=M249R01;LINKAGE=A

**$D_1^*(2760)^0$  REFERENCES**

AAIJ 15V PR D91 092002 R. Aaij *et al.* (LHCb Collab.) JP  
Also PR D93 119901 (errat.) R. Aaij *et al.* (LHCb Collab.)

NODE=M249

REFID=56575  
REFID=57289

NODE=M229

 **$D(3000)^0$** 

$$I(J^P) = \frac{1}{2}(?)$$

OMITTED FROM SUMMARY TABLE

Both natural- and unnatural-parity components observed depending on the decay mode (AAIJ 13CC).

NODE=M229

 **$D(3000)^0$  MASS**

NODE=M229M

NODE=M229M

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID         | TECN      | COMMENT                           |
|-------------------------------------------------------------------------------|-------|---------------------|-----------|-----------------------------------|
| <b>3214 ±29 ±49</b>                                                           | 28k   | <sup>1</sup> AAIJ   | 16AH LHCb | $B^- \rightarrow D^+ \pi^- \pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                     |           |                                   |
| 2971.8 ± 8.7                                                                  | 9.5k  | <sup>2,3</sup> AAIJ | 13CC LHCb | $pp \rightarrow D^{*+} \pi^- X$   |
| 3008.1 ± 4.0                                                                  | 17.6k | <sup>2,4</sup> AAIJ | 13CC LHCb | $pp \rightarrow D^+ \pi^- X$      |

<sup>1</sup> From the amplitude analysis in the model describing the  $D^+ \pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, and components corresponding to the  $D_2^*(2460)^0$ ,  $D_1^*(2680)^0$ ,  $D_3^*(2760)^0$ , and  $D_2^*(3000)^0$  resonances.

<sup>2</sup> Systematic uncertainty not estimated.

<sup>3</sup> Unnatural parity preferred.

<sup>4</sup> Natural parity state. A state  $D(3000)^+$  is possibly seen in  $D^0 \pi^+$  final state.

OCCUR=2

NODE=M229M;LINKAGE=D

NODE=M229M;LINKAGE=A

NODE=M229M;LINKAGE=B

NODE=M229M;LINKAGE=C

 **$D(3000)^0$  WIDTH**

NODE=M229W

NODE=M229W

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID         | TECN      | COMMENT                           |
|-------------------------------------------------------------------------------|-------|---------------------|-----------|-----------------------------------|
| <b>186 ±38 ±72</b>                                                            | 28k   | <sup>5</sup> AAIJ   | 16AH LHCb | $B^- \rightarrow D^+ \pi^- \pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                     |           |                                   |
| 188.1 ±44.8                                                                   | 9.5k  | <sup>6,7</sup> AAIJ | 13CC LHCb | $pp \rightarrow D^{*+} \pi^- X$   |
| 110.5 ±11.5                                                                   | 17.6k | <sup>6,8</sup> AAIJ | 13CC LHCb | $pp \rightarrow D^+ \pi^- X$      |

<sup>5</sup> From the amplitude analysis in the model describing the  $D^+ \pi^-$  wave together with virtual contributions from the  $D^*(2007)^0$  and  $B^{*0}$  states, and components corresponding to the  $D_2^*(2460)^0$ ,  $D_1^*(2680)^0$ ,  $D_3^*(2760)^0$ , and  $D_2^*(3000)^0$  resonances.

<sup>6</sup> Systematic uncertainty not estimated.

<sup>7</sup> Unnatural parity preferred.

<sup>8</sup> Natural parity state. A state  $D(3000)^+$  is possibly seen in  $D^0 \pi^+$  final state.

OCCUR=2

NODE=M229W;LINKAGE=D

NODE=M229W;LINKAGE=A

NODE=M229W;LINKAGE=C

NODE=M229W;LINKAGE=B

 **$D(3000)^0$  DECAY MODES**

NODE=M229215;NODE=M229

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $D^{*+} \pi^-$ | seen                           |

DESIG=1;OUR EVAL;→ UNCHECKED ←

 **$D(3000)^0$  POLARIZATION AMPLITUDE  $A_{D_J}$** 

NODE=M229PAM

NODE=M229PAM

A polarization amplitude  $A_{D_J}$  is a parameter that depends on the initial polarization of the  $D_J$ . For  $D_J$  decays the helicity angle,  $\theta_H$ , distribution varies like  $1 + A_{D_J} \cos^2(\theta_H)$ , where  $\theta_H$  is the angle in the  $D_J$  rest frame between the two pions emitted in the  $D_J \rightarrow D^* \pi$  and  $D^* \rightarrow D \pi$  decays.

| VALUE                                                                         | EVTS | DOCUMENT ID       | TECN      | COMMENT                         |
|-------------------------------------------------------------------------------|------|-------------------|-----------|---------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                   |           |                                 |
| 1.5 ±0.9                                                                      | 9.5k | <sup>9</sup> AAIJ | 13CC LHCb | $pp \rightarrow D^{*+} \pi^- X$ |

<sup>9</sup> Systematic uncertainty not estimated.

NODE=M229PAM

NODE=M229PAM;LINKAGE=A

 **$D(3000)^0$  REFERENCES**

NODE=M229

AAIJ 16AH PR D94 072001 R. Aaij *et al.* (LHCb Collab.)  
AAIJ 13CC JHEP 1309 145 R. Aaij *et al.* (LHCb Collab.)

REFID=57518  
REFID=55581



# CHARMED, STRANGE MESONS ( $C = S = \pm 1$ ) (including possibly non- $q\bar{q}$ states)

$$D_s^+ = c\bar{s}, D_s^- = \bar{c}s, \text{ similarly for } D_s^{*+}s$$

 $D_s^{*\pm}$ 

$$I(J^P) = 0(?^?)$$

$J^P$  is natural, width and decay modes consistent with  $1^-$ .

## $D_s^{*\pm}$ MASS

The fit includes  $D_s^\pm, D_s^0, D_s^{*\pm}, D^{*0}, D_s^{*+}, D_1(2420)^0, D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

| VALUE (MeV)                                         | DOCUMENT ID           | TECN | COMMENT                                    |
|-----------------------------------------------------|-----------------------|------|--------------------------------------------|
| <b>2112.2<math>\pm</math>0.4 OUR FIT</b>            |                       |      |                                            |
| <b>2106.6<math>\pm</math>2.1<math>\pm</math>2.7</b> | <sup>1</sup> BLAYLOCK | 87   | MRK3 $e^+e^- \rightarrow D_s^\pm \gamma X$ |

<sup>1</sup> Assuming  $D_s^\pm$  mass = 1968.7  $\pm$  0.9 MeV.

## $m_{D_s^{*\pm}} - m_{D_s^\pm}$

The fit includes  $D_s^\pm, D_s^0, D_s^{*\pm}, D^{*0}, D_s^{*+}, D_1(2420)^0, D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID           | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|------|-----------------------|------|--------------------------------------------|
| <b>143.8 <math>\pm</math> 0.4 OUR FIT</b>                                     |      |                       |      |                                            |
| <b>143.9 <math>\pm</math> 0.4 OUR AVERAGE</b>                                 |      |                       |      |                                            |
| 143.76 $\pm$ 0.39 $\pm$ 0.40                                                  |      | GRONBERG              | 95   | CLE2 $e^+e^-$                              |
| 144.22 $\pm$ 0.47 $\pm$ 0.37                                                  |      | BROWN                 | 94   | CLE2 $e^+e^-$                              |
| 142.5 $\pm$ 0.8 $\pm$ 1.5                                                     |      | <sup>2</sup> ALBRECHT | 88   | ARG $e^+e^- \rightarrow D_s^\pm \gamma X$  |
| 139.5 $\pm$ 8.3 $\pm$ 9.7                                                     | 60   | AIHARA                | 84D  | TPC $e^+e^- \rightarrow$ hadrons           |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |      |                                            |
| 143.0 $\pm$ 18.0                                                              | 8    | ASRATYAN              | 85   | HLBC FNAL 15-ft, $\nu$ - <sup>2</sup> H    |
| 110 $\pm$ 46                                                                  |      | BRANDELIK             | 79   | DASP $e^+e^- \rightarrow D_s^\pm \gamma X$ |

<sup>2</sup> Result includes data of ALBRECHT 84B.

## $D_s^{*\pm}$ WIDTH

| VALUE (MeV)                                                                   | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|-----|-------------|------|--------------------------------------------|
| <b>&lt; 1.9</b>                                                               | 90  | GRONBERG    | 95   | CLE2 $e^+e^-$                              |
| < 4.5                                                                         | 90  | ALBRECHT    | 88   | ARG $E_{cm}^{ee} = 10.2$ GeV               |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                            |
| < 4.9                                                                         | 90  | BROWN       | 94   | CLE2 $e^+e^-$                              |
| < 22                                                                          | 90  | BLAYLOCK    | 87   | MRK3 $e^+e^- \rightarrow D_s^\pm \gamma X$ |

## $D_s^{*+}$ DECAY MODES

$D_s^{*-}$  modes are charge conjugates of the modes below.

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ )    |
|--------------------------------|-----------------------------------|
| $\Gamma_1 \quad D_s^+ \gamma$  | (93.5 $\pm$ 0.7) %                |
| $\Gamma_2 \quad D_s^+ \pi^0$   | ( 5.8 $\pm$ 0.7) %                |
| $\Gamma_3 \quad D_s^+ e^+ e^-$ | ( 6.7 $\pm$ 1.6) $\times 10^{-3}$ |

NODE=MXXX040

NODE=MXXX040

NODE=S074

NODE=S074

NODE=S074M

NODE=S074M

NODE=S074M

NODE=S074M;LINKAGE=E

NODE=S074DM

NODE=S074DM

NODE=S074DM

NODE=S074DM;LINKAGE=A

NODE=S074W

NODE=S074W

NODE=S074215;NODE=S074

NODE=S074

DESIG=1

DESIG=2

DESIG=3

## CONSTRAINED FIT INFORMATION

An overall fit to 2 branching ratios uses 3 measurements and one constraint to determine 3 parameters. The overall fit has a  $\chi^2 = 0.0$  for 1 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|       |       |       |
|-------|-------|-------|
| $x_2$ | −97   |       |
| $x_3$ | −19   | −4    |
|       | $x_1$ | $x_2$ |

## $D_s^{*+}$ BRANCHING RATIOS

NODE=S074220

 $\Gamma(D_s^{*+} \gamma) / \Gamma_{\text{total}}$  $\Gamma_1 / \Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=S074R1  
NODE=S074R1

**0.935 ± 0.007 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |           |     |      |                                        |
|------|-----------|-----|------|----------------------------------------|
| seen | ASRATYAN  | 91  | HLBC | $\bar{\nu}_\mu \text{Ne}$              |
| seen | ALBRECHT  | 88  | ARG  | $e^+ e^- \rightarrow D_s^\pm \gamma X$ |
| seen | AIHARA    | 84D |      |                                        |
| seen | ALBRECHT  | 84B |      |                                        |
| seen | BRANDELIK | 79  |      |                                        |

 $\Gamma(D_s^{*+} \pi^0) / \Gamma(D_s^{*+} \gamma)$  $\Gamma_2 / \Gamma_1$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=S074R2  
NODE=S074R2

**0.062 ± 0.008 OUR FIT****0.062 ± 0.008 OUR AVERAGE**

|                                      |           |     |      |                                           |
|--------------------------------------|-----------|-----|------|-------------------------------------------|
| 0.062 ± 0.005 ± 0.006                | AUBERT,BE | 05G | BABR | 10.6 $e^+ e^- \rightarrow \text{hadrons}$ |
| 0.062 $^{+0.020}_{-0.018} \pm 0.022$ | GRONBERG  | 95  | CLE2 | $e^+ e^-$                                 |

 $\Gamma(D_s^{*+} e^+ e^-) / \Gamma(D_s^{*+} \gamma)$  $\Gamma_3 / \Gamma_1$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

NODE=S074R01  
NODE=S074R01

**7.2 ± 1.7 OUR FIT**

|                                                |    |                |      |                                           |
|------------------------------------------------|----|----------------|------|-------------------------------------------|
| <b>7.2 <math>^{+1.5}_{-1.3} \pm 1.0</math></b> | 38 | CRONIN-HEN..12 | CLEO | 4.17 $e^+ e^- \rightarrow \text{hadrons}$ |
|------------------------------------------------|----|----------------|------|-------------------------------------------|

## $D_s^{*\pm}$ REFERENCES

NODE=S074

|                 |               |                                   |                     |             |
|-----------------|---------------|-----------------------------------|---------------------|-------------|
| CRONIN-HEN...12 | PR D86 072005 | D. Cronin-Hennessey <i>et al.</i> | (CLEO Collab.)      | REFID=54627 |
| AUBERT,BE 05G   | PR D72 091101 | B. Aubert <i>et al.</i>           | (BABAR Collab.)     | REFID=50942 |
| GRONBERG 95     | PRL 75 3232   | J. Gronberg <i>et al.</i>         | (CLEO Collab.)      | REFID=44568 |
| BROWN 94        | PR D50 1884   | D. Brown <i>et al.</i>            | (CLEO Collab.)      | REFID=43868 |
| ASRATYAN 91     | PL B257 525   | A.E. Asratyan <i>et al.</i>       | (ITEP, BELG, SACL+) | REFID=41582 |
| ALBRECHT 88     | PL B207 349   | H. Albrecht <i>et al.</i>         | (ARGUS Collab.)     | REFID=40269 |
| BLAYLOCK 87     | PRL 58 2171   | G.T. Blaylock <i>et al.</i>       | (Mark III Collab.)  | REFID=40005 |
| ASRATYAN 85     | PL 156B 441   | A.E. Asratyan <i>et al.</i>       | (ITEP, SERP)        | REFID=22887 |
| AIHARA 84D      | PRL 53 2465   | H. Aihara <i>et al.</i>           | (TPC Collab.)       | REFID=11561 |
| ALBRECHT 84B    | PL 146B 111   | H. Albrecht <i>et al.</i>         | (ARGUS Collab.)     | REFID=22886 |
| BRANDELIK 79    | PL 80B 412    | R. Brandelik <i>et al.</i>        | (DASP Collab.)      | REFID=11442 |

$$D_{s0}^*(2317)^\pm$$

$$I(J^P) = 0(0^+)$$

$J, P$  need confirmation.

AUBERT 06P and CHOI 15A do not observe neutral and doubly charged partners of the  $D_{s0}^*(2317)^+$ .

NODE=M172

NODE=M172

### $D_{s0}^*(2317)^\pm$ MASS

The fit includes  $D^\pm, D^0, D_s^\pm, D^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M172M

NODE=M172M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN     | COMMENT                                                |
|-------------------------------------------------------------------------------|------|-----------------------|----------|--------------------------------------------------------|
| <b>2317.8±0.5 OUR FIT</b>                                                     |      |                       |          |                                                        |
| <b>2318.0±0.7 OUR AVERAGE</b>                                                 |      |                       |          |                                                        |
| 2318.3±1.2±1.2                                                                | 115  | <sup>1</sup> ABLIKIM  | 18J BES3 | 4.6 $e^+e^- \rightarrow D_s^{*\pm} D_{s0}^*(2317)^\mp$ |
| 2319.6±0.2±1.4                                                                | 3.1k | AUBERT                | 06P BABR | 10.6 $e^+e^- \rightarrow D_s^+ \pi^0 X$                |
| 2317.3±0.4±0.8                                                                | 1.0k | <sup>2</sup> AUBERT   | 04E BABR | 10.6 $e^+e^-$                                          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |          |                                                        |
| 2317.2±1.3                                                                    | 88   | <sup>3</sup> AUBERT,B | 04S BABR | $B \rightarrow D_{s0}^{(*)}(2317)^+ \bar{D}^{(*)}$     |
| 2317.2±0.5±0.9                                                                | 761  | <sup>4</sup> MIKAMI   | 04 BELL  | 10.6 $e^+e^-$                                          |
| 2316.8±0.4±3.0                                                                | 1.2k | <sup>4,5</sup> AUBERT | 03G BABR | 10.6 $e^+e^-$                                          |
| 2317.6±1.3                                                                    | 273  | <sup>4,6</sup> AUBERT | 03G BABR | 10.6 $e^+e^-$                                          |
| 2319.8±2.1±2.0                                                                | 24   | <sup>4</sup> KROKOVNY | 03B BELL | 10.6 $e^+e^-$                                          |

NODE=M172M

OCCUR=2

<sup>1</sup> From a fit of the  $D_s^*$  recoil mass where the  $D_{s0}^*(2317)$  signal is described with a Crystal Ball function convolved with a Gaussian function.

<sup>2</sup> Supersedes AUBERT 03G.

<sup>3</sup> Systematic errors not evaluated.

<sup>4</sup> Not independent of the corresponding  $m_{D_{s0}^*(2317)} - m_{D_s^*}$ .

<sup>5</sup> From  $D_s^+ \rightarrow K^+ K^- \pi^+$  decay.

<sup>6</sup> From  $D_s^+ \rightarrow K^+ K^- \pi^+ \pi^0$  decay.

NODE=M172M;LINKAGE=A

NODE=M172M;LINKAGE=AU

NODE=M172M;LINKAGE=AB

NODE=M172M;LINKAGE=B1

NODE=M172M;LINKAGE=A1

NODE=M172M;LINKAGE=A2

$$m_{D_{s0}^*(2317)^\pm} - m_{D_s^\pm}$$

The fit includes  $D^\pm, D^0, D_s^\pm, D^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M172DM

NODE=M172DM

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID             | TECN     | COMMENT       |
|-------------------------------------------------------------------------------|------|-------------------------|----------|---------------|
| <b>349.4±0.5 OUR FIT</b>                                                      |      |                         |          |               |
| <b>349.2±0.7 OUR AVERAGE</b>                                                  |      |                         |          |               |
| 348.7±0.5±0.7                                                                 | 761  | MIKAMI                  | 04 BELL  | 10.6 $e^+e^-$ |
| 350.0±1.2±1.0                                                                 | 135  | BESSON                  | 03 CLE2  | 10.6 $e^+e^-$ |
| 351.3±2.1±1.9                                                                 | 24   | <sup>7</sup> KROKOVNY   | 03B BELL | 10.6 $e^+e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                         |          |               |
| 349.6±0.4±3.0                                                                 | 1267 | <sup>8,9</sup> AUBERT   | 03G BABR | 10.6 $e^+e^-$ |
| 350.2±1.3                                                                     | 273  | <sup>10,11</sup> AUBERT | 03G BABR | 10.6 $e^+e^-$ |

NODE=M172DM

OCCUR=2

<sup>7</sup> Recalculated by us using  $m_{D_s^+} = 1968.5 \pm 0.6$  MeV.

<sup>8</sup> From  $D_s^+ \rightarrow K^+ K^- \pi^+$  decay.

<sup>9</sup> Recalculated by us using  $m_{D_s^+} = 1967.20 \pm 0.03$  MeV.

<sup>10</sup> From  $D_s^+ \rightarrow K^+ K^- \pi^+ \pi^0$  decay.

<sup>11</sup> Recalculated by us using  $m_{D_s^+} = 1967.4 \pm 0.2$  MeV. Systematic errors not estimated.

NODE=M172DM;LINKAGE=K3

NODE=M172DM;LINKAGE=A1

NODE=M172DM;LINKAGE=C1

NODE=M172DM;LINKAGE=A2

NODE=M172DM;LINKAGE=C2

$$D_{s0}^*(2317)^\pm \text{ WIDTH}$$

| VALUE (MeV)                                                                   | CL%  | EVTS   | DOCUMENT ID | TECN                                    | COMMENT       |
|-------------------------------------------------------------------------------|------|--------|-------------|-----------------------------------------|---------------|
| <b>&lt; 3.8</b>                                                               |      |        |             |                                         |               |
| 95                                                                            | 3180 | AUBERT | 06P BABR    | 10.6 $e^+e^- \rightarrow D_s^+ \pi^0 X$ |               |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |        |             |                                         |               |
| < 4.6                                                                         | 90   | 761    | MIKAMI      | 04 BELL                                 | 10.6 $e^+e^-$ |
| <10                                                                           |      |        | AUBERT      | 03G BABR                                | 10.6 $e^+e^-$ |
| < 7                                                                           | 90   | 135    | BESSON      | 03 CLE2                                 | 10.6 $e^+e^-$ |

NODE=M172W

NODE=M172W

**$D_{s0}^*(2317)^\pm$  DECAY MODES**

NODE=M172215;NODE=M172

 $D_{s0}^*(2317)^-$  modes are charge conjugates of modes below.

NODE=M172

| Mode                                  | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|---------------------------------------|--------------------------------|------------------|
| $\Gamma_1 \quad D_s^+ \pi^0$          | $(100^{+0}_{-20}) \%$          |                  |
| $\Gamma_2 \quad D_s^+ \gamma$         | $< 5 \%$                       | 90%              |
| $\Gamma_3 \quad D_s^*(2112)^+ \gamma$ | $< 6 \%$                       | 90%              |
| $\Gamma_4 \quad D_s^+ \gamma \gamma$  | $< 18 \%$                      | 95%              |
| $\Gamma_5 \quad D_s^*(2112)^+ \pi^0$  | $< 11 \%$                      | 90%              |
| $\Gamma_6 \quad D_s^+ \pi^+ \pi^-$    | $< 4 \times 10^{-3}$           | 90%              |
| $\Gamma_7 \quad D_s^+ \pi^0 \pi^0$    | not seen                       |                  |

DESIG=1

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=6

DESIG=7;OUR EVAL;→ UNCHECKED ←

 **$D_{s0}^*(2317)^\pm$  BRANCHING RATIOS**

NODE=M172220

| $\Gamma(D_s^+ \pi^0)/\Gamma_{\text{total}}$ |      |             |      |         | $\Gamma_1/\Gamma$                                       |
|---------------------------------------------|------|-------------|------|---------|---------------------------------------------------------|
| VALUE                                       | EVTS | DOCUMENT ID | TECN | COMMENT |                                                         |
| $1.00^{+0.00+0.00}_{-0.14-0.14}$            | 47   | ABLIKIM     | 18J  | BES3    | $4.6 e^+ e^- \rightarrow D_s^{*\pm} D_{s0}^*(2317)^\mp$ |

NODE=M172R1  
NODE=M172R1

• • • We do not use the following data for averages, fits, limits, etc. • • •  
seen 1.5k AUBERT 03G BABR  $10.6 e^+ e^-$

| $\Gamma(D_s^+ \gamma)/\Gamma(D_s^+ \pi^0)$                                    |     |             |      |         | $\Gamma_2/\Gamma_1$ |
|-------------------------------------------------------------------------------|-----|-------------|------|---------|---------------------|
| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT |                     |
| <b>&lt;0.05</b>                                                               | 90  | MIKAMI      | 04   | BELL    | $10.6 e^+ e^-$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |         |                     |
| <0.14                                                                         | 95  | AUBERT      | 06P  | BABR    | $10.6 e^+ e^-$      |
| <0.052                                                                        | 90  | BESSION     | 03   | CLE2    | $10.6 e^+ e^-$      |

NODE=M172R5  
NODE=M172R5

| $\Gamma(D_s^*(2112)^+ \gamma)/\Gamma(D_s^+ \pi^0)$                            |     |             |      |         | $\Gamma_3/\Gamma_1$ |
|-------------------------------------------------------------------------------|-----|-------------|------|---------|---------------------|
| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT |                     |
| <b>&lt;0.059</b>                                                              | 90  | BESSION     | 03   | CLE2    | $10.6 e^+ e^-$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |         |                     |
| <0.16                                                                         | 95  | AUBERT      | 06P  | BABR    | $10.6 e^+ e^-$      |
| <0.18                                                                         | 90  | MIKAMI      | 04   | BELL    | $10.6 e^+ e^-$      |

NODE=M172R6  
NODE=M172R6

| $\Gamma(D_s^+ \gamma \gamma)/\Gamma(D_s^+ \pi^0)$                             |     |             |      |         | $\Gamma_4/\Gamma_1$ |
|-------------------------------------------------------------------------------|-----|-------------|------|---------|---------------------|
| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT |                     |
| <b>&lt;0.18</b>                                                               | 95  | AUBERT      | 06P  | BABR    | $10.6 e^+ e^-$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |         |                     |
| not seen                                                                      |     | AUBERT      | 03G  | BABR    | $10.6 e^+ e^-$      |

NODE=M172R7  
NODE=M172R7

| $\Gamma(D_s^*(2112)^+ \pi^0)/\Gamma(D_s^+ \pi^0)$ |     |             |      |         | $\Gamma_5/\Gamma_1$ |
|---------------------------------------------------|-----|-------------|------|---------|---------------------|
| VALUE                                             | CL% | DOCUMENT ID | TECN | COMMENT |                     |
| <b>&lt;0.11</b>                                   | 90  | BESSION     | 03   | CLE2    | $10.6 e^+ e^-$      |

NODE=M172R8  
NODE=M172R8

| $\Gamma(D_s^+ \pi^+ \pi^-)/\Gamma(D_s^+ \pi^0)$                               |     |             |      |         | $\Gamma_6/\Gamma_1$ |
|-------------------------------------------------------------------------------|-----|-------------|------|---------|---------------------|
| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT |                     |
| <b>&lt;0.004</b>                                                              | 90  | MIKAMI      | 04   | BELL    | $10.6 e^+ e^-$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |         |                     |
| <0.005                                                                        | 95  | AUBERT      | 06P  | BABR    | $10.6 e^+ e^-$      |
| <0.019                                                                        | 90  | BESSION     | 03   | CLE2    | $10.6 e^+ e^-$      |

NODE=M172R9  
NODE=M172R9

| $\Gamma(D_s^+ \pi^0 \pi^0)/\Gamma(D_s^+ \pi^0)$ |     |             |      |         | $\Gamma_7/\Gamma_1$ |
|-------------------------------------------------|-----|-------------|------|---------|---------------------|
| VALUE                                           | CL% | DOCUMENT ID | TECN | COMMENT |                     |
| <b>&lt;0.25</b>                                 | 95  | AUBERT      | 06P  | BABR    | $10.6 e^+ e^-$      |

NODE=M172R10  
NODE=M172R10

**$D_{s0}^*(2317)^\pm$  REFERENCES**

|          |     |               |                           |                  |
|----------|-----|---------------|---------------------------|------------------|
| ABLIKIM  | 18J | PR D97 051103 | M. Ablikim <i>et al.</i>  | (BESIII Collab.) |
| CHOI     | 15A | PR D91 092011 | S.-K. Choi <i>et al.</i>  | (BELLE Collab.)  |
| AUBERT   | 06P | PR D74 032007 | B. Aubert <i>et al.</i>   | (BABAR Collab.)  |
| AUBERT   | 04E | PR D69 031101 | B. Aubert <i>et al.</i>   | (BABAR Collab.)  |
| AUBERT,B | 04S | PRL 93 181801 | B. Aubert <i>et al.</i>   | (BABAR Collab.)  |
| MIKAMI   | 04  | PRL 92 012002 | Y. Mikami <i>et al.</i>   | (BELLE Collab.)  |
| AUBERT   | 03G | PRL 90 242001 | B. Aubert <i>et al.</i>   | (BABAR Collab.)  |
| BESSION  | 03  | PR D68 032002 | D. Besson <i>et al.</i>   | (CLEO Collab.)   |
| KROKOVNY | 03B | PRL 91 262002 | P. Krokovny <i>et al.</i> | (BELLE Collab.)  |

NODE=M172

REFID=58895  
REFID=56577  
REFID=51144  
REFID=49747  
REFID=50195  
REFID=49629  
REFID=49417  
REFID=49583  
REFID=49615

 **$D_{s1}(2460)^\pm$** 

$$I(J^P) = 0(1^+)$$

NODE=M173

 **$D_{s1}(2460)^\pm$  MASS**

NODE=M173M

The fit includes  $D^\pm$ ,  $D^0$ ,  $D_s^\pm$ ,  $D^{*\pm}$ ,  $D^{*0}$ ,  $D_s^{*\pm}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ ,  
and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M173M

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

NODE=M173M

**2459.5±0.6 OUR FIT** Error includes scale factor of 1.1.**2459.6±0.9 OUR AVERAGE** Error includes scale factor of 1.3.2460.1±0.2±0.8 <sup>1</sup> AUBERT 06P BABR 10.6 e<sup>+</sup>e<sup>-</sup>2458.0±1.0±1.0 195 AUBERT 04E BABR 10.6 e<sup>+</sup>e<sup>-</sup>

• • • We do not use the following data for averages, fits, limits, etc. • • •

2459.5±1.2±3.7 920 AUBERT 06P BABR 10.6 e<sup>+</sup>e<sup>-</sup> →  $D_s^+ \gamma X$ 

OCCUR=2

2458.6±1.0±2.5 560 AUBERT 06P BABR 10.6 e<sup>+</sup>e<sup>-</sup> →  $D_s^+ \pi^0 \gamma X$ 

OCCUR=3

2460.2±0.2±0.8 123 AUBERT 06P BABR 10.6 e<sup>+</sup>e<sup>-</sup> →  $D_s^+ \pi^+ \pi^- X$ 

OCCUR=4

2458.9±1.5 112 <sup>2</sup> AUBERT,B 04S BABR  $B \rightarrow D_{s1}(2460)^+ \bar{D}^{(*)}$ 2461.1±1.6 139 <sup>3</sup> AUBERT,B 04S BABR  $B \rightarrow D_{s1}(2460)^+ \bar{D}^{(*)}$ 

OCCUR=2

2456.5±1.3±1.3 126 <sup>4,5</sup> MIKAMI 04 BELL 10.6 e<sup>+</sup>e<sup>-</sup>2459.5±1.3±2.0 152 <sup>6,7</sup> MIKAMI 04 BELL 10.6 e<sup>+</sup>e<sup>-</sup>

OCCUR=2

2459.9±0.9±1.6 60 <sup>6,7</sup> MIKAMI 04 BELL 10.6 e<sup>+</sup>e<sup>-</sup>

OCCUR=3

2459.2±1.6±2.0 57 KROKOVNY 03B BELL 10.6 e<sup>+</sup>e<sup>-</sup><sup>1</sup> The average of the values obtained from the  $D_s^+ \gamma$ ,  $D_s^+ \pi^0 \gamma$ ,  $D_s^+ \pi^+ \pi^-$  final state.

NODE=M173M;LINKAGE=UB

<sup>2</sup> Systematic errors not evaluated. From the decay to  $D_s^{*+} \pi^0$ .

NODE=M173M;LINKAGE=AU

<sup>3</sup> Systematic errors not evaluated. From the decay to  $D_s^+ \gamma$ .

NODE=M173M;LINKAGE=AB

<sup>4</sup> Not independent of the corresponding  $m_{D_{s1}(2460)^\pm} - m_{D_s^{*\pm}}$ .

NODE=M173M;LINKAGE=B1

<sup>5</sup> Using  $m_{D_s^{*+}} = 2112.4 \pm 0.7$  MeV.

NODE=M173M;LINKAGE=B2

<sup>6</sup> Not independent of the corresponding  $m_{D_{s1}(2460)^\pm} - m_{D_s^\pm}$ .

NODE=M173M;LINKAGE=B3

<sup>7</sup> Using  $m_{D_s^+} = 1968.5 \pm 0.6$  MeV.

NODE=M173M;LINKAGE=B4

 **$m_{D_{s1}(2460)^\pm} - m_{D_s^{*\pm}}$** 

NODE=M173MD

The fit includes  $D^\pm$ ,  $D^0$ ,  $D_s^\pm$ ,  $D^{*\pm}$ ,  $D^{*0}$ ,  $D_s^{*\pm}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ ,  
and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M173MD

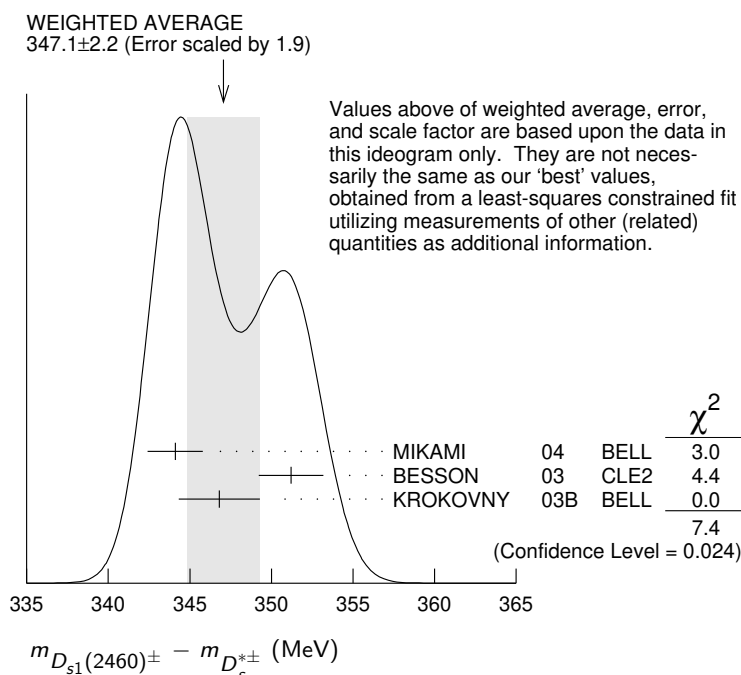
| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

NODE=M173MD

**347.3±0.7 OUR FIT** Error includes scale factor of 1.2.**347.1±2.2 OUR AVERAGE** Error includes scale factor of 1.9. See the ideogram below.344.1±1.3±1.1 126 MIKAMI 04 BELL 10.6 e<sup>+</sup>e<sup>-</sup>351.2±1.7±1.0 41 BESSION 03 CLE2 10.6 e<sup>+</sup>e<sup>-</sup>346.8±1.6±1.9 57 <sup>8</sup> KROKOVNY 03B BELL 10.6 e<sup>+</sup>e<sup>-</sup>

<sup>8</sup> Recalculated by us using  $m_{D_s^{*+}} = 2112.4 \pm 0.7$  MeV.

NODE=M173MD;LINKAGE=K3



### $m_{D_{s1}(2460)^{\pm}} - m_{D_s^{\pm}}$

The fit includes  $D^{\pm}$ ,  $D^0$ ,  $D_s^{\pm}$ ,  $D^{*\pm}$ ,  $D^{*0}$ ,  $D_s^{*\pm}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ , and  $D_{s1}(2536)^{\pm}$  mass and mass difference measurements.

NODE=M173DM

NODE=M173DM

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**491.2±0.6 OUR FIT** Error includes scale factor of 1.1.

**491.3±1.4 OUR AVERAGE**

|               |     |                      |    |      |               |
|---------------|-----|----------------------|----|------|---------------|
| 491.0±1.3±1.9 | 152 | <sup>9</sup> MIKAMI  | 04 | BELL | 10.6 $e^+e^-$ |
| 491.4±0.9±1.5 | 60  | <sup>10</sup> MIKAMI | 04 | BELL | 10.6 $e^+e^-$ |

<sup>9</sup> From the decay to  $D_s^{\pm}\gamma$ .

<sup>10</sup> From the decay to  $D_s^{\pm}\pi^+\pi^-$ .

NODE=M173DM

OCCUR=2

NODE=M173DM;LINKAGE=M1

NODE=M173DM;LINKAGE=M2

### $D_{s1}(2460)^{\pm}$ WIDTH

NODE=M173W

| VALUE (MeV) | CL% | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|-----|------|-------------|------|---------|
|-------------|-----|------|-------------|------|---------|

|       |    |     |        |     |                                                 |
|-------|----|-----|--------|-----|-------------------------------------------------|
| < 3.5 | 95 | 123 | AUBERT | 06P | BABR 10.6 $e^+e^- \rightarrow D_s^+\pi^+\pi^-X$ |
|-------|----|-----|--------|-----|-------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |     |        |     |                                                   |
|-------|----|-----|--------|-----|---------------------------------------------------|
| < 6.3 | 95 | 560 | AUBERT | 06P | BABR 10.6 $e^+e^- \rightarrow D_s^+\pi^0\gamma X$ |
| < 10  |    | 195 | AUBERT | 04E | BABR 10.6 $e^+e^-$                                |
| < 5.5 | 90 | 126 | MIKAMI | 04  | BELL 10.6 $e^+e^-$                                |
| < 7   | 90 | 41  | BESSON | 03  | CLE2 10.6 $e^+e^-$                                |

NODE=M173W

OCCUR=2

### $D_{s1}(2460)^+$ DECAY MODES

NODE=M173215;NODE=M173

$D_{s1}(2460)^-$  modes are charge conjugates of the modes below.

NODE=M173

| Mode                         | Fraction ( $\Gamma_i/\Gamma$ ) | Scale factor/<br>Confidence level |
|------------------------------|--------------------------------|-----------------------------------|
| $\Gamma_1$ $D_s^{*+}\pi^0$   | (48 ± 11) %                    |                                   |
| $\Gamma_2$ $D_s^+\gamma$     | (18 ± 4) %                     |                                   |
| $\Gamma_3$ $D_s^+\pi^+\pi^-$ | (4.3 ± 1.3) %                  | S=1.1                             |
| $\Gamma_4$ $D_s^{*+}\gamma$  | < 8 %                          | CL=90%                            |

DESIG=1

DESIG=2

DESIG=3

DESIG=4

|            |                           |                          |         |
|------------|---------------------------|--------------------------|---------|
| $\Gamma_5$ | $D_{s0}^*(2317)^+ \gamma$ | $(3.7^{+5.0}_{-2.4}) \%$ | DESIG=5 |
| $\Gamma_6$ | $D_s^+ \pi^0$             |                          | DESIG=7 |
| $\Gamma_7$ | $D_s^+ \pi^0 \pi^0$       |                          | DESIG=8 |
| $\Gamma_8$ | $D_s^+ \gamma \gamma$     |                          | DESIG=9 |

### CONSTRAINED FIT INFORMATION

An overall fit to 7 branching ratios uses 8 measurements and one constraint to determine 5 parameters. The overall fit has a  $\chi^2 = 3.4$  for 4 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|       |       |       |       |
|-------|-------|-------|-------|
| $x_2$ | 80    |       |       |
| $x_3$ | 68    | 62    |       |
| $x_5$ | -3    | 25    | 26    |
|       | $x_1$ | $x_2$ | $x_3$ |

### $D_{s1}(2460)^\pm$ BRANCHING RATIOS

NODE=M173220

$\Gamma(D_s^{*+} \pi^0) / \Gamma_{\text{total}}$   $\Gamma_1 / \Gamma$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.48 ± 0.11 OUR FIT****0.56 ± 0.13 ± 0.09** <sup>11</sup> AUBERT 06N BABR  $B \rightarrow D_{s1}(2460)^- \bar{D}^*$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

seen 41 BESSON 03 CLE2 10.6  $e^+ e^-$ <sup>11</sup> Evaluated in AUBERT 06N including measurements from AUBERT,B 04s.NODE=M173R1  
NODE=M173R1

NODE=M173R1;LINKAGE=AU

$\Gamma(D_s^+ \gamma) / \Gamma_{\text{total}}$   $\Gamma_2 / \Gamma$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.18 ± 0.04 OUR FIT****0.16 ± 0.04 ± 0.03** <sup>12</sup> AUBERT 06N BABR  $B \rightarrow D_{s1}(2460)^- \bar{D}^*$ <sup>12</sup> Evaluated in AUBERT 06N including measurements from AUBERT,B 04s.NODE=M173R6  
NODE=M173R6

NODE=M173R6;LINKAGE=AU

$\Gamma(D_s^+ \gamma) / \Gamma(D_s^{*+} \pi^0)$   $\Gamma_2 / \Gamma_1$

| VALUE | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|-----|------|-------------|------|---------|
|-------|-----|------|-------------|------|---------|

**0.38 ± 0.05 OUR FIT****0.44 ± 0.09 OUR AVERAGE**0.55 ± 0.13 ± 0.08 152 MIKAMI 04 BELL 10.6  $e^+ e^-$ 0.38 ± 0.11 ± 0.04 38 KROKOVNY 03B BELL 10.6  $e^+ e^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.274 ± 0.045 ± 0.020 251 <sup>13</sup> AUBERT,B 04S BABR  $B \rightarrow D_{s1}(2460)^+ \bar{D}^*$ < 0.49 90 BESSON 03 CLE2 10.6  $e^+ e^-$ <sup>13</sup> Used by AUBERT 06N in their measurement of  $B(D_s^{*-} \pi^0)$  and  $B(D_s^- \gamma)$ .NODE=M173R2  
NODE=M173R2

NODE=M173R2;LINKAGE=AU

$\Gamma(D_s^+ \pi^+ \pi^-) / \Gamma(D_s^{*+} \pi^0)$   $\Gamma_3 / \Gamma_1$

| VALUE | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|-----|------|-------------|------|---------|
|-------|-----|------|-------------|------|---------|

**0.090 ± 0.020 OUR FIT** Error includes scale factor of 1.2.**0.14 ± 0.04 ± 0.02** 60 MIKAMI 04 BELL 10.6  $e^+ e^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 0.08 90 BESSON 03 CLE2 10.6  $e^+ e^-$ NODE=M173R3  
NODE=M173R3

$\Gamma(D_s^{*+} \gamma) / \Gamma(D_s^{*+} \pi^0)$   $\Gamma_4 / \Gamma_1$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

**< 0.16** 90 BESSON 03 CLE2 10.6  $e^+ e^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 0.31 90 MIKAMI 04 BELL 10.6  $e^+ e^-$ NODE=M173R4  
NODE=M173R4

| $\Gamma(D_{s0}^*(2317)^+\gamma)/\Gamma(D_s^{*+}\pi^0)$                                    |                                     |             |      |                    | $\Gamma_5/\Gamma_1$            | NODE=M173R5<br>NODE=M173R5   |
|-------------------------------------------------------------------------------------------|-------------------------------------|-------------|------|--------------------|--------------------------------|------------------------------|
| VALUE                                                                                     | CL%                                 | DOCUMENT ID | TECN | COMMENT            |                                |                              |
| <b>&lt;0.22</b>                                                                           | 95                                  | AUBERT      | 04E  | BABR 10.6 $e^+e^-$ |                                |                              |
| • • • We do not use the following data for averages, fits, limits, etc. • • •             |                                     |             |      |                    |                                |                              |
| <0.58                                                                                     | 90                                  | BESSION     | 03   | CLE2 10.6 $e^+e^-$ |                                |                              |
| $\Gamma(D_s^{*+}\pi^0)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$          |                                     |             |      |                    | $\Gamma_1/(\Gamma_1+\Gamma_5)$ | NODE=M173R7<br>NODE=M173R7   |
| VALUE                                                                                     |                                     | DOCUMENT ID | TECN | COMMENT            |                                |                              |
| <b>0.93±0.09 OUR FIT</b>                                                                  |                                     |             |      |                    |                                |                              |
| <b>0.97±0.09±0.05</b>                                                                     |                                     | AUBERT      | 06P  | BABR 10.6 $e^+e^-$ |                                |                              |
| $\Gamma(D_s^+\gamma)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$            |                                     |             |      |                    | $\Gamma_2/(\Gamma_1+\Gamma_5)$ | NODE=M173R8<br>NODE=M173R8   |
| VALUE                                                                                     |                                     | DOCUMENT ID | TECN | COMMENT            |                                |                              |
| <b>0.35 ±0.04 OUR FIT</b>                                                                 |                                     |             |      |                    |                                |                              |
| <b>0.337±0.036±0.038</b>                                                                  |                                     | AUBERT      | 06P  | BABR 10.6 $e^+e^-$ |                                |                              |
| $\Gamma(D_s^+\pi^+\pi^-)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$        |                                     |             |      |                    | $\Gamma_3/(\Gamma_1+\Gamma_5)$ | NODE=M173R9<br>NODE=M173R9   |
| VALUE                                                                                     |                                     | DOCUMENT ID | TECN | COMMENT            |                                |                              |
| <b>0.083±0.017 OUR FIT</b>                                                                | Error includes scale factor of 1.2. |             |      |                    |                                |                              |
| <b>0.077±0.013±0.008</b>                                                                  |                                     | AUBERT      | 06P  | BABR 10.6 $e^+e^-$ |                                |                              |
| $\Gamma(D_s^{*+}\gamma)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$         |                                     |             |      |                    | $\Gamma_4/(\Gamma_1+\Gamma_5)$ | NODE=M173R10<br>NODE=M173R10 |
| VALUE                                                                                     | CL%                                 | DOCUMENT ID | TECN | COMMENT            |                                |                              |
| <b>&lt;0.24</b>                                                                           | 95                                  | AUBERT      | 06P  | BABR 10.6 $e^+e^-$ |                                |                              |
| $\Gamma(D_{s0}^*(2317)^+\gamma)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$ |                                     |             |      |                    | $\Gamma_5/(\Gamma_1+\Gamma_5)$ | NODE=M173R11<br>NODE=M173R11 |
| VALUE                                                                                     | CL%                                 | DOCUMENT ID | TECN | COMMENT            |                                |                              |
| <b>&lt;0.25</b>                                                                           | 95                                  | AUBERT      | 06P  | BABR 10.6 $e^+e^-$ |                                |                              |
| $\Gamma(D_s^+\pi^0)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$             |                                     |             |      |                    | $\Gamma_6/(\Gamma_1+\Gamma_5)$ | NODE=M173R12<br>NODE=M173R12 |
| VALUE                                                                                     | CL%                                 | DOCUMENT ID | TECN | COMMENT            |                                |                              |
| <b>&lt;0.042</b>                                                                          | 95                                  | AUBERT      | 06P  | BABR 10.6 $e^+e^-$ |                                |                              |
| $\Gamma(D_s^+\pi^0\pi^0)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$        |                                     |             |      |                    | $\Gamma_7/(\Gamma_1+\Gamma_5)$ | NODE=M173R13<br>NODE=M173R13 |
| VALUE                                                                                     | CL%                                 | DOCUMENT ID | TECN | COMMENT            |                                |                              |
| <b>&lt;0.68</b>                                                                           | 95                                  | AUBERT      | 06P  | BABR 10.6 $e^+e^-$ |                                |                              |
| $\Gamma(D_s^+\gamma\gamma)/[\Gamma(D_s^{*+}\pi^0) + \Gamma(D_{s0}^*(2317)^+\gamma)]$      |                                     |             |      |                    | $\Gamma_8/(\Gamma_1+\Gamma_5)$ | NODE=M173R14<br>NODE=M173R14 |
| VALUE                                                                                     | CL%                                 | DOCUMENT ID | TECN | COMMENT            |                                |                              |
| <b>&lt;0.33</b>                                                                           | 95                                  | AUBERT      | 06P  | BABR 10.6 $e^+e^-$ |                                |                              |

### $D_{s1}(2460)^\pm$ REFERENCES

NODE=M173

|          |     |               |                           |                 |             |
|----------|-----|---------------|---------------------------|-----------------|-------------|
| AUBERT   | 06N | PR D74 031103 | B. Aubert <i>et al.</i>   | (BABAR Collab.) | REFID=51142 |
| AUBERT   | 06P | PR D74 032007 | B. Aubert <i>et al.</i>   | (BABAR Collab.) | REFID=51144 |
| AUBERT   | 04E | PR D69 031101 | B. Aubert <i>et al.</i>   | (BABAR Collab.) | REFID=49747 |
| AUBERT,B | 04S | PRL 93 181801 | B. Aubert <i>et al.</i>   | (BABAR Collab.) | REFID=50195 |
| MIKAMI   | 04  | PRL 92 012002 | Y. Mikami <i>et al.</i>   | (BELLE Collab.) | REFID=49629 |
| BESSION  | 03  | PR D68 032002 | D. Besson <i>et al.</i>   | (CLEO Collab.)  | REFID=49583 |
| KROKOVNY | 03B | PRL 91 262002 | P. Krokovny <i>et al.</i> | (BELLE Collab.) | REFID=49615 |



**$D_{s1}(2536)^\pm$**  $I(J^P) = 0(1^+)$   
 $J, P$  need confirmation.Seen in  $D^*(2010)^+ K^0$ ,  $D^*(2007)^0 K^+$ , and  $D_s^+ \pi^+ \pi^-$ . Not seen in  $D^+ K^0$  or  $D^0 K^+$ .  $J^P = 1^+$  assignment strongly favored.

NODE=M121

NODE=M121

 **$D_{s1}(2536)^\pm$  MASS**

NODE=M121M

The fit includes  $D^\pm$ ,  $D^0$ ,  $D_s^\pm$ ,  $D^{*\pm}$ ,  $D^{*0}$ ,  $D_s^{*\pm}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M121M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN     | COMMENT                                                  |
|-------------------------------------------------------------------------------|------|------------------------|----------|----------------------------------------------------------|
| <b>2535.11±0.06 OUR FIT</b>                                                   |      |                        |          |                                                          |
| <b>2535.21±0.28 OUR AVERAGE</b>                                               |      |                        |          |                                                          |
| 2537.7 ±0.5 ±3.1                                                              | 24   | <sup>1</sup> ABLIKIM   | 19P BES3 | $4.6 e^+ e^- \rightarrow D_s^+ \bar{D}^0 K^-$            |
| 2535.7 ±0.6 ±0.5                                                              | 46   | <sup>2</sup> ABAZOV    | 09G D0   | $B_s^0 \rightarrow D_{s1}^- \mu^+ \nu_\mu X$             |
| 2534.78±0.31±0.40                                                             | 182  | AUBERT                 | 08B BABR | $B \rightarrow \bar{D}^{(*)} D^* K$                      |
| 2534.6 ±0.3 ±0.7                                                              | 193  | AUBERT                 | 06P BABR | $10.6 e^+ e^- \rightarrow D_s^+ \pi^+ \pi^- X$           |
| 2535.3 ±0.7                                                                   | 92   | <sup>3</sup> HEISTER   | 02B ALEP | $e^+ e^- \rightarrow D^{*+} K^0 X$ ,<br>$D^{*0} K^+ X$   |
| 2534.2 ±1.2                                                                   | 9    | ASRATYAN               | 94 BEBC  | $\nu N \rightarrow D^* K^0 X, D^{*0} K^\pm X$            |
| 2535 ±0.6 ±1                                                                  | 75   | FRABETTI               | 94B E687 | $\gamma Be \rightarrow D^{*+} K^0 X$ ,<br>$D^{*0} K^+ X$ |
| 2535.2 ±0.5 ±1.5                                                              | 28   | ALBRECHT               | 92R ARG  | $10.4 e^+ e^- \rightarrow D^{*0} K^+ X$                  |
| 2536.6 ±0.7 ±0.4                                                              |      | AVERY                  | 90 CLEO  | $e^+ e^- \rightarrow D^{*+} K^0 X$                       |
| 2535.9 ±0.6 ±2.0                                                              |      | ALBRECHT               | 89E ARG  | $D_{s1}^* \rightarrow D^*(2010) K^0$                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |          |                                                          |
| 2534.1 ±0.6                                                                   | 116  | <sup>4</sup> AUSHEV    | 11 BELL  | $B \rightarrow D_{s1}(2536)^+ D^{(*)}$                   |
| 2535.08±0.01±0.15                                                             | 8038 | <sup>5</sup> LEES      | 11B BABR | $10.6 e^+ e^- \rightarrow D^{*+} K_S^0 X$                |
| 2535.57 <sup>+0.44</sup> <sub>-0.41</sub> ±0.10                               | 236  | <sup>6</sup> CHEKANOV  | 09 ZEUS  | $e^\pm p \rightarrow D^{*+} K_S^0 X$ ,<br>$D^{*0} K^+ X$ |
| 2535.3 ±0.2 ±0.5                                                              | 134  | <sup>7</sup> ALEXANDER | 93 CLE2  | $e^+ e^- \rightarrow D^{*0} K^+ X$                       |
| 2534.8 ±0.6 ±0.6                                                              | 44   | <sup>8</sup> ALEXANDER | 93 CLE2  | $e^+ e^- \rightarrow D^{*+} K^0 X$                       |
| 2535 ± 28                                                                     |      | <sup>9</sup> ASRATYAN  | 88 HLBC  | $\nu N \rightarrow D_s \gamma \gamma X$                  |

NODE=M121M

OCCUR=2

- <sup>1</sup> From a fit of the  $D_s^+$  recoil mass distribution with an incoherent sum of the  $S$ -wave and  $D$ -wave Breit-Wigner line shapes.
- <sup>2</sup> Using the  $D^*(2010)^\pm$  mass of  $2010.0 \pm 0.4$  MeV from PDG 06.
- <sup>3</sup> Calculated using  $m(D^*(2010)^\pm) = 2010.0 \pm 0.5$  MeV,  $m(D^*(2007)^0) = 2006.7 \pm 0.5$  MeV, and the mass difference below.
- <sup>4</sup> Systematic uncertainties not evaluated.
- <sup>5</sup> Calculated using the mass difference  $m(D_{s1}^+) - m(D^{*+})_{PDG}$  below and  $m(D^{*+})_{PDG} = 2010.25 \pm 0.14$  MeV. Assuming  $S$ -wave decay of the  $D_{s1}(2536)$  to  $D^{*+} K_S^0$ , using a Breit-Wigner line shape corresponding to  $L=0$ .
- <sup>6</sup> Calculated using the mass difference  $m(D_{s1}^+) - m(D^{*+})_{PDG}$  reported below and  $m(D^{*+})_{PDG} = 2010.27 \pm 0.17$  MeV.
- <sup>7</sup> Calculated using  $m(D^*(2007)^0) = 2006.6 \pm 0.5$  MeV and the mass difference below.
- <sup>8</sup> Calculated using  $m(D^*(2010)^\pm) = 2010.1 \pm 0.6$  MeV and the mass difference below.
- <sup>9</sup> Not seen in  $D^* K$ .

NODE=M121M;LINKAGE=D

NODE=M121M;LINKAGE=AB

NODE=M121M;LINKAGE=HI

NODE=M121M;LINKAGE=AU

NODE=M121M;LINKAGE=LE

NODE=M121M;LINKAGE=CH

NODE=M121M;LINKAGE=A

NODE=M121M;LINKAGE=C

NODE=M121M;LINKAGE=B

 **$m_{D_{s1}(2536)^\pm} - m_{D_s^*(2111)}$** 

NODE=M121DM

The fit includes  $D^\pm$ ,  $D^0$ ,  $D_s^\pm$ ,  $D^{*\pm}$ ,  $D^{*0}$ ,  $D_s^{*\pm}$ ,  $D_1(2420)^0$ ,  $D_2^*(2460)^0$ , and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M121DM

| VALUE (MeV)               | DOCUMENT ID | TECN    | COMMENT             |
|---------------------------|-------------|---------|---------------------|
| <b>422.9± 0.4 OUR FIT</b> |             |         |                     |
| <b>424 ±28</b>            | ASRATYAN    | 88 HLBC | $D_s^{*\pm} \gamma$ |

NODE=M121DM

 **$m_{D_{s1}(2536)^\pm} - m_{D^*(2010)^\pm}$** 

NODE=M121DN

The fit includes  $D^\pm, D^0, D_s^\pm, D^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ ,  
and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M121DN

| VALUE (MeV)                                                                                                                               | EVTS     | DOCUMENT ID        | TECN     | COMMENT                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------------|----------|----------------------------------------------------------|
| <b>524.85±0.04 OUR FIT</b>                                                                                                                |          |                    |          |                                                          |
| <b>524.84±0.04 OUR AVERAGE</b>                                                                                                            |          |                    |          |                                                          |
| 524.83±0.01±0.04                                                                                                                          | 8038     | <sup>10</sup> LEES | 11B BABR | 10.6 $e^+e^- \rightarrow D^{*+} K_S^0 X$                 |
| 525.30 <sup>+0.44</sup> <sub>-0.41</sub> ±0.10                                                                                            | 236 ± 30 | CHEKANOV           | 09 ZEUS  | $e^\pm p \rightarrow D^{*+} K_S^0 X$ ,<br>$D^{*0} K^+ X$ |
| 525.3 ±0.6 ±0.1                                                                                                                           | 41       | HEISTER            | 02B ALEP | $e^+e^- \rightarrow D^{*+} K^0 X$                        |
| 524.7 ±0.6 ±0.2                                                                                                                           | 44       | ALEXANDER          | 93 CLE2  | $e^+e^- \rightarrow D^{*+} K_S^0 X$                      |
| <sup>10</sup> Assuming $S$ -wave decay of the $D_{s1}(2536)$ to $D^{*+} K_S^0$ , using a Breit-Wigner line shape corresponding to $L=0$ . |          |                    |          |                                                          |

NODE=M121DN

OCCUR=2

NODE=M121DN;LINKAGE=LE

### $m_{D_{s1}(2536)^\pm} = m_{D^*(2007)^0}$

The fit includes  $D^\pm, D^0, D_s^\pm, D^{*\pm}, D^{*0}, D_s^{*\pm}, D_1(2420)^0, D_2^*(2460)^0$ ,  
and  $D_{s1}(2536)^\pm$  mass and mass difference measurements.

NODE=M121DP

NODE=M121DP

| VALUE (MeV)                                                    | EVTS | DOCUMENT ID | TECN     | COMMENT                           |
|----------------------------------------------------------------|------|-------------|----------|-----------------------------------|
| <b>528.26±0.05 OUR FIT</b> Error includes scale factor of 1.2. |      |             |          |                                   |
| <b>528.68±0.28 OUR AVERAGE</b>                                 |      |             |          |                                   |
| 528.7 ±1.9 ±0.5                                                | 51   | HEISTER     | 02B ALEP | $e^+e^- \rightarrow D^{*0} K^+ X$ |
| 527.3 ±2.2                                                     | 29   | ACKERSTAFF  | 97W OPAL | $e^+e^- \rightarrow D^{*0} K^+ X$ |
| 528.7 ±0.2 ±0.2                                                | 134  | ALEXANDER   | 93 CLE2  | $e^+e^- \rightarrow D^{*0} K^+ X$ |

NODE=M121DP

OCCUR=2

### $D_{s1}(2536)^\pm$ WIDTH

NODE=M121W

NODE=M121W

| VALUE (MeV)                                                                   | CL% EVTS | DOCUMENT ID           | TECN     | COMMENT                                                  |
|-------------------------------------------------------------------------------|----------|-----------------------|----------|----------------------------------------------------------|
| <b>0.92±0.05 OUR AVERAGE</b>                                                  |          |                       |          |                                                          |
| 1.7 ±1.2 ±0.6                                                                 | 24       | <sup>11</sup> ABLIKIM | 19P BES3 | 4.6 $e^+e^- \rightarrow D_s^+ \bar{D}^0 K^-$             |
| 0.92±0.03±0.04                                                                | 8038     | <sup>12</sup> LEES    | 11B BABR | 10.6 $e^+e^- \rightarrow D^{*+} K_S^0 X$                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |          |                       |          |                                                          |
| 0.75±0.23                                                                     | 116      | <sup>13</sup> AUSHEV  | 11 BELL  | $B \rightarrow D_{s1}(2536)^+ D^{(*)}$                   |
| < 2.5                                                                         | 95       | 193 AUBERT            | 06P BABR | 10.6 $e^+e^- \rightarrow D_s^+ \pi^+ \pi^- X$            |
| < 3.2                                                                         | 90       | 75 FRABETTI           | 94B E687 | $\gamma Be \rightarrow D^{*+} K^0 X$ ,<br>$D^{*0} K^+ X$ |
| < 2.3                                                                         | 90       | ALEXANDER             | 93 CLEO  | $e^+e^- \rightarrow D^{*0} K^+ X$                        |
| < 3.9                                                                         | 90       | ALBRECHT              | 92R ARG  | 10.4 $e^+e^- \rightarrow D^{*0} K^+ X$                   |
| < 5.44                                                                        | 90       | AVERY                 | 90 CLEO  | $e^+e^- \rightarrow D^{*+} K^0 X$                        |
| < 4.6                                                                         | 90       | ALBRECHT              | 89E ARG  | $D_{s1}^* \rightarrow D^*(2010) K^0$                     |

<sup>11</sup> From a fit of the  $D_s^+$  recoil mass distribution with an incoherent sum of the  $S$ -wave and  $S$ -wave Breit-Wigner line shapes.

<sup>12</sup> Assuming  $S$ -wave decay of the  $D_{s1}(2536)$  to  $D^{*+} K_S^0$ , using a Breit-Wigner line shape corresponding to  $L=0$ .

<sup>13</sup> Systematic uncertainties not evaluated.

NODE=M121W;LINKAGE=A

NODE=M121W;LINKAGE=LE

NODE=M121W;LINKAGE=AU

### $D_{s1}(2536)^+$ DECAY MODES

NODE=M121215;NODE=M121

NODE=M121

$D_{s1}(2536)^-$  modes are charge conjugates of the modes below.

| Mode                                    | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|-----------------------------------------|--------------------------------|------------------|
| $\Gamma_1$ $D^*(2010)^+ K^0$            | 0.85 ±0.12                     | DESIG=1          |
| $\Gamma_2$ $(D^*(2010)^+ K^0)_{S-wave}$ | 0.61 ±0.09                     | DESIG=7          |
| $\Gamma_3$ $(D^*(2010)^+ K^0)_{D-wave}$ |                                | DESIG=9          |
| $\Gamma_4$ $D^+ \pi^- K^+$              | 0.028±0.005                    | DESIG=8          |
| $\Gamma_5$ $D^*(2007)^0 K^+$            | <b>DEFINED AS 1</b>            | DESIG=4          |
| $\Gamma_6$ $D^+ K^0$                    | <0.34                          | 90%<br>DESIG=2   |
| $\Gamma_7$ $D^0 K^+$                    | <0.12                          | 90%<br>DESIG=5   |
| $\Gamma_8$ $D_s^{*+} \gamma$            | possibly seen                  | DESIG=3          |
| $\Gamma_9$ $D_s^+ \pi^+ \pi^-$          | seen                           | DESIG=6          |

**$D_{s1}(2536)^+$  BRANCHING RATIOS**

NODE=M121220

 **$\Gamma(D^*(2007)^0 K^+)/\Gamma(D^*(2010)^+ K^0)$**  **$\Gamma_5/\Gamma_1$** 

| VALUE                        | EVTS     | DOCUMENT ID              | TECN | COMMENT                                                   |
|------------------------------|----------|--------------------------|------|-----------------------------------------------------------|
| <b>1.18±0.16 OUR AVERAGE</b> |          |                          |      |                                                           |
| 0.88±0.24±0.08               | 116      | AUSHEV                   | 11   | BELL $B \rightarrow D_{s1}(2536)^+ D^{(*)}$               |
| 2.3 ±0.6 ±0.3                | 236 ± 30 | CHEKANOV                 | 09   | ZEUS $e^\pm p \rightarrow D^{*+} K_S^0 X$ ,               |
| 1.32±0.47±0.23               | 92       | <sup>14</sup> HEISTER    | 02B  | ALEP $e^+ e^- \rightarrow D^{*+} K^0 X$ ,                 |
| 1.9 $^{+1.1}_{-0.9}$ ±0.4    | 35       | <sup>14</sup> ACKERSTAFF | 97W  | OPAL $e^+ e^- \rightarrow D^{*0} K^+ X$ ,                 |
| 1.1 ±0.3                     |          | ALEXANDER                | 93   | CLEO $e^+ e^- \rightarrow D^{*+} K^0 X$                   |
| 1.4 ±0.3 ±0.2                |          | <sup>15</sup> ALBRECHT   | 92R  | ARG $10.4 e^+ e^- \rightarrow D^{*0} K^+ X, D^{*+} K^0 X$ |

<sup>14</sup> Ratio of the production rates measured in  $Z^0$  decays.<sup>15</sup> Evaluated by us from published inclusive cross-sections.NODE=M121R6  
NODE=M121R6NODE=M121R6;LINKAGE=6A  
NODE=M121R6;LINKAGE=A **$\Gamma((D^*(2010)^+ K^0)_{S\text{-wave}})/\Gamma(D^*(2010)^+ K^0)$**  **$\Gamma_2/\Gamma_1$** 

| VALUE                 | EVTS | DOCUMENT ID | TECN | COMMENT                                      |
|-----------------------|------|-------------|------|----------------------------------------------|
| <b>0.72±0.05±0.01</b> | 5485 | BALAGURA    | 08   | BELL $10.6 e^+ e^- \rightarrow D^{*+} K^0 X$ |

NODE=M121R8  
NODE=M121R8 **$\Gamma(D^+ \pi^- K^+)/\Gamma(D^*(2010)^+ K^0)$**  **$\Gamma_4/\Gamma_1$** 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                         |
|--------------------------|------|-------------|------|-------------------------------------------------|
| <b>3.27±0.18±0.37</b>    | 1264 | BALAGURA    | 08   | BELL $10.6 e^+ e^- \rightarrow D^+ \pi^- K^+ X$ |

NODE=M121R9  
NODE=M121R9 **$\Gamma(D^+ K^0)/\Gamma(D^*(2010)^+ K^0)$**  **$\Gamma_6/\Gamma_1$** 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------|-----|-------------|------|------------------------------------------|
| <b>&lt;0.40</b>                                                               | 90  | ALEXANDER   | 93   | CLEO $e^+ e^- \rightarrow D^{*+} K^0 X$  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                          |
| <0.43                                                                         | 90  | ALBRECHT    | 89E  | ARG $D_{s1}^* \rightarrow D^*(2010) K^0$ |

NODE=M121R1  
NODE=M121R1 **$\Gamma(D^0 K^+)/\Gamma(D^*(2007)^0 K^+)$**  **$\Gamma_7/\Gamma_5$** 

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|-----------------|-----|-------------|------|-----------------------------------------|
| <b>&lt;0.12</b> | 90  | ALEXANDER   | 93   | CLEO $e^+ e^- \rightarrow D^{*0} K^+ X$ |

NODE=M121R4  
NODE=M121R4 **$\Gamma(D_s^{*+} \gamma)/\Gamma_{\text{total}}$**  **$\Gamma_8/\Gamma$** 

| VALUE                | DOCUMENT ID | TECN | COMMENT                                      |
|----------------------|-------------|------|----------------------------------------------|
| <b>possibly seen</b> | ASRATYAN    | 88   | HLBC $\nu N \rightarrow D_s \gamma \gamma X$ |

NODE=M121R3  
NODE=M121R3 **$\Gamma(D_s^{*+} \gamma)/\Gamma(D^*(2007)^0 K^+)$**  **$\Gamma_8/\Gamma_5$** 

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                                 |
|-----------------|-----|-------------|------|-----------------------------------------|
| <b>&lt;0.42</b> | 90  | ALEXANDER   | 93   | CLEO $e^+ e^- \rightarrow D^{*0} K^+ X$ |

NODE=M121R5  
NODE=M121R5 **$\Gamma(D_s^+ \pi^+ \pi^-)/\Gamma_{\text{total}}$**  **$\Gamma_9/\Gamma$** 

| VALUE       | DOCUMENT ID | TECN | COMMENT                                             |
|-------------|-------------|------|-----------------------------------------------------|
| <b>seen</b> | AUBERT      | 06P  | BABR $10.6 e^+ e^- \rightarrow D_s^+ \pi^+ \pi^- X$ |

NODE=M121R7  
NODE=M121R7 **$D_{s1}(2536)^\pm$  REFERENCES**

NODE=M121

|            |     |                |                             |                     |             |
|------------|-----|----------------|-----------------------------|---------------------|-------------|
| ABLIKIM    | 19P | CP C43 031001  | M. Ablikim <i>et al.</i>    | (BESIII Collab.)    | REFID=59617 |
| AUSHEV     | 11  | PR D83 051102  | T. Aushev <i>et al.</i>     | (BELLE Collab.)     | REFID=16505 |
| LEES       | 11B | PR D83 072003  | J.P. Lees <i>et al.</i>     | (BABAR Collab.)     | REFID=16773 |
| ABAZOV     | 09G | PRL 102 051801 | V.M. Abazov <i>et al.</i>   | (D0 Collab.)        | REFID=52652 |
| CHEKANOV   | 09  | EPJ C60 25     | S. Chekanov <i>et al.</i>   | (ZEUS Collab.)      | REFID=52733 |
| AUBERT     | 08B | PR D77 011102  | B. Aubert <i>et al.</i>     | (BABAR Collab.)     | REFID=52120 |
| BALAGURA   | 08  | PR D77 032001  | V. Balagura <i>et al.</i>   | (BELLE Collab.)     | REFID=52133 |
| AUBERT     | 06P | PR D74 032007  | B. Aubert <i>et al.</i>     | (BABAR Collab.)     | REFID=51144 |
| PDG        | 06  | JP G33 1       | W.-M. Yao <i>et al.</i>     | (PDG Collab.)       | REFID=51004 |
| HEISTER    | 02B | PL B526 34     | A. Heister <i>et al.</i>    | (ALEPH Collab.)     | REFID=48562 |
| ACKERSTAFF | 97W | ZPHY C76 425   | K. Ackerstaff <i>et al.</i> | (OPAL Collab.)      | REFID=45788 |
| ASRATYAN   | 94  | ZPHY C61 563   | A.E. Asratyan <i>et al.</i> | (BIRM, BELG, CERN+) | REFID=43667 |
| FRABETTI   | 94B | PRL 72 324     | P.L. Frabetti <i>et al.</i> | (FNAL E687 Collab.) | REFID=43687 |
| ALEXANDER  | 93  | PL B303 377    | J. Alexander <i>et al.</i>  | (CLEO Collab.)      | REFID=43316 |
| ALBRECHT   | 92R | PL B297 425    | H. Albrecht <i>et al.</i>   | (ARGUS Collab.)     | REFID=43179 |
| AVERY      | 90  | PR D41 774     | P. Avery, D. Besson         | (CLEO Collab.)      | REFID=41013 |
| ALBRECHT   | 89E | PL B230 162    | H. Albrecht <i>et al.</i>   | (ARGUS Collab.)     | REFID=40914 |
| ASRATYAN   | 88  | ZPHY C40 483   | A.E. Asratyan <i>et al.</i> | (ITEP, SERP)        | REFID=40916 |

$D_{s2}^*(2573)$

$$I(J^P) = 0(2^+)$$

$J^P$  is natural, width and decay modes consistent with  $2^+$ .  
AAIJ 14AW confirms  $J^P = 2^+$ .

NODE=M148

NODE=M148

NODE=M148M

NODE=M148M

### $D_{s2}^*(2573)$ MASS

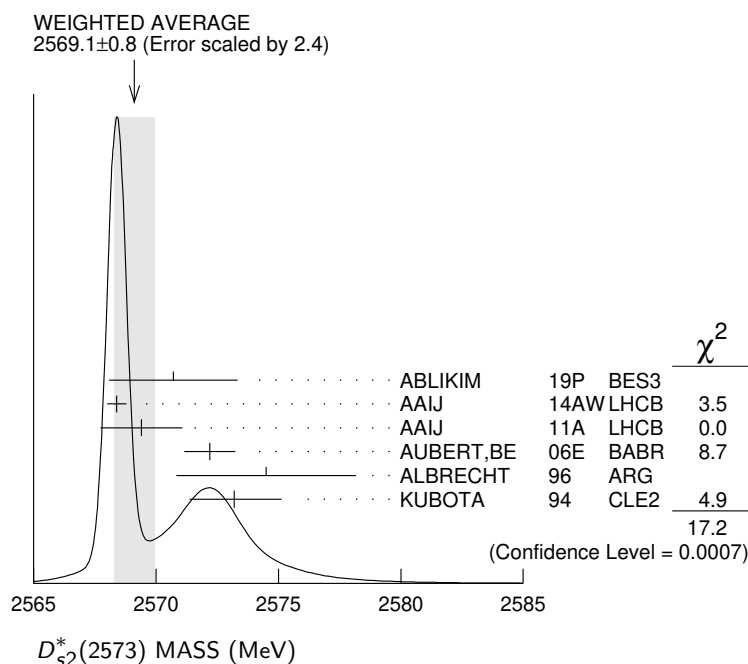
| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN      | COMMENT                                          |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|-----------|--------------------------------------------------|
| <b>2569.1 ±0.8 OUR AVERAGE</b>                                                |      | Error includes scale factor of 2.4. See the ideogram below. |           |                                                  |
| 2570.7 ±2.0 ±1.7                                                              | 62   | <sup>1</sup> ABLIKIM                                        | 19P BES3  | $4.6 e^+ e^- \rightarrow D_s^+ \bar{D}^0 K^-$    |
| 2568.39 ±0.29 ±0.26                                                           |      | AAIJ                                                        | 14AW LHCb | $B_s^0 \rightarrow \bar{D}^0 K^- \pi^+$          |
| 2569.4 ±1.6 ±0.5                                                              | 82   | AAIJ                                                        | 11A LHCb  | $B_s \rightarrow D_{s2}^*(2573) \mu \bar{\nu} X$ |
| 2572.2 ±0.3 ±1.0                                                              |      | AUBERT,BE                                                   | 06E BABR  | $e^+ e^- \rightarrow D K X$                      |
| 2574.5 ±3.3 ±1.6                                                              |      | ALBRECHT                                                    | 96 ARG    | $e^+ e^- \rightarrow D^0 K^+ X$                  |
| 2573.2 $^{+1.7}_{-1.6}$ ±0.9                                                  | 217  | KUBOTA                                                      | 94 CLE2   | $e^+ e^- \sim 10.5 \text{ GeV}$                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                             |           |                                                  |
| 2570.0 ±4.3                                                                   | 25   | <sup>2</sup> EVDOKIMOV                                      | 04 SELX   | $600 \Sigma^- A \rightarrow D^0 K^+ X$           |
| 2568.6 ±3.2                                                                   | 64   | <sup>3</sup> HEISTER                                        | 02B ALEP  | $e^+ e^- \rightarrow D^0 K^+ X$                  |

<sup>1</sup> From a fit of the  $D_s^+$  recoil mass distribution.

<sup>2</sup> Not independent of the mass difference below.

<sup>3</sup> Calculated using  $m_{D^0} = 1864.5 \pm 0.5 \text{ MeV}$  and the mass difference below.

NODE=M148M;LINKAGE=A  
NODE=M148M;LINKAGE=EV  
NODE=M148M;LINKAGE=HI



$$m_{D_{s2}^*(2573)} - m_{D^0}$$

NODE=M148DM

NODE=M148DM

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN     | COMMENT                                |
|-------------------------------------------------------------------------------|------|------------------------|----------|----------------------------------------|
| <b>704 ±3 ±1</b>                                                              | 64   | HEISTER                | 02B ALEP | $e^+ e^- \rightarrow D^0 K^+ X$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |          |                                        |
| 705.4 ±4.3                                                                    | 25   | <sup>1</sup> EVDOKIMOV | 04 SELX  | $600 \Sigma^- A \rightarrow D^0 K^+ X$ |
| <sup>1</sup> Systematic errors not estimated.                                 |      |                        |          |                                        |

NODE=M148DM;LINKAGE=EV

### $D_{s2}^*(2573)$ WIDTH

NODE=M148W

NODE=M148W

| VALUE (MeV)                  | EVTS | DOCUMENT ID          | TECN     | COMMENT                                       |
|------------------------------|------|----------------------|----------|-----------------------------------------------|
| <b>16.9 ±0.7 OUR AVERAGE</b> |      |                      |          |                                               |
| 17.2 ±3.6 ±1.1               | 62   | <sup>1</sup> ABLIKIM | 19P BES3 | $4.6 e^+ e^- \rightarrow D_s^+ \bar{D}^0 K^-$ |

|                       |     |           |      |      |                                                  |
|-----------------------|-----|-----------|------|------|--------------------------------------------------|
| 16.9±0.5±0.6          |     | AAIJ      | 14AW | LHCB | $B_s^0 \rightarrow \bar{D}^0 K^- \pi^+$          |
| 12.1±4.5±1.6          | 82  | AAIJ      | 11A  | LHCB | $B_s \rightarrow D_{s2}^*(2573) \mu \bar{\nu} X$ |
| 27.1±0.6±5.6          |     | AUBERT,BE | 06E  | BABR | $e^+ e^- \rightarrow D K X$                      |
| 10.4±8.3±3.0          |     | ALBRECHT  | 96   | ARG  | $e^+ e^- \rightarrow D^0 K^+ X$                  |
| 16 $^{+5}_{-4} \pm 3$ | 217 | KUBOTA    | 94   | CLE2 | $e^+ e^- \sim 10.5 \text{ GeV}$                  |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |    |                        |    |      |                                        |
|-----------------|----|------------------------|----|------|----------------------------------------|
| 14 $^{+9}_{-6}$ | 25 | <sup>2</sup> EVDOKIMOV | 04 | SELX | 600 $\Sigma^- A \rightarrow D^0 K^+ X$ |
|-----------------|----|------------------------|----|------|----------------------------------------|

<sup>1</sup> From a fit of the  $D_s^+$  recoil mass distribution .

<sup>2</sup> Systematic errors not estimated.

NODE=M148W;LINKAGE=A  
NODE=M148W;LINKAGE=EV

## $D_{s2}^*(2573)^+$ DECAY MODES

$D_{s2}^*(2573)^-$  modes are charge conjugates of the modes below.

| Mode                         | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------|--------------------------------|
| $\Gamma_1$ $D^0 K^+$         | seen                           |
| $\Gamma_2$ $D^*(2007)^0 K^+$ | not seen                       |
| $\Gamma_3$ $D^+ K_S^0$       |                                |
| $\Gamma_4$ $D^{*+} K_S^0$    |                                |

NODE=M148215;NODE=M148

NODE=M148

DESIG=1

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=4

DESIG=5

## $D_{s2}^*(2573)^+$ BRANCHING RATIOS

| $\Gamma(D^0 K^+)/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$                                    |
|-----------------------------------------|------------------------------------------------------|
| <u>VALUE</u>                            | <u>EVTS</u>                                          |
| <u>DOCUMENT ID</u>                      | <u>TECN</u>                                          |
| <u>CHG</u>                              | <u>COMMENT</u>                                       |
| seen                                    | 217 KUBOTA 94 CLE2 ± $e^+ e^- \sim 10.5 \text{ GeV}$ |

NODE=M148220

NODE=M148R2  
NODE=M148R2

| $\Gamma(D^*(2007)^0 K^+)/\Gamma(D^0 K^+)$ | $\Gamma_2/\Gamma_1$                                 |
|-------------------------------------------|-----------------------------------------------------|
| <u>VALUE</u>                              | <u>CL%</u>                                          |
| <u>DOCUMENT ID</u>                        | <u>TECN</u>                                         |
| <u>CHG</u>                                | <u>COMMENT</u>                                      |
| <0.33                                     | 90 KUBOTA 94 CLE2 + $e^+ e^- \sim 10.5 \text{ GeV}$ |

NODE=M148R1  
NODE=M148R1

| $\Gamma(D^{*+} K_S^0)/\Gamma(D^+ K_S^0)$ | $\Gamma_4/\Gamma_3$                                                          |
|------------------------------------------|------------------------------------------------------------------------------|
| <u>VALUE</u>                             | <u>EVTS</u>                                                                  |
| <u>DOCUMENT ID</u>                       | <u>TECN</u>                                                                  |
| <u>COMMENT</u>                           |                                                                              |
| 0.044±0.005±0.011                        | 2000 <sup>1</sup> AAIJ 16AW LHCB $pp \rightarrow D^{*+} K_S^0 X$ at 7, 8 TeV |

NODE=M148R00  
NODE=M148R00

<sup>1</sup> First observation of the  $D_{s2}^*(2573)^+ \rightarrow D^{*+} K_S^0$  decay with a significance of 6.9  $\sigma$ .

NODE=M148R00;LINKAGE=A

## $D_{s2}^*(2573)$ REFERENCES

|           |      |                |                              |                   |
|-----------|------|----------------|------------------------------|-------------------|
| ABLIKIM   | 19P  | CP C43 031001  | M. Ablikim <i>et al.</i>     | (BESIII Collab.)  |
| AAIJ      | 16AW | JHEP 1602 133  | R. Aaij <i>et al.</i>        | (LHCb Collab.)    |
| AAIJ      | 14AW | PRL 113 162001 | R. Aaij <i>et al.</i>        | (LHCb Collab.) JP |
| AAIJ      | 11A  | PL B698 14     | R. Aaij <i>et al.</i>        | (LHCb Collab.)    |
| AUBERT,BE | 06E  | PRL 97 222001  | B. Aubert <i>et al.</i>      | (BABAR Collab.)   |
| EVDOKIMOV | 04   | PRL 93 242001  | A.V. Evdokimov <i>et al.</i> | (SELEX Collab.)   |
| HEISTER   | 02B  | PL B526 34     | A. Heister <i>et al.</i>     | (ALEPH Collab.)   |
| ALBRECHT  | 96   | ZPHY C69 405   | H. Albrecht <i>et al.</i>    | (ARGUS Collab.)   |
| KUBOTA    | 94   | PRL 72 1972    | Y. Kubota <i>et al.</i>      | (CLEO Collab.)    |

NODE=M148

REFID=59617  
REFID=60464  
REFID=56105  
REFID=16665  
REFID=51512  
REFID=50337  
REFID=48562  
REFID=44631  
REFID=43781

NODE=M182

 $D_{s1}^*(2700)^\pm$ 

$$I(J^P) = 0(1^-)$$

 $D_{s1}^*(2700)^+$  MASS

NODE=M182M

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT  
**2714 ± 5 OUR AVERAGE** Error includes scale factor of 1.5. See the ideogram below.  
 [2708.3<sup>+4.0</sup><sub>-3.4</sub> MeV OUR 2020 AVERAGE]

NODE=M182M

NEW

|                                        |       |                     |           |                                             |
|----------------------------------------|-------|---------------------|-----------|---------------------------------------------|
| 2732.3 ± 4.3 ± 5.8                     | 15.7k | AAIJ                | 16AW LHCB | $pp \rightarrow D^{*+} K_S^0 X$ at 7, 8 TeV |
| 2699 <sup>+14</sup> <sub>-7</sub>      |       | <sup>1</sup> LEES   | 15C BABR  | $B \rightarrow D D^0 K^+$                   |
| 2709.2 ± 1.9 ± 4.5                     | 52k   | <sup>2</sup> AAIJ   | 12AU LHCB | $pp \rightarrow (DK)^+ X$ at 7 TeV          |
| 2710 ± 2 <sup>+12</sup> <sub>-7</sub>  | 10.4k | <sup>3</sup> AUBERT | 09AR BABR | $e^+ e^- \rightarrow D^{(*)} K X$           |
| 2708 ± 9 <sup>+11</sup> <sub>-10</sub> | 182   | BRODZICKA           | 08 BELL   | $B^+ \rightarrow D^0 \bar{D}^0 K^+$         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                       |  |                         |          |                                     |
|---------------------------------------|--|-------------------------|----------|-------------------------------------|
| 2694 ± 8 <sup>+13</sup> <sub>-3</sub> |  | LEES                    | 15C BABR | $B^0 \rightarrow D^- D^0 K^+$       |
| 2707 ± 8 ± 8                          |  | LEES                    | 15C BABR | $B^+ \rightarrow \bar{D}^0 D^0 K^+$ |
| 2688 ± 4 ± 3                          |  | <sup>4</sup> AUBERT, BE | 06E BABR | 10.6 $e^+ e^- \rightarrow DKX$      |

OCCUR=2

OCCUR=3

<sup>1</sup> From a combined analysis of  $B^0 \rightarrow D^- D^0 K^+$  and  $B^+ \rightarrow \bar{D}^0 D^0 K^+$ .

<sup>2</sup> From the combined fit of the  $D^+ K_S^0$  and  $D^0 K^+$  modes in the model including the  $D_{s2}^*(2573)^+$ ,  $D_{s1}^*(2700)^+$  and spin-0  $D_{sJ}^*(2860)^+$ .

<sup>3</sup> From simultaneous fits to the two  $DK$  mass spectra and to the total  $D^* K$  mass spectrum.

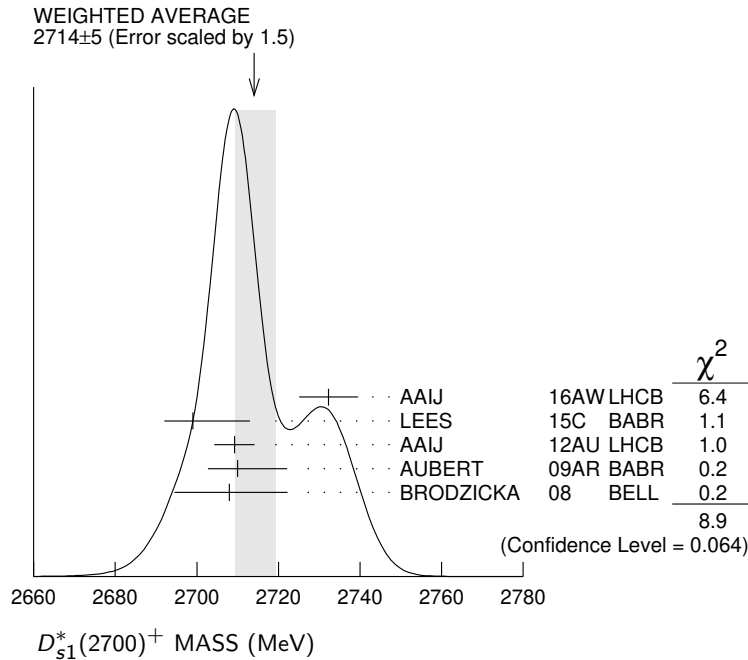
<sup>4</sup> Superseded by AUBERT 09AR.

NODE=M182M; LINKAGE=B

NODE=M182M; LINKAGE=AA

NODE=M182M; LINKAGE=AB

NODE=M182M; LINKAGE=AU

 $D_{s1}^*(2700)^+$  WIDTH

NODE=M182W

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT  
**122 ± 10 OUR AVERAGE**  
 [120 ± 11 MeV OUR 2020 AVERAGE]

NODE=M182W

NEW

|                                        |       |                     |           |                                             |
|----------------------------------------|-------|---------------------|-----------|---------------------------------------------|
| 136 ± 19 ± 24                          | 15.7k | AAIJ                | 16AW LHCB | $pp \rightarrow D^{*+} K_S^0 X$ at 7, 8 TeV |
| 127 <sup>+24</sup> <sub>-19</sub>      |       | <sup>1</sup> LEES   | 15C BABR  | $B \rightarrow D D^0 K^+$                   |
| 115.8 ± 7.3 ± 12.1                     | 52k   | <sup>2</sup> AAIJ   | 12AU LHCB | $pp \rightarrow (DK)^+ X$ at 7 TeV          |
| 149 ± 7 <sup>+39</sup> <sub>-52</sub>  | 10.4k | <sup>3</sup> AUBERT | 09AR BABR | $e^+ e^- \rightarrow D^{(*)} K X$           |
| 108 ± 23 <sup>+36</sup> <sub>-31</sub> | 182   | BRODZICKA           | 08 BELL   | $B^+ \rightarrow D^0 \bar{D}^0 K^+$         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |          |                |                        |     |      |                                     |
|-----|----------|----------------|------------------------|-----|------|-------------------------------------|
| 145 | $\pm 24$ | $^{+22}_{-14}$ | LEES                   | 15C | BABR | $B^0 \rightarrow D^- D^0 K^+$       |
| 113 | $\pm 21$ | $^{+20}_{-16}$ | LEES                   | 15C | BABR | $B^+ \rightarrow \bar{D}^0 D^0 K^+$ |
| 112 | $\pm 7$  | $\pm 36$       | <sup>4</sup> AUBERT,BE | 06E | BABR | $10.6 e^+ e^- \rightarrow DKX$      |

<sup>1</sup> From a combined analysis of  $B^0 \rightarrow D^- D^0 K^+$  and  $B^+ \rightarrow \bar{D}^0 D^0 K^+$ .

<sup>2</sup> From the combined fit of the  $D^+ K_S^0$  and  $D^0 K^+$  modes in the model including the  $D_{s2}^*(2573)^+$ ,  $D_{s1}^*(2700)^+$  and spin-0  $D_{sJ}^*(2860)^+$ .

<sup>3</sup> From simultaneous fits to the two  $DK$  mass spectra and to the total  $D^* K$  mass spectrum.

<sup>4</sup> Superseded by AUBERT 09AR.

OCCUR=2

OCCUR=3

NODE=M182W;LINKAGE=A

NODE=M182W;LINKAGE=AA

NODE=M182W;LINKAGE=AB

NODE=M182W;LINKAGE=AU

### $D_{s1}^*(2700)^\pm$ DECAY MODES

NODE=M182215;NODE=M182

| Mode       |                |
|------------|----------------|
| $\Gamma_1$ | $DK$           |
| $\Gamma_2$ | $D^0 K^+$      |
| $\Gamma_3$ | $D^+ K_S^0$    |
| $\Gamma_4$ | $D^* K$        |
| $\Gamma_5$ | $D^{*0} K^+$   |
| $\Gamma_6$ | $D^{*+} K_S^0$ |

DESIG=2

DESIG=1

DESIG=3

DESIG=4

DESIG=5

DESIG=6

### $D_{s1}^*(2700)^\pm$ BRANCHING RATIOS

NODE=M182225

| $\Gamma(D^* K)/\Gamma(DK)$                 |       |                     |           | $\Gamma_4/\Gamma_1$               |  |
|--------------------------------------------|-------|---------------------|-----------|-----------------------------------|--|
| VALUE                                      | EVTS  | DOCUMENT ID         | TECN      | COMMENT                           |  |
| <b><math>0.91 \pm 0.13 \pm 0.12</math></b> | 10.4k | <sup>1</sup> AUBERT | 09AR BABR | $e^+ e^- \rightarrow D^{(*)} K X$ |  |

NODE=M182R01

NODE=M182R01

<sup>1</sup> From the average of the corresponding ratios with  $D^{(*)0} K^+$  and  $D^{(*)+} K_S^0$ .

NODE=M182R01;LINKAGE=AU

| $\Gamma(D^{*0} K^+)/\Gamma(D^0 K^+)$ |      |             |      | $\Gamma_5/\Gamma_2$ |  |
|--------------------------------------|------|-------------|------|---------------------|--|
| VALUE                                | EVTS | DOCUMENT ID | TECN | COMMENT             |  |

NODE=M182R02

NODE=M182R02

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |      |                     |           |                                   |
|--------------------------|------|---------------------|-----------|-----------------------------------|
| $0.88 \pm 0.14 \pm 0.14$ | 7716 | <sup>1</sup> AUBERT | 09AR BABR | $e^+ e^- \rightarrow D^{(*)} K X$ |
|--------------------------|------|---------------------|-----------|-----------------------------------|

<sup>1</sup> From the  $D^{*0} K^+$  and  $D^0 K^+$ , where  $D^{*0} \rightarrow D^0 \pi^0$ .

NODE=M182R02;LINKAGE=AU

| $\Gamma(D^{*+} K_S^0)/\Gamma(D^+ K_S^0)$ |      |             |      | $\Gamma_6/\Gamma_3$ |  |
|------------------------------------------|------|-------------|------|---------------------|--|
| VALUE                                    | EVTS | DOCUMENT ID | TECN | COMMENT             |  |

NODE=M182R03

NODE=M182R03

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |      |                     |           |                                   |
|--------------------------|------|---------------------|-----------|-----------------------------------|
| $1.14 \pm 0.39 \pm 0.23$ | 2700 | <sup>1</sup> AUBERT | 09AR BABR | $e^+ e^- \rightarrow D^{(*)} K X$ |
|--------------------------|------|---------------------|-----------|-----------------------------------|

<sup>1</sup> From the  $D^{*+} K_S^0$  and  $D^+ K_S^0$ , where  $D^{*+} \rightarrow D^+ \pi^0$ .

NODE=M182R03;LINKAGE=AU

### $D_{s1}^*(2700)^\pm$ REFERENCES

NODE=M182

|           |      |                |                            |                 |             |
|-----------|------|----------------|----------------------------|-----------------|-------------|
| AAIJ      | 16AW | JHEP 1602 133  | R. Aaij <i>et al.</i>      | (LHCb Collab.)  | REFID=60464 |
| LEES      | 15C  | PR D91 052002  | J.P. Lees <i>et al.</i>    | (BABAR Collab.) | REFID=56412 |
| AAIJ      | 12AU | JHEP 1210 151  | R. Aaij <i>et al.</i>      | (LHCb Collab.)  | REFID=54735 |
| AUBERT    | 09AR | PR D80 092003  | B. Aubert <i>et al.</i>    | (BABAR Collab.) | REFID=53135 |
| BRODZICKA | 08   | PRL 100 092001 | J. Brodzicka <i>et al.</i> | (BELLE Collab.) | REFID=52144 |
| AUBERT,BE | 06E  | PRL 97 222001  | B. Aubert <i>et al.</i>    | (BABAR Collab.) | REFID=51512 |

$$D_{s1}^*(2860)^\pm$$

$$I(J^P) = 0(1^-)$$

OMITTED FROM SUMMARY TABLE

$J^P$  consistent with  $1^-$  from angular analysis of AAIJ 14AW. Observed by AUBERT,BE 06E and AUBERT 09AR in inclusive production of  $DK$  and  $D^*K$  in  $e^+e^-$  annihilation.

NODE=M196

NODE=M196

### $D_{s1}^*(2860)^+$ MASS

NODE=M196M

NODE=M196M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN      | COMMENT                                 |
|-------------------------------------------------------------------------------|------|------------------------|-----------|-----------------------------------------|
| <b>2859 ±12 ±24</b>                                                           |      | <sup>1</sup> AAIJ      | 14AW LHCB | $B_s^0 \rightarrow \bar{D}^0 K^- \pi^+$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |           |                                         |
| 2866.1 ± 1.0 ± 6.3                                                            | 36k  | <sup>2,3</sup> AAIJ    | 12AU LHCB | $pp \rightarrow (DK)^+ X$ at 7 TeV      |
| 2862 ± 2 ± $\frac{5}{2}$                                                      | 3122 | <sup>3,4</sup> AUBERT  | 09AR BABR | $e^+e^- \rightarrow D^{(*)} K X$        |
| 2856.6 ± 1.5 ± 5.0                                                            |      | <sup>5</sup> AUBERT,BE | 06E BABR  | $e^+e^- \rightarrow DK X$               |

<sup>1</sup> Separated from the spin-3 component  $D_{s3}^*(2860)^-$  by a fit of the helicity angle of the  $\bar{D}^0 K^-$  system, with a statistical significance of the spin-3 and spin-1 components in excess of  $10\sigma$ .

<sup>2</sup> From the combined fit of the  $D^+ K_S^0$  and  $D^0 K^+$  modes in the model including the  $D_{s2}^*(2573)^+$ ,  $D_{s1}^*(2700)^+$  and spin-0  $D_{sJ}^*(2860)^+$ .

<sup>3</sup> Possible contribution from the  $D_{s3}^*(2860)$  state.

<sup>4</sup> From simultaneous fits to the two  $DK$  mass spectra and to the total  $D^*K$  mass spectrum.

<sup>5</sup> Superseded by AUBERT 09AR.

NODE=M196M;LINKAGE=A

NODE=M196M;LINKAGE=AA

NODE=M196M;LINKAGE=B  
NODE=M196M;LINKAGE=AB

NODE=M196M;LINKAGE=AU

### $D_{s1}^*(2860)^+$ WIDTH

NODE=M196W

NODE=M196W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN      | COMMENT                                 |
|-------------------------------------------------------------------------------|------|------------------------|-----------|-----------------------------------------|
| <b>159 ±23 ±77</b>                                                            |      | <sup>1</sup> AAIJ      | 14AW LHCB | $B_s^0 \rightarrow \bar{D}^0 K^- \pi^+$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |           |                                         |
| 69.9 ± 3.2 ± 6.6                                                              | 36k  | <sup>2,3</sup> AAIJ    | 12AU LHCB | $pp \rightarrow (DK)^+ X$ at 7 TeV      |
| 48 ± 3 ± 6                                                                    | 3122 | <sup>3,4</sup> AUBERT  | 09AR BABR | $e^+e^- \rightarrow D^{(*)} K X$        |
| 47 ± 7 ± 10                                                                   |      | <sup>5</sup> AUBERT,BE | 06E BABR  | $e^+e^- \rightarrow DK X$               |

<sup>1</sup> Separated from the spin-3 component  $D_{s3}^*(2860)^-$  by a fit of the helicity angle of the  $\bar{D}^0 K^-$  system, with a statistical significance of the spin-3 and spin-1 components in excess of  $10\sigma$ .

<sup>2</sup> From the combined fit of the  $D^+ K_S^0$  and  $D^0 K^+$  modes in the model including the  $D_{s2}^*(2573)^+$ ,  $D_{s1}^*(2700)^+$  and spin-0  $D_{sJ}^*(2860)^+$ .

<sup>3</sup> Possible contribution from the  $D_{s3}^*(2860)$  state.

<sup>4</sup> From simultaneous fits to the two  $DK$  mass spectra and to the total  $D^*K$  mass spectrum.

<sup>5</sup> Superseded by AUBERT 09AR.

NODE=M196W;LINKAGE=A

NODE=M196W;LINKAGE=AA

NODE=M196W;LINKAGE=B  
NODE=M196W;LINKAGE=AB

NODE=M196W;LINKAGE=AU

### $D_{s1}^*(2860)^\pm$ DECAY MODES

NODE=M196215;NODE=M196

| Mode       |                |
|------------|----------------|
| $\Gamma_1$ | $DK$           |
| $\Gamma_2$ | $D^0 K^+$      |
| $\Gamma_3$ | $D^+ K_S^0$    |
| $\Gamma_4$ | $D^* K$        |
| $\Gamma_5$ | $D^{*0} K^+$   |
| $\Gamma_6$ | $D^{*+} K_S^0$ |

DESIG=1

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=6

### $D_{s1}^*(2860)^\pm$ BRANCHING RATIOS

NODE=M196225

$\Gamma(D^*K)/\Gamma(DK)$

$\Gamma_4/\Gamma_1$

| VALUE                 | EVTS | DOCUMENT ID         | TECN      | COMMENT                          |
|-----------------------|------|---------------------|-----------|----------------------------------|
| <b>1.10±0.15±0.19</b> | 3122 | <sup>1</sup> AUBERT | 09AR BABR | $e^+e^- \rightarrow D^{(*)} K X$ |

<sup>1</sup> From the average of the corresponding ratios with  $D^{(*)0} K^+$  and  $D^{(*)+} K_S^0$ .

NODE=M196R01  
NODE=M196R01

NODE=M196R01;LINKAGE=AU



$\Gamma(D^{*0}K^+)/\Gamma(D^0K^+)$  $\Gamma_5/\Gamma_2$ 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.04±0.17±0.20      2241      <sup>1</sup> AUBERT      09AR BABR       $e^+e^- \rightarrow D^{(*)}KX$ <sup>1</sup> From the  $D^{*0}K^+$  and  $D^0K^+$ , where  $D^{*0} \rightarrow D^0\pi^0$ .NODE=M196R02  
NODE=M196R02

NODE=M196R02;LINKAGE=AU

 $\Gamma(D^{*+}K_S^0)/\Gamma(D^+K_S^0)$  $\Gamma_6/\Gamma_3$ 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.38±0.35±0.49      881      <sup>1</sup> AUBERT      09AR BABR       $e^+e^- \rightarrow D^{(*)}KX$ <sup>1</sup> From the  $D^{*+}K_S^0$  and  $D^+K_S^0$ , where  $D^{*+} \rightarrow D^+\pi^0$ .NODE=M196R03  
NODE=M196R03

NODE=M196R03;LINKAGE=AU

 $D_{s1}^*(2860)^\pm$  REFERENCES

|           |                     |                         |                   |
|-----------|---------------------|-------------------------|-------------------|
| AAIJ      | 14AW PRL 113 162001 | R. Aaij <i>et al.</i>   | (LHCb Collab.) JP |
| AAIJ      | 12AU JHEP 1210 151  | R. Aaij <i>et al.</i>   | (LHCb Collab.)    |
| AUBERT    | 09AR PR D80 092003  | B. Aubert <i>et al.</i> | (BABAR Collab.)   |
| AUBERT,BE | 06E PRL 97 222001   | B. Aubert <i>et al.</i> | (BABAR Collab.)   |

NODE=M196

REFID=56105  
REFID=54735  
REFID=53135  
REFID=51512

NODE=M226

 $D_{s3}^*(2860)^\pm$  $I(J^P) = 0(3^-)$ 

OMITTED FROM SUMMARY TABLE

 $J^P$  consistent with  $3^-$  from angular analysis of AAIJ 14AW.

NODE=M226

 $D_{s3}^*(2860)^+$  MASS

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**2860.5±2.6±6.5**      <sup>1</sup> AAIJ      14AW LHCb       $B_S^0 \rightarrow \bar{D}^0 K^- \pi^+$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

2867.1±4.3±1.9      3.1k      AAIJ      16AW LHCb       $pp \rightarrow D^{*+}K_S^0 X$  at 7, 8 TeV<sup>1</sup> Separated from the spin-1 component  $D_{s1}^*(2860)^-$  by a fit of the helicity angle of the  $\bar{D}^0 K^-$  system, with a statistical significance of the spin-3 and spin-1 components in excess of 10  $\sigma$ .

NODE=M226M

NODE=M226M

NODE=M226M;LINKAGE=A

 $D_{s3}^*(2860)^+$  WIDTH

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**53± 7± 7**      <sup>1</sup> AAIJ      14AW LHCb       $B_S^0 \rightarrow \bar{D}^0 K^- \pi^+$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

50±11±13      3.1k      AAIJ      16AW LHCb       $pp \rightarrow D^{*+}K_S^0 X$  at 7, 8 TeV<sup>1</sup> Separated from the spin-1 component  $D_{s1}^*(2860)^-$  by a fit of the helicity angle of the  $\bar{D}^0 K^-$  system, with a statistical significance of the spin-3 and spin-1 components in excess of 10  $\sigma$ .

NODE=M226W

NODE=M226W

NODE=M226W;LINKAGE=A

 $D_{s3}^*(2860)^\pm$  REFERENCES

|      |                     |                       |                   |
|------|---------------------|-----------------------|-------------------|
| AAIJ | 16AW JHEP 1602 133  | R. Aaij <i>et al.</i> | (LHCb Collab.)    |
| AAIJ | 14AW PRL 113 162001 | R. Aaij <i>et al.</i> | (LHCb Collab.) JP |

NODE=M226

REFID=60464  
REFID=56105

X<sub>0</sub>(2900)

$I(J^P) = ?(0^+)$

OMITTED FROM SUMMARY TABLE

An exotic state with minimal quark content  $\bar{c}d\bar{s}u$ . Observed by AAIJ 20Ai using full amplitude analysis of  $B^+ \rightarrow D^+ D^- K^+$  decays.

NODE=M250

NODE=M250

X<sub>0</sub>(2900) MASS

NODE=M250M

| VALUE (MeV)                                                                                                                                                                         | EVTS | DOCUMENT ID       | TECN      | COMMENT                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------|-------------------------------|
| 2866±7±2                                                                                                                                                                            | 1.2k | <sup>1</sup> AAIJ | 20Ai LHCb | $B^+ \rightarrow D^+ D^- K^+$ |
| <sup>1</sup> Obtained from the full amplitude analysis. Parameterized with the relativistic Breit-Wigner line shape. Also confirmed by the model-independent analysis of AAIJ 20AF. |      |                   |           |                               |

NODE=M250M

NODE=M250M;LINKAGE=A

X<sub>0</sub>(2900) WIDTH

NODE=M250W

| VALUE (MeV)                                                                                                                                                                         | EVTS | DOCUMENT ID       | TECN      | COMMENT                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------|-------------------------------|
| 57±12±4                                                                                                                                                                             | 1.2k | <sup>1</sup> AAIJ | 20Ai LHCb | $B^+ \rightarrow D^+ D^- K^+$ |
| <sup>1</sup> Obtained from the full amplitude analysis. Parameterized with the relativistic Breit-Wigner line shape. Also confirmed by the model-independent analysis of AAIJ 20AF. |      |                   |           |                               |

NODE=M250W

NODE=M250W;LINKAGE=A

X<sub>0</sub>(2900) DECAY MODES

NODE=M250215;NODE=M250

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1 \quad D^- K^+$ | seen                           |

DESIG=1

X<sub>0</sub>(2900) BRANCHING RATIOS

NODE=M250225

| $\Gamma(D^- K^+)/\Gamma_{\text{total}}$ |             |           |                               | $\Gamma_1/\Gamma$ |
|-----------------------------------------|-------------|-----------|-------------------------------|-------------------|
| VALUE                                   | DOCUMENT ID | TECN      | COMMENT                       |                   |
| seen                                    | AAIJ        | 20Ai LHCb | $B^+ \rightarrow D^+ D^- K^+$ |                   |

NODE=M250R01  
NODE=M250R01

X<sub>0</sub>(2900) REFERENCES

NODE=M250

|      |                     |                       |                |
|------|---------------------|-----------------------|----------------|
| AAIJ | 20AF PRL 125 242001 | R. Aaij <i>et al.</i> | (LHCb Collab.) |
| AAIJ | 20Ai PR D102 112003 | R. Aaij <i>et al.</i> | (LHCb Collab.) |

REFID=60702  
REFID=60739

NODE=M251

X<sub>1</sub>(2900)

$I(J^P) = ?(1^-)$

OMITTED FROM SUMMARY TABLE

An exotic state with minimal quark content  $\bar{c}d\bar{s}u$ . Observed by AAIJ 20Ai using full amplitude analysis of  $B^+ \rightarrow D^+ D^- K^+$  decays.

NODE=M251

X<sub>1</sub>(2900) MASS

NODE=M251M

| VALUE (MeV)                                                                                                                                                                         | EVTS | DOCUMENT ID       | TECN      | COMMENT                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------|-------------------------------|
| 2904±5±1                                                                                                                                                                            | 1.2k | <sup>1</sup> AAIJ | 20Ai LHCb | $B^+ \rightarrow D^+ D^- K^+$ |
| <sup>1</sup> Obtained from the full amplitude analysis. Parameterized with the relativistic Breit-Wigner line shape. Also confirmed by the model-independent analysis of AAIJ 20AF. |      |                   |           |                               |

NODE=M251M

NODE=M251M;LINKAGE=B

X<sub>1</sub>(2900) WIDTH

NODE=M251W

| VALUE (MeV)                                                                                                                                                                         | EVTS | DOCUMENT ID       | TECN      | COMMENT                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------|-------------------------------|
| 110±11±4                                                                                                                                                                            | 1.2k | <sup>1</sup> AAIJ | 20Ai LHCb | $B^+ \rightarrow D^+ D^- K^+$ |
| <sup>1</sup> Obtained from the full amplitude analysis. Parameterized with the relativistic Breit-Wigner line shape. Also confirmed by the model-independent analysis of AAIJ 20AF. |      |                   |           |                               |

NODE=M251W

NODE=M251W;LINKAGE=A

**X<sub>1</sub>(2900) DECAY MODES**

NODE=M251215;NODE=M251

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1 \quad D^- K^+$ | seen                           |

DESIG=1

**X<sub>1</sub>(2900) BRANCHING RATIOS**

NODE=M251225

| $\Gamma(D^- K^+)/\Gamma_{\text{total}}$ |             |           |                               | $\Gamma_1/\Gamma$ |
|-----------------------------------------|-------------|-----------|-------------------------------|-------------------|
| VALUE                                   | DOCUMENT ID | TECN      | COMMENT                       |                   |
| seen                                    | AAIJ        | 20Al LHCb | $B^+ \rightarrow D^+ D^- K^+$ |                   |

NODE=M251R01  
NODE=M251R01

**X<sub>1</sub>(2900) REFERENCES**

NODE=M251

|      |                     |                       |                |
|------|---------------------|-----------------------|----------------|
| AAIJ | 20AF PRL 125 242001 | R. Aaij <i>et al.</i> | (LHCb Collab.) |
| AAIJ | 20Al PR D102 112003 | R. Aaij <i>et al.</i> | (LHCb Collab.) |

REFID=60702  
REFID=60739

NODE=M197

$D_{sJ}(3040)^\pm$

$$I(J^P) = 0(?^?)$$

OMITTED FROM SUMMARY TABLE

Observed by AUBERT 09AR in inclusive production of  $D^* K$  in  $e^+ e^-$  annihilation.

NODE=M197

**D<sub>sJ</sub>(3040)<sup>+</sup> MASS**

NODE=M197M

| VALUE (MeV)             | DOCUMENT ID | TECN      | COMMENT                       |
|-------------------------|-------------|-----------|-------------------------------|
| $3044 \pm 8^{+30}_{-5}$ | AUBERT      | 09AR BABR | $e^+ e^- \rightarrow D^* K X$ |

NODE=M197M

**D<sub>sJ</sub>(3040)<sup>+</sup> WIDTH**

NODE=M197W

| VALUE (MeV)              | DOCUMENT ID | TECN      | COMMENT                       |
|--------------------------|-------------|-----------|-------------------------------|
| $239 \pm 35^{+46}_{-42}$ | AUBERT      | 09AR BABR | $e^+ e^- \rightarrow D^* K X$ |

NODE=M197W

**D<sub>sJ</sub>(3040)<sup>±</sup> DECAY MODES**

NODE=M197215;NODE=M197

| Mode                          |
|-------------------------------|
| $\Gamma_1 \quad D^* K$        |
| $\Gamma_2 \quad D^{*0} K^+$   |
| $\Gamma_3 \quad D^{*+} K_S^0$ |

DESIG=1

DESIG=2

DESIG=3

**D<sub>sJ</sub>(3040)<sup>±</sup> REFERENCES**

NODE=M197

|        |                    |                         |                 |
|--------|--------------------|-------------------------|-----------------|
| AUBERT | 09AR PR D80 092003 | B. Aubert <i>et al.</i> | (BABAR Collab.) |
|--------|--------------------|-------------------------|-----------------|

REFID=53135

# BOTTOM MESONS

## ( $B = \pm 1$ )

$$B^+ = u\bar{b}, B^0 = d\bar{b}, \bar{B}^0 = \bar{d}b, B^- = \bar{u}b, \text{ similarly for } B^{*'}s$$

### $B_1(5721)$

$$I(J^P) = \frac{1}{2}(1^+)$$

$I, J, P$  need confirmation.

Quantum numbers shown are quark-model predictions.

### $B_1(5721)$ MASS

#### $B_1(5721)^+$ mass

OUR FIT uses  $m_{B^{*0}}$  and  $m_{B_1^+} - m_{B^{*0}}$  to determine  $m_{B_1(5721)^+}$ .

| VALUE (MeV) | DOCUMENT ID |
|-------------|-------------|
|-------------|-------------|

**$5725.9^{+2.5}_{-2.7}$  OUR FIT**

#### $m_{B_1^+} - m_{B^{*0}}$

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**$401.2^{+2.4}_{-2.7}$  OUR FIT**

**$401.2^{+2.4}_{-2.7}$  OUR AVERAGE**

|                   |    |                   |           |                |
|-------------------|----|-------------------|-----------|----------------|
| 400.5 ± 1.8 ± 3.1 | 8k | <sup>1</sup> AAIJ | 15AB LHCb | pp at 7, 8 TeV |
|-------------------|----|-------------------|-----------|----------------|

|                           |  |                       |         |                         |
|---------------------------|--|-----------------------|---------|-------------------------|
| 402 ± 3 ± $\frac{+1}{-3}$ |  | <sup>2</sup> AALTONEN | 14i CDF | p $\bar{p}$ at 1.96 TeV |
|---------------------------|--|-----------------------|---------|-------------------------|

<sup>1</sup> AAIJ 15AB reports  $[m_{B_1^+} - m_{B^0}] - (m_{B^{*0}} - m_{B^0}) - m_{\pi^+} = 260.9 \pm 1.8 \pm 3.1$

MeV which we adjust by the  $\pi^+$  mass and assume  $(m_{B^{*0}} - m_{B^0}) = (m_{B^{*+}} - m_{B^+}) = 45.01 \pm 0.30 \pm 0.23$  MeV. The masses inside the square brackets were measured for each candidate event.

<sup>2</sup> AALTONEN 14i reports  $m_{B_1(5721)^+} - m_{B^{*0}} - m_{\pi^+} = 262 \pm 3^{+1}_{-3}$  MeV which we adjusted by the  $\pi^+$  mass.

#### $B_1(5721)^0$ mass

OUR FIT uses mass differences measurements listed below to determine the mass  $m_{B_1(5721)^0}$ .

| VALUE (MeV) | DOCUMENT ID |
|-------------|-------------|
|-------------|-------------|

**$5726.1 \pm 1.3$  OUR FIT** Error includes scale factor of 1.2.

#### $m_{B_1^0} - m_{B^{*+}}$

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**$446.7 \pm 1.3$  OUR FIT** Error includes scale factor of 1.2.

**$441.5 \pm 2.4 \pm 1.3$**  <sup>1</sup> ABAZOV 07T D0 p $\bar{p}$  at 1.96 TeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                |  |                       |         |                       |
|--------------------------------|--|-----------------------|---------|-----------------------|
| 446.2 ± 1.9 ± 1.0<br>-2.1 -1.2 |  | <sup>1</sup> AALTONEN | 09D CDF | Repl. by AALTONEN 14i |
|--------------------------------|--|-----------------------|---------|-----------------------|

<sup>1</sup> Observed in  $B_1^0 \rightarrow B^{*+} \pi^-$ .

#### $m_{B_1^0} - m_{B^{*+}}$

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**$401.4 \pm 1.2$  OUR FIT** Error includes scale factor of 1.2.

**$402.8 \pm 1.1$  OUR AVERAGE**

|                   |     |                   |           |                |
|-------------------|-----|-------------------|-----------|----------------|
| 403.4 ± 0.7 ± 1.5 | 35k | <sup>1</sup> AAIJ | 15AB LHCb | pp at 7, 8 TeV |
|-------------------|-----|-------------------|-----------|----------------|

|                                   |  |                       |         |                         |
|-----------------------------------|--|-----------------------|---------|-------------------------|
| 402.3 ± 0.9 ± $\frac{+1.1}{-1.2}$ |  | <sup>2</sup> AALTONEN | 14i CDF | p $\bar{p}$ at 1.96 TeV |
|-----------------------------------|--|-----------------------|---------|-------------------------|

<sup>1</sup> AAIJ 15AB reports  $[m_{B_1^0} - m_{B^+}] - (m_{B^{*+}} - m_{B^+}) - m_{\pi^-} = 263.9 \pm 0.7 \pm 1.4$

MeV which we adjust by the  $\pi^-$  mass and  $(m_{B^{*+}} - m_{B^+}) = 45.01 \pm 0.30 \pm 0.23$  MeV. The masses inside the square brackets were measured for each candidate event.

<sup>2</sup> AALTONEN 14i reports  $m_{B_1(5721)^0} - m_{B^{*+}} - m_{\pi^-} = 262.7 \pm 0.9^{+1.1}_{-1.2}$  MeV which we adjusted by the  $\pi^-$  mass.

NODE=MXXX045

NODE=MXXX045

NODE=M244

NODE=M244

NODE=M244205

NODE=M244M+

NODE=M244M+  
NODE=M244M+

NODE=M244DM+  
NODE=M244DM+

NODE=M244DM+;LINKAGE=A

NODE=M244DM+;LINKAGE=AA

NODE=M244M0  
NODE=M244M0

NODE=M244M0

NODE=M244DM0  
NODE=M244DM0

NODE=M244DM0;LINKAGE=AA

NODE=M244DM1  
NODE=M244DM1

NODE=M244DM1;LINKAGE=B

NODE=M244DM1;LINKAGE=AA

**$B_1(5721)$  WIDTH**

NODE=M244210

 **$B_1(5721)^+$  width**

| VALUE (MeV)                              | EVTS                                | DOCUMENT ID | TECN      | COMMENT                |
|------------------------------------------|-------------------------------------|-------------|-----------|------------------------|
| <b><math>31 \pm 6</math> OUR AVERAGE</b> | Error includes scale factor of 1.1. |             |           |                        |
| $29.1 \pm 3.6 \pm 4.3$                   | 8k                                  | AAIJ        | 15AB LHCb | $p\bar{p}$ at 7, 8 TeV |
| $49^{+12}_{-10} \pm 2_{-13}$             |                                     | AALTONEN    | 14l CDF   | $p\bar{p}$ at 1.96 TeV |

NODE=M244W+  
NODE=M244W+ **$B_1(5721)^0$  width**

| VALUE (MeV)                                  | EVTS                                | DOCUMENT ID | TECN      | COMMENT                |
|----------------------------------------------|-------------------------------------|-------------|-----------|------------------------|
| <b><math>27.5 \pm 3.4</math> OUR AVERAGE</b> | Error includes scale factor of 1.1. |             |           |                        |
| $30.1 \pm 1.5 \pm 3.5$                       | 35k                                 | AAIJ        | 15AB LHCb | $p\bar{p}$ at 7, 8 TeV |
| $23 \pm 3 \pm 4$                             |                                     | AALTONEN    | 14l CDF   | $p\bar{p}$ at 1.96 TeV |

NODE=M244W0  
NODE=M244W0 **$B_1(5721)$  DECAY MODES**

NODE=M244215;NODE=M244

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1 \quad B^* \pi$ | seen                           |

DESIG=1

 **$\Gamma(B^* \pi)/\Gamma_{\text{total}}$**  **$\Gamma_1/\Gamma$** 

| VALUE       | DOCUMENT ID         | TECN      | CHG     | COMMENT                |
|-------------|---------------------|-----------|---------|------------------------|
| seen        | AAIJ                | 15AB LHCb | $\pm 0$ | $p\bar{p}$ at 7, 8 TeV |
| <b>seen</b> | AALTONEN            | 14l CDF   | $\pm$   | $p\bar{p}$ at 1.96 TeV |
| seen        | AALTONEN            | 09D CDF   | 0       | $p\bar{p}$ at 1.96 TeV |
| <b>seen</b> | <sup>1</sup> ABAZOV | 07T D0    | 0       | $p\bar{p}$ at 1.96 TeV |

NODE=M244R01  
NODE=M244R01

OCCUR=2

<sup>1</sup> Observed in  $B_1^0 \rightarrow B^{*+} \pi^-$  with  $B^{*+} \rightarrow B^+ \gamma$  and  $B^+ \rightarrow J/\psi \pi^+$ .

NODE=M244R01;LINKAGE=AB

 **$B_1(5721)$  REFERENCES**

NODE=M244

|          |                    |                           |                |
|----------|--------------------|---------------------------|----------------|
| AAIJ     | 15AB JHEP 1504 024 | R. Aaij <i>et al.</i>     | (LHCb Collab.) |
| AALTONEN | 14l PR D90 012013  | T. Aaltonen <i>et al.</i> | (CDF Collab.)  |
| AALTONEN | 09D PRL 102 102003 | T. Aaltonen <i>et al.</i> | (CDF Collab.)  |
| ABAZOV   | 07T PRL 99 172001  | V.M. Abazov <i>et al.</i> | (D0 Collab.)   |

REFID=56628  
REFID=56029  
REFID=52700  
REFID=52014

NODE=M151

 **$B_J^*(5732)$**  $I(J^P) = ?(??)$   
 $I, J, P$  need confirmation.OMITTED FROM SUMMARY TABLE  
also known as  $B^{**}$ 

Quantum numbers shown are quark-model predictions. Signal can be interpreted as stemming from several narrow and broad resonances.

NODE=M151

 **$B_J^*(5732)$  MASS**

NODE=M151M

| VALUE (MeV)                                | EVTS                                | DOCUMENT ID           | TECN     | COMMENT                          |
|--------------------------------------------|-------------------------------------|-----------------------|----------|----------------------------------|
| <b><math>5698 \pm 8</math> OUR AVERAGE</b> | Error includes scale factor of 1.2. |                       |          |                                  |
| $5710 \pm 20$                              |                                     | <sup>1</sup> AFFOLDER | 01F CDF  | $p\bar{p}$ at 1.8 TeV            |
| $5695^{+17}_{-19}$                         |                                     | <sup>2</sup> BARATE   | 98L ALEP | $e^+ e^- \rightarrow Z$          |
| $5704 \pm 4 \pm 10$                        | 1944                                | <sup>3</sup> BUSKULIC | 96D ALEP | $E_{\text{cm}}^{ee} = 88-94$ GeV |
| $5732 \pm 5 \pm 20$                        | 2157                                | ABREU                 | 95B DLPH | $E_{\text{cm}}^{ee} = 88-94$ GeV |
| $5681 \pm 11$                              | 1738                                | AKERS                 | 95E OPAL | $E_{\text{cm}}^{ee} = 88-94$ GeV |
| $5713 \pm 2$                               |                                     | <sup>4</sup> ACCIARRI | 99N L3   | $e^+ e^- \rightarrow Z$          |

NODE=M151M

• • • We do not use the following data for averages, fits, limits, etc. • • •

<sup>1</sup> AFFOLDER 01F uses the reconstructed  $B$  meson through semileptonic decay channels. The fraction of light  $B$  mesons that are produced at  $L=1$   $B^{**}$  states is measured to be  $0.28 \pm 0.06 \pm 0.03$ .

NODE=M151M;LINKAGE=MF

<sup>2</sup> BARATE 98L uses fully reconstructed  $B$  mesons to search for  $B^{**}$  production in the  $B\pi^\pm$  system. In the framework of heavy quark symmetry (HQS), they also measured the mass of  $B_2^*$  to be  $5739^{+8}_{-11} \pm 6_{-4}$  MeV/ $c^2$  and the relative production rate of  $B(b \rightarrow B_2^* \rightarrow B^{(*)} \pi)/B(b \rightarrow B_{u,d}) = (31 \pm 9^{+6}_{-5})\%$ .

NODE=M151M;LINKAGE=B

<sup>3</sup> Using  $m_{B\pi} - m_B = 424 \pm 4 \pm 10$  MeV.

NODE=M151M;LINKAGE=A

<sup>4</sup> ACCIARRI 99N uses inclusive reconstructed  $B$  mesons to search for  $B^{**}$  production in the  $B^{(*)}\pi^\pm$  system. In the framework of HQET, they measured the mass of  $B_1^*$  and  $B_2^*$  to be  $5670 \pm 10 \pm 13$  MeV and  $5768 \pm 5 \pm 6$  with the  $B(b \rightarrow B^{**}) = (32 \pm 3 \pm 6) \times 10^{-2}$ . They also reported the evidence for the existence of an excited  $B$ -meson state or mixture of states in the region 5.9–6.0 GeV.

NODE=M151M;LINKAGE=N

**$B_J^*(5732)$  WIDTH**

NODE=M151W

| VALUE (MeV)               | EVTs | DOCUMENT ID | TECN     | COMMENT                           |
|---------------------------|------|-------------|----------|-----------------------------------|
| <b>128±18 OUR AVERAGE</b> |      |             |          |                                   |
| 145±28                    | 2157 | ABREU       | 95B DLPH | $E_{cm}^{ee} = 88\text{--}94$ GeV |
| 116±24                    | 1738 | AKERS       | 95E OPAL | $E_{cm}^{ee} = 88\text{--}94$ GeV |

NODE=M151W

**$B_J^*(5732)$  DECAY MODES**

NODE=M151215;NODE=M151

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------|--------------------------------|
| $\Gamma_1 \quad B^*\pi + B\pi$ | seen                           |
| $\Gamma_2 \quad B^*\pi(X)$     | [a] (85±29) %                  |

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=2

[a] X refers to decay modes with or without additional accompanying decay particles.

LINKAGE=151

**$B_J^*(5732)$  BRANCHING RATIOS**

NODE=M151220

X refers to decay modes with or without additional accompanying decay particles.

NODE=M151220

| $\Gamma(B^*\pi(X))/\Gamma_{\text{total}}$         |             |          |                        | $\Gamma_2/\Gamma$ |
|---------------------------------------------------|-------------|----------|------------------------|-------------------|
| VALUE                                             | DOCUMENT ID | TECN     | COMMENT                |                   |
| <b><math>0.85^{+0.26}_{-0.27} \pm 0.12</math></b> | ABBIENDI    | 02E OPAL | $e^+e^- \rightarrow Z$ |                   |

NODE=M151R1  
NODE=M151R1

**$B_J^*(5732)$  REFERENCES**

NODE=M151

|          |     |               |                           |                  |
|----------|-----|---------------|---------------------------|------------------|
| ABBIENDI | 02E | EPJ C23 437   | G. Abbiendi <i>et al.</i> | (OPAL Collab.)   |
| AFFOLDER | 01F | PR D64 072002 | T. Affolder <i>et al.</i> | (CDF Collab.)    |
| ACCIARRI | 99N | PL B465 323   | M. Acciarri <i>et al.</i> | (L3 Collab.)     |
| BARATE   | 98L | PL B425 215   | R. Barate <i>et al.</i>   | (ALEPH Collab.)  |
| BUSKULIC | 96D | ZPHY C69 393  | D. Buskulic <i>et al.</i> | (ALEPH Collab.)  |
| ABREU    | 95B | PL B345 598   | P. Abreu <i>et al.</i>    | (DELPHI Collab.) |
| AKERS    | 95E | ZPHY C66 19   | R. Akers <i>et al.</i>    | (OPAL Collab.)   |

REFID=48742  
REFID=48369  
REFID=47247  
REFID=46082  
REFID=44677  
REFID=44131  
REFID=44182

**$B_2^*(5747)$** 

$$I(J^P) = \frac{1}{2}(2^+)$$

$I, J, P$  need confirmation.

Quantum numbers shown are quark-model predictions.

NODE=M245

NODE=M245

NODE=M245205

NODE=M245M+

 NODE=M245M+  
 NODE=M245M+

 NODE=M245DM+  
 NODE=M245DM+

NODE=M245DM+;LINKAGE=B

NODE=M245DM+;LINKAGE=A

NODE=M245M0

NODE=M245M0

NODE=M245M0

 NODE=M245DM0  
 NODE=M245DM0

NODE=M245DM0;LINKAGE=AB

 NODE=M245DM2  
 NODE=M245DM2

NODE=M245DM2;LINKAGE=A

NODE=M245DM2;LINKAGE=AA

NODE=M245210

 NODE=M245W+  
 NODE=M245W+
 **$B_2^*(5747)$  MASS** **$B_2^*(5747)^+$  mass**OUR FIT uses  $m_{B^0}$  and  $m_{B_2^{*+}} - m_{B^0}$  to determine  $m_{B_2^*(5747)^+}$ .

| VALUE (MeV)               | DOCUMENT ID |
|---------------------------|-------------|
| <b>5737.2±0.7 OUR FIT</b> |             |

 **$m_{B_2^{*+}} - m_{B^0}$** 

| VALUE (MeV)                   | EVTs | DOCUMENT ID           | TECN      | COMMENT                |
|-------------------------------|------|-----------------------|-----------|------------------------|
| <b>457.5 ±0.7 OUR FIT</b>     |      |                       |           |                        |
| <b>457.5 ±0.7 OUR AVERAGE</b> |      |                       |           |                        |
| 457.62±0.72±0.40              | 4k   | <sup>1</sup> AAIJ     | 15AB LHCb | $pp$ at 7, 8 TeV       |
| 457.3 ±1.3 $^{+0.3}_{-0.9}$   |      | <sup>2</sup> AALTONEN | 14i CDF   | $p\bar{p}$ at 1.96 TeV |

<sup>1</sup> AAIJ 15AB reports  $[m_{B_2^{*+}} - m_{B^0}] - m_{\pi^+} = 318.1 \pm 0.7 \pm 0.4$  MeV which we adjust by the  $\pi^+$  mass. The masses inside the square brackets were measured for each candidate event.

<sup>2</sup> AALTONEN 14i reports  $m_{B_2^*(5747)^+} - m_{B^0} - m_{\pi^+} = 317.7 \pm 1.2^{+0.3}_{-0.9}$  MeV which we adjusted by the  $\pi^+$  mass.

 **$B_2^*(5747)^0$  mass**

OUR FIT uses  $m_{B^+}$ ,  $m_{B_1^0} - m_{B^+}$ , and mass differences below to determine  $m_{B_2^*(5747)^0}$ . The  $-0.659$  correlation between statistical uncertainties of  $m_{B_1^0} - m_{B^+}$  and  $m_{B_2^{*0}} - m_{B_1^0}$  measurements reported by ABAZOV 07T is taken into account.

| VALUE (MeV)               | DOCUMENT ID                         |
|---------------------------|-------------------------------------|
| <b>5739.5±0.7 OUR FIT</b> | Error includes scale factor of 1.4. |

 **$m_{B_2^{*0}} - m_{B_1^0}$** 

| VALUE (MeV)                                                                   | DOCUMENT ID                         | TECN    | COMMENT                |
|-------------------------------------------------------------------------------|-------------------------------------|---------|------------------------|
| <b>13.4±1.4 OUR FIT</b>                                                       | Error includes scale factor of 1.3. |         |                        |
| <b>26.2±3.1±0.9</b>                                                           | <sup>1</sup> ABAZOV                 | 07T D0  | $p\bar{p}$ at 1.96 TeV |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |         |                        |
| 14.9 $^{+2.2+1.2}_{-2.5-1.4}$                                                 | <sup>1</sup> AALTONEN               | 09D CDF | Repl. by AALTONEN 14i  |

<sup>1</sup> Observed in  $B_2^{*0} \rightarrow B^{*+}\pi^-$  and  $B_2^{*0} \rightarrow B^+\pi^-$ .

 **$m_{B_2^{*0}} - m_{B^+}$** 

| VALUE (MeV)                   | EVTs                                | DOCUMENT ID           | TECN      | COMMENT                |
|-------------------------------|-------------------------------------|-----------------------|-----------|------------------------|
| <b>460.2 ±0.6 OUR FIT</b>     | Error includes scale factor of 1.4. |                       |           |                        |
| <b>459.9 ±0.8 OUR AVERAGE</b> | Error includes scale factor of 1.8. |                       |           |                        |
| 460.18±0.37±0.33              | 17k                                 | <sup>1</sup> AAIJ     | 15AB LHCb | $pp$ at 7, 8 TeV       |
| 457.5 ±1.2 $^{+0.8}_{-0.9}$   |                                     | <sup>2</sup> AALTONEN | 14i CDF   | $p\bar{p}$ at 1.96 TeV |

<sup>1</sup> AAIJ 15AB reports  $[m_{B_2^{*0}} - m_{B^+}] - m_{\pi^-} = 320.6 \pm 0.4 \pm 0.3$  MeV which we adjust by the  $\pi^-$  mass. The masses inside the square brackets were measured for each candidate event.

<sup>2</sup> AALTONEN 14i reports  $m_{B_2^*(5747)^0} - m_{B^+} - m_{\pi^-} = 317.9 \pm 1.2^{+0.8}_{-0.9}$  MeV which we adjusted by the  $\pi^-$  mass.

 **$B_2^*(5747)$  WIDTH** **$B_2^*(5747)^+$  width**

| VALUE (MeV)                  | EVTs                                | DOCUMENT ID | TECN      | COMMENT                |
|------------------------------|-------------------------------------|-------------|-----------|------------------------|
| <b>20 ±5 OUR AVERAGE</b>     | Error includes scale factor of 2.2. |             |           |                        |
| 23.6±2.0±2.1                 | 4k                                  | AAIJ        | 15AB LHCb | $pp$ at 7, 8 TeV       |
| 11 $^{+4}_{-3}$ $^{+3}_{-4}$ |                                     | AALTONEN    | 14i CDF   | $p\bar{p}$ at 1.96 TeV |

**$B_2^*(5747)^0$  width**

| VALUE (MeV)                                                                                                     | EVTs | DOCUMENT ID | TECN      | COMMENT                |
|-----------------------------------------------------------------------------------------------------------------|------|-------------|-----------|------------------------|
| <b>24.2±1.7 OUR AVERAGE</b>                                                                                     |      |             |           |                        |
| 24.5±1.0± 1.5                                                                                                   | 17k  | AAIJ        | 15AB LHCB | $pp$ at 7, 8 TeV       |
| 22 $\begin{smallmatrix} +3 \\ -2 \end{smallmatrix}$ $\begin{smallmatrix} +4 \\ -5 \end{smallmatrix}$            |      | AALTONEN    | 14I CDF   | $p\bar{p}$ at 1.96 TeV |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                   |      |             |           |                        |
| 22.7 $\begin{smallmatrix} +3.8 \\ -3.2 \end{smallmatrix}$ $\begin{smallmatrix} +3.2 \\ -10.2 \end{smallmatrix}$ |      | AALTONEN    | 09D CDF   | Repl. by AALTONEN 14I  |

NODE=M245W0  
 NODE=M245W0

 **$B_2^*(5747)$  DECAY MODES**

| Mode                | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------|--------------------------------|
| $\Gamma_1$ $B\pi$   | seen                           |
| $\Gamma_2$ $B^*\pi$ | seen                           |

NODE=M245215;NODE=M245

DESIG=1  
 DESIG=2

 **$\Gamma(B\pi)/\Gamma_{\text{total}}$** 

| VALUE       | EVTs   | DOCUMENT ID | TECN      | CHG | COMMENT                |
|-------------|--------|-------------|-----------|-----|------------------------|
| seen        | 4k,17k | AAIJ        | 15AB LHCB | ±0  | $pp$ at 7, 8 TeV       |
| <b>seen</b> |        | AALTONEN    | 14I CDF   | ±   | $p\bar{p}$ at 1.96 TeV |
| seen        |        | AALTONEN    | 09D CDF   | 0   | $p\bar{p}$ at 1.96 TeV |
| <b>seen</b> |        | ABAZOV      | 07T D0    | 0   | $p\bar{p}$ at 1.96 TeV |

 **$\Gamma_1/\Gamma$** 

NODE=M245R01  
 NODE=M245R01

 **$\Gamma(B^*\pi)/\Gamma_{\text{total}}$** 

| VALUE       | EVTs   | DOCUMENT ID | TECN      | CHG | COMMENT                |
|-------------|--------|-------------|-----------|-----|------------------------|
| seen        | 4k,17k | AAIJ        | 15AB LHCB | ±0  | $pp$ at 7, 8 TeV       |
| seen        |        | AALTONEN    | 09D CDF   | 0   | $p\bar{p}$ at 1.96 TeV |
| <b>seen</b> |        | ABAZOV      | 07T D0    | 0   | $p\bar{p}$ at 1.96 TeV |

 **$\Gamma_2/\Gamma$** 

NODE=M245R02  
 NODE=M245R02

 **$\Gamma(B^*\pi)/\Gamma(B\pi)$** 

| VALUE                        | EVTs | DOCUMENT ID         | TECN      | CHG | COMMENT                |
|------------------------------|------|---------------------|-----------|-----|------------------------|
| <b>0.84±0.27 OUR AVERAGE</b> |      |                     |           |     |                        |
| 0.71±0.14±0.30               | 17k  | AAIJ                | 15AB LHCB | 0   | $pp$ at 7, 8 TeV       |
| 1.0 ±0.5 ±0.8                | 4k   | AAIJ                | 15AB LHCB | ±   | $pp$ at 7, 8 TeV       |
| 1.10±0.42±0.31               |      | <sup>1</sup> ABAZOV | 07T D0    | 0   | $p\bar{p}$ at 1.96 TeV |

 **$\Gamma_2/\Gamma_1$** 

NODE=M245R03  
 NODE=M245R03

<sup>1</sup> Converted from measured ratio of  $R = B(B_2^{*0} \rightarrow B^{*+}\pi^-) / B(B_2^{*0} \rightarrow B^{(*)+}\pi^-)$   
 = 0.475 ± 0.095 ± 0.069.

OCCUR=2

NODE=M245R03;LINKAGE=AB

 **$B_2^*(5747)$  REFERENCES**

|          |      |                |                           |                |
|----------|------|----------------|---------------------------|----------------|
| AAIJ     | 15AB | JHEP 1504 024  | R. Aaij <i>et al.</i>     | (LHCb Collab.) |
| AALTONEN | 14I  | PR D90 012013  | T. Aaltonen <i>et al.</i> | (CDF Collab.)  |
| AALTONEN | 09D  | PRL 102 102003 | T. Aaltonen <i>et al.</i> | (CDF Collab.)  |
| ABAZOV   | 07T  | PRL 99 172001  | V.M. Abazov <i>et al.</i> | (D0 Collab.)   |

NODE=M245

REFID=56628  
 REFID=56029  
 REFID=52700  
 REFID=52014



**$B_J(5840)$** 

$$I(J^P) = \frac{1}{2}(?)$$

$I, J, P$  need confirmation.

OMITTED FROM SUMMARY TABLE

Quantum numbers shown are quark-model predictions.

NODE=M246

NODE=M246

NODE=M246205

NODE=M246M+

NODE=M246M+  
NODE=M246M+NODE=M246DM+  
NODE=M246DM+

OCCUR=2

NODE=M246DM+;LINKAGE=A

NODE=M246DM+;LINKAGE=B

NODE=M246DM1  
NODE=M246DM1

NODE=M246DM1;LINKAGE=A

NODE=M246M0

NODE=M246M0  
NODE=M246M0NODE=M246DM0  
NODE=M246DM0

OCCUR=2

NODE=M246DM0;LINKAGE=A

NODE=M246DM0;LINKAGE=B

 **$B_J(5840)$  MASS** **$B_J(5840)^+$  MASS**OUR FIT uses  $m_{B^0}$  and  $m_{B_J(5840)^+} - m_{B^0}$  to determine  $m_{B_J(5840)^+}$ .

| VALUE (MeV) | DOCUMENT ID |
|-------------|-------------|
|-------------|-------------|

**5851±19 OUR FIT** **$m_{B_J(5840)^+} - m_{B^0}$** 

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**571±19 OUR FIT****571±13±14** 7k <sup>1</sup> AAIJ 15AB LHCB  $pp$  at 7, 8 TeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

595±26±14 7k <sup>2</sup> AAIJ 15AB LHCB  $pp$  at 7, 8 TeV<sup>1</sup> AAIJ 15AB reports  $[m_{B_J^+} - m_{B^0}] - m_{\pi^+} = 431 \pm 13 \pm 14$  MeV which we adjust bythe  $\pi^+$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = (-1)^J$  and uses two relativistic Breit-Wigner functions in the fit for mass difference.<sup>2</sup> AAIJ 15AB reports  $[m_{B_J^+} - m_{B^0}] - m_{\pi^+} = 455 \pm 26 \pm 14$  MeV which we adjust bythe  $\pi^+$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = (-1)^J$  and uses three relativistic Breit-Wigner functions in the fit for mass difference. **$m_{B_J(5840)^+} - m_{B^{*0}}$** 

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

565±15±14 7k <sup>1</sup> AAIJ 15AB LHCB  $pp$  at 7, 8 TeV<sup>1</sup> AAIJ 15AB reports  $[m_{B_J^+} - m_{B^0}] - (m_{B^{*+}} - m_{B^+}) - m_{\pi^+} = 425 \pm 15 \pm 14$ MeV which we adjust by the  $\pi^+$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = -(-1)^J$ ,  $(m_{B^{*0}} - m_{B^0}) = (m_{B^{*+}} - m_{B^+}) = 45.01 \pm 0.30 \pm 0.23$  MeV, and uses three relativistic Breit-Wigner functions in the fit for mass difference. **$B_J(5840)^0$  MASS**OUR FIT uses  $m_{B^+}$  and  $m_{B_J(5840)^0} - m_{B^+}$  to determine  $m_{B_J(5840)^0}$ .

| VALUE (MeV) | DOCUMENT ID |
|-------------|-------------|
|-------------|-------------|

**5863±9 OUR FIT** **$m_{B_J(5840)^0} - m_{B^+}$** 

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**584± 9 OUR FIT****584± 5±7** 12k <sup>1</sup> AAIJ 15AB LHCB  $pp$  at 7, 8 TeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

610±22±7 12k <sup>2</sup> AAIJ 15AB LHCB  $pp$  at 7, 8 TeV<sup>1</sup> AAIJ 15AB reports  $[m_{B_J^0} - m_{B^+}] - m_{\pi^-} = 444 \pm 5 \pm 7$  MeV which we adjust bythe  $\pi^-$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = (-1)^J$  and uses two relativistic Breit-Wigner functions in the fit for mass difference.<sup>2</sup> AAIJ 15AB reports  $[m_{B_J^0} - m_{B^+}] - m_{\pi^-} = 471 \pm 22 \pm 7$  MeV which we adjust bythe  $\pi^-$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = (-1)^J$  and uses three relativistic Breit-Wigner functions in the fit for mass difference.

**$m_{B_J(5840)^0} - m_{B^{*+}}$** 

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |     |                   |           |                  |
|-------------------|-----|-------------------|-----------|------------------|
| $584 \pm 5 \pm 7$ | 12k | <sup>1</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|-------------------|-----|-------------------|-----------|------------------|

<sup>1</sup> AAIJ 15AB reports  $[m_{B_J^0} - m_{B^+}] - (m_{B^{*+}} - m_{B^+}) - m_{\pi^-} = 444 \pm 5 \pm 7$  MeV

which we adjust by the  $\pi^-$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = -(-1)^J$ ,  $(m_{B^{*+}} - m_{B^+}) = 45.01 \pm 0.30 \pm 0.23$  MeV, and uses three relativistic Breit-Wigner functions in the fit for mass difference.

NODE=M246DM2  
NODE=M246DM2

NODE=M246DM2;LINKAGE=A

 **$B_J(5840)$  WIDTH**

NODE=M246210

 **$B_J(5840)^+$  WIDTH**

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

|                     |    |                   |           |                  |
|---------------------|----|-------------------|-----------|------------------|
| $224 \pm 24 \pm 80$ | 7k | <sup>1</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|---------------------|----|-------------------|-----------|------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                     |    |                   |           |                  |
|---------------------|----|-------------------|-----------|------------------|
| $215 \pm 27 \pm 80$ | 7k | <sup>2</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|---------------------|----|-------------------|-----------|------------------|

|                     |    |                   |           |                  |
|---------------------|----|-------------------|-----------|------------------|
| $229 \pm 27 \pm 80$ | 7k | <sup>3</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|---------------------|----|-------------------|-----------|------------------|

<sup>1</sup> Assuming  $P = (-1)^J$  and using two relativistic Breit-Wigner functions in the fit for mass difference.

<sup>2</sup> Assuming  $P = (-1)^J$  and using three relativistic Breit-Wigner functions in the fit for mass difference.

<sup>3</sup> Assuming  $P = -(-1)^J$  and using three relativistic Breit-Wigner functions in the fit for mass difference.

NODE=M246W+  
NODE=M246W+

OCCUR=2  
OCCUR=3

NODE=M246W+;LINKAGE=A

NODE=M246W+;LINKAGE=B

NODE=M246W+;LINKAGE=C

 **$B_J(5840)^0$  WIDTH**

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

|                     |     |                   |           |                  |
|---------------------|-----|-------------------|-----------|------------------|
| $127 \pm 17 \pm 34$ | 12k | <sup>1</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|---------------------|-----|-------------------|-----------|------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                     |     |                   |           |                  |
|---------------------|-----|-------------------|-----------|------------------|
| $107 \pm 20 \pm 34$ | 12k | <sup>2</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|---------------------|-----|-------------------|-----------|------------------|

|                     |     |                   |           |                  |
|---------------------|-----|-------------------|-----------|------------------|
| $119 \pm 17 \pm 34$ | 12k | <sup>3</sup> AAIJ | 15AB LHCB | $pp$ at 7, 8 TeV |
|---------------------|-----|-------------------|-----------|------------------|

<sup>1</sup> Assuming  $P = (-1)^J$  and using two relativistic Breit-Wigner functions in the fit for mass difference.

<sup>2</sup> Assuming  $P = (-1)^J$  and using three relativistic Breit-Wigner functions in the fit for mass difference.

<sup>3</sup> Assuming  $P = -(-1)^J$  and using three relativistic Breit-Wigner functions in the fit for mass difference.

NODE=M246W0  
NODE=M246W0

OCCUR=2  
OCCUR=3

NODE=M246W0;LINKAGE=A

NODE=M246W0;LINKAGE=B

NODE=M246W0;LINKAGE=C

 **$B_J(5840)$  DECAY MODES**

NODE=M246215;NODE=M246

| Mode                 | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------|--------------------------------|
| $\Gamma_1$ $B^* \pi$ | seen                           |
| $\Gamma_2$ $B \pi$   | possibly seen                  |

DESIG=1  
DESIG=2

 **$B_J(5840)$  BRANCHING RATIOS**

NODE=M246220

| $\Gamma(B^*\pi)/\Gamma_{\text{total}}$ |      |             |           |       | $\Gamma_1/\Gamma$ |
|----------------------------------------|------|-------------|-----------|-------|-------------------|
| VALUE                                  | EVTS | DOCUMENT ID | TECN      | CHG   | COMMENT           |
| seen                                   | 7k   | AAIJ        | 15AB LHCB | $\pm$ | $pp$ at 7, 8 TeV  |
| seen                                   | 12k  | AAIJ        | 15AB LHCB | 0     | $pp$ at 7, 8 TeV  |

NODE=M246R01  
NODE=M246R01

OCCUR=2

| $\Gamma(B\pi)/\Gamma_{\text{total}}$ |      |                   |           |       | $\Gamma_2/\Gamma$ |
|--------------------------------------|------|-------------------|-----------|-------|-------------------|
| VALUE                                | EVTS | DOCUMENT ID       | TECN      | CHG   | COMMENT           |
| possibly seen                        | 7k   | <sup>1</sup> AAIJ | 15AB LHCB | $\pm$ | $pp$ at 7, 8 TeV  |
| possibly seen                        |      | <sup>1</sup> AAIJ | 15AB LHCB | 0     | $pp$ at 7, 8 TeV  |

NODE=M246R02  
NODE=M246R02

OCCUR=2

<sup>1</sup> A  $B \pi$  decay is forbidden from a  $P = -(-1)^J$  parent, whereas  $B^* \pi$  is allowed.

NODE=M246R02;LINKAGE=A

 **$B_J(5840)$  REFERENCES**

NODE=M246

|      |                    |                       |                |
|------|--------------------|-----------------------|----------------|
| AAIJ | 15AB JHEP 1504 024 | R. Aaij <i>et al.</i> | (LHCb Collab.) |
|------|--------------------|-----------------------|----------------|

REFID=56628

**$B_J(5970)$** 

$$I(J^P) = \frac{1}{2}(??)$$

$I, J, P$  need confirmation.

Quantum numbers shown are quark-model predictions.

NODE=M248

NODE=M248

NODE=M248205

NODE=M248M+

NODE=M248M+  
NODE=M248M+NODE=M248DM+  
NODE=M248DM+ **$B_J(5970)$  MASS** **$B_J(5970)^+$  MASS**OUR FIT uses  $m_{B^0}$  and  $m_{B_J(5970)^+} - m_{B^0}$  to determine  $m_{B_J(5970)^+}$ .

VALUE (MeV)

DOCUMENT ID

**5964 ± 5 OUR FIT** **$m_{B_J(5970)^+} - m_{B^0}$** 

VALUE (MeV)

EPTS

DOCUMENT ID

TECN

COMMENT

**685 ± 5 OUR FIT****685 ± 5 OUR AVERAGE**

685.3 ± 4.1 ± 2.5

2k

<sup>1</sup>

AAIJ

15AB LHCB

 $pp$  at 7, 8 TeV

681 ± 5 ± 12

1.4k

<sup>2</sup>

AALTONEN

14l CDF

 $p\bar{p}$  at 1.96 TeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

686.8 ± 4.5 ± 2.5

2k

<sup>3</sup>

AAIJ

15AB LHCB

 $pp$  at 7, 8 TeV<sup>1</sup> AAIJ 15AB reports  $[m_{B_J^+} - m_{B^0}] - m_{\pi^+} = 545.8 \pm 4.1 \pm 2.5$  MeV which we adjust bythe  $\pi^+$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = (-1)^J$  and uses two relativistic Breit-Wigner functions in the fit for mass difference.<sup>2</sup> AALTONEN 14l reports  $m_{B_J(5970)^+} - m_{B^0} - m_{\pi^+} = 541 \pm 5 \pm 12$  MeV which we adjusted by the  $\pi^+$  mass.<sup>3</sup> AAIJ 15AB reports  $[m_{B_J^+} - m_{B^0}] - m_{\pi^+} = 547 \pm 5 \pm 3$  MeV which we adjust by the  $\pi^+$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = (-1)^J$  and uses three relativistic Breit-Wigner functions in the fit for mass difference.

OCCUR=2

NODE=M248DM+;LINKAGE=B

NODE=M248DM+;LINKAGE=A

NODE=M248DM+;LINKAGE=C

 **$m_{B_J(5970)^+} - m_{B^{*0}}$** 

VALUE (MeV)

EPTS

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

686.0 ± 4.0 ± 2.5

2k

<sup>1</sup>

AAIJ

15AB LHCB

 $pp$  at 7, 8 TeV<sup>1</sup> AAIJ 15AB reports  $[m_{B_J^+} - m_{B^0}] - (m_{B^{*+}} - m_{B^+}) - m_{\pi^+} = 547 \pm 4 \pm 3$  MeV whichwe adjust by the  $\pi^+$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = -(-1)^J$ ,  $(m_{B^{*0}} - m_{B^0}) = (m_{B^{*+}} - m_{B^+}) = 45.01 \pm 0.30 \pm 0.23$  MeV, and uses three relativistic Breit-Wigner functions in the fit for mass difference.NODE=M248DM1  
NODE=M248DM1

NODE=M248DM1;LINKAGE=A

 **$B_J(5970)^0$  MASS**OUR FIT uses  $m_{B^+}$  and  $m_{B_J(5970)^0} - m_{B^+}$  to determine  $m_{B_J(5970)^0}$ .

VALUE (MeV)

DOCUMENT ID

**5971 ± 5 OUR FIT** **$m_{B_J(5970)^0} - m_{B^+}$** 

VALUE (MeV)

EPTS

DOCUMENT ID

TECN

COMMENT

**691 ± 5 OUR FIT****691 ± 5 OUR AVERAGE**

689.9 ± 2.9 ± 5.1

10k

<sup>1</sup>

AAIJ

15AB LHCB

 $pp$  at 7, 8 TeV

698 ± 5 ± 12

2.6k

<sup>2</sup>

AALTONEN

14l CDF

 $p\bar{p}$  at 1.96 TeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

714.3 ± 6.4 ± 5.1

10k

<sup>3</sup>

AAIJ

15AB LHCB

 $pp$  at 7, 8 TeV<sup>1</sup> AAIJ 15AB reports  $[m_{B_J^0} - m_{B^+}] - m_{\pi^-} = 550.4 \pm 2.9 \pm 5.1$  MeV which we adjust bythe  $\pi^-$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = (-1)^J$  and uses two relativistic Breit-Wigner functions in the fit for mass difference.<sup>2</sup> AALTONEN 14l reports  $m_{B_J(5970)^0} - m_{B^+} - m_{\pi^-} = 558 \pm 5 \pm 12$  MeV which we adjusted by the  $\pi^-$  mass.<sup>3</sup> AAIJ 15AB reports  $[m_{B_J^0} - m_{B^+}] - m_{\pi^-} = 575 \pm 6 \pm 5$  MeV which we adjust by the  $\pi^-$  mass. The masses inside the square brackets were measured for each candidate event. The result assumes  $P = (-1)^J$  and uses three relativistic Breit-Wigner functions in the fit for mass difference.

NODE=M248M0

NODE=M248M0  
NODE=M248M0NODE=M248DM0  
NODE=M248DM0

OCCUR=2

NODE=M248DM0;LINKAGE=B

NODE=M248DM0;LINKAGE=A

NODE=M248DM0;LINKAGE=C

**$m_{B_J(5970)^0} - m_{B^{*+}}$** 

| VALUE (MeV)                                                                                                                                                                                                                                                                                      | EVTS | DOCUMENT ID       | TECN      | COMMENT          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------|------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                    |      |                   |           |                  |
| $691.6 \pm 3.7 \pm 5.1$                                                                                                                                                                                                                                                                          | 10k  | <sup>1</sup> AAIJ | 15AB LHCb | $pp$ at 7, 8 TeV |
| <sup>1</sup> AAIJ 15AB reports $[m_{B_J^0} - m_{B^{*+}}] - (m_{B^{*+}} - m_{B^+}) - m_{\pi^-} = 552 \pm 4 \pm 5$ MeV                                                                                                                                                                             |      |                   |           |                  |
| which we adjust by the $\pi^-$ mass. The masses inside the square brackets were measured for each candidate event. The result assumes $P = -(-1)^J$ , $(m_{B^{*+}} - m_{B^+}) = 45.01 \pm 0.30 \pm 0.23$ MeV, and uses three relativistic Breit-Wigner functions in the fit for mass difference. |      |                   |           |                  |

NODE=M248DM2  
 NODE=M248DM2

NODE=M248DM2;LINKAGE=A

 **$B_J(5970)$  WIDTH**

NODE=M248210

 **$B_J(5970)^+$  WIDTH**

| VALUE (MeV)                                                                                                             | EVTS | DOCUMENT ID       | TECN      | COMMENT                |
|-------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------|------------------------|
| <b><math>62 \pm 20</math> OUR AVERAGE</b>                                                                               |      |                   |           |                        |
| $63 \pm 15 \pm 17$                                                                                                      | 2k   | <sup>1</sup> AAIJ | 15AB LHCb | $pp$ at 7, 8 TeV       |
| $60^{+30}_{-20} \pm 40$                                                                                                 | 1.4k | AALTONEN          | 14l CDF   | $p\bar{p}$ at 1.96 TeV |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                           |      |                   |           |                        |
| $61 \pm 14 \pm 17$                                                                                                      | 2k   | <sup>2</sup> AAIJ | 15AB LHCb | $pp$ at 7, 8 TeV       |
| $61 \pm 15 \pm 17$                                                                                                      | 2k   | <sup>3</sup> AAIJ | 15AB LHCb | $pp$ at 7, 8 TeV       |
| <sup>1</sup> Assuming $P = (-1)^J$ and using two relativistic Breit-Wigner functions in the fit for mass difference.    |      |                   |           |                        |
| <sup>2</sup> Assuming $P = (-1)^J$ and using three relativistic Breit-Wigner functions in the fit for mass difference.  |      |                   |           |                        |
| <sup>3</sup> Assuming $P = -(-1)^J$ and using three relativistic Breit-Wigner functions in the fit for mass difference. |      |                   |           |                        |

NODE=M248W+  
 NODE=M248W+

OCCUR=2  
 OCCUR=3

NODE=M248W+;LINKAGE=A

NODE=M248W+;LINKAGE=B

NODE=M248W+;LINKAGE=C

 **$B_J(5970)^0$  WIDTH**

| VALUE (MeV)                                                                                                             | EVTS | DOCUMENT ID       | TECN      | COMMENT                |
|-------------------------------------------------------------------------------------------------------------------------|------|-------------------|-----------|------------------------|
| <b><math>81 \pm 12</math> OUR AVERAGE</b>                                                                               |      |                   |           |                        |
| $82 \pm 8 \pm 9$                                                                                                        | 10k  | <sup>1</sup> AAIJ | 15AB LHCb | $pp$ at 7, 8 TeV       |
| $70^{+30}_{-20} \pm 30$                                                                                                 | 2.6k | AALTONEN          | 14l CDF   | $p\bar{p}$ at 1.96 TeV |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                           |      |                   |           |                        |
| $56 \pm 7 \pm 9$                                                                                                        | 10k  | <sup>2</sup> AAIJ | 15AB LHCb | $pp$ at 7, 8 TeV       |
| $82 \pm 10 \pm 9$                                                                                                       | 10k  | <sup>3</sup> AAIJ | 15AB LHCb | $pp$ at 7, 8 TeV       |
| <sup>1</sup> Assuming $P = (-1)^J$ and using two relativistic Breit-Wigner functions in the fit for mass difference.    |      |                   |           |                        |
| <sup>2</sup> Assuming $P = (-1)^J$ and using three relativistic Breit-Wigner functions in the fit for mass difference.  |      |                   |           |                        |
| <sup>3</sup> Assuming $P = -(-1)^J$ and using three relativistic Breit-Wigner functions in the fit for mass difference. |      |                   |           |                        |

NODE=M248W0  
 NODE=M248W0

OCCUR=2  
 OCCUR=3

NODE=M248W0;LINKAGE=A

NODE=M248W0;LINKAGE=B

NODE=M248W0;LINKAGE=C

 **$B_J(5970)$  DECAY MODES**

NODE=M248215;NODE=M248

| Mode                | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------|--------------------------------|
| $\Gamma_1$ $B\pi$   | possibly seen                  |
| $\Gamma_2$ $B^*\pi$ | seen                           |

DESIG=1  
 DESIG=2

 **$B_J(5970)$  BRANCHING RATIOS**

NODE=M248220

| $\Gamma(B\pi)/\Gamma_{\text{total}}$                                                               | VALUE | EVTS | DOCUMENT ID       | TECN      | CHG   | COMMENT                | $\Gamma_1/\Gamma$ |
|----------------------------------------------------------------------------------------------------|-------|------|-------------------|-----------|-------|------------------------|-------------------|
| possibly seen                                                                                      |       | 2k   | <sup>1</sup> AAIJ | 15AB LHCb | $\pm$ | $pp$ at 7, 8 TeV       |                   |
| possibly seen                                                                                      |       | 10k  | <sup>1</sup> AAIJ | 15AB LHCb | 0     | $pp$ at 7, 8 TeV       |                   |
| <b>possibly seen</b>                                                                               |       | 2.6k | AALTONEN          | 14l CDF   | 0     | $p\bar{p}$ at 1.96 TeV |                   |
| <b>possibly seen</b>                                                                               |       | 1.4k | AALTONEN          | 14l CDF   | $\pm$ | $p\bar{p}$ at 1.96 TeV |                   |
| <sup>1</sup> A $B\pi$ decay is forbidden from a $P = -(-1)^J$ parent, whereas $B^*\pi$ is allowed. |       |      |                   |           |       |                        |                   |
| $\Gamma(B^*\pi)/\Gamma_{\text{total}}$                                                             | VALUE | EVTS | DOCUMENT ID       | TECN      | CHG   | COMMENT                | $\Gamma_2/\Gamma$ |
| seen                                                                                               |       | 10k  | AAIJ              | 15AB LHCb | 0     | $pp$ at 7, 8 TeV       |                   |
| seen                                                                                               |       | 2k   | AAIJ              | 15AB LHCb | $\pm$ | $pp$ at 7, 8 TeV       |                   |
| <b>seen</b>                                                                                        |       | 2.6k | AALTONEN          | 14l CDF   | 0     | $p\bar{p}$ at 1.96 TeV |                   |
| <b>seen</b>                                                                                        |       | 1.4k | AALTONEN          | 14l CDF   | $\pm$ | $p\bar{p}$ at 1.96 TeV |                   |

NODE=M248R01  
 NODE=M248R01

OCCUR=2

OCCUR=2

NODE=M248R01;LINKAGE=A

NODE=M248R02  
 NODE=M248R02

OCCUR=2

OCCUR=2

 **$B_J(5970)$  REFERENCES**

NODE=M248

|          |      |               |                           |                |
|----------|------|---------------|---------------------------|----------------|
| AAIJ     | 15AB | JHEP 1504 024 | R. Aaij <i>et al.</i>     | (LHCb Collab.) |
| AALTONEN | 14l  | PR D90 012013 | T. Aaltonen <i>et al.</i> | (CDF Collab.)  |

REFID=56628  
 REFID=56029

# BOTTOM, STRANGE MESONS

## $(B = \pm 1, S = \mp 1)$

$$B_s^0 = s\bar{b}, \bar{B}_s^0 = \bar{s}b, \quad \text{similarly for } B_s^{*\prime}s$$

### X(5568) $^\pm$

$$I(J^P) = ?(??)$$

OMITTED FROM SUMMARY TABLE

Seen as a peak in the  $B_s\pi^\pm$  mass spectrum with a significance of more than  $3\sigma$  by ABAZOV 16E and ABAZOV 18A in inclusive  $p\bar{p}$  collisions at 1.96 TeV. Not seen by AAIJ 16AI, AABOUD 18L, AALTONEN 18A, and SIRUNYAN 18J. Needs confirmation.

### X(5568) $^\pm$ MASS

| VALUE (MeV)                                                                                                                                                    | EVTs | DOCUMENT ID         | TECN   | COMMENT                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------|---------------------|--------|---------------------------------------|
| <b>5566.9<math>^{+3.2+0.6}_{-3.1-1.2}</math></b>                                                                                                               | 278  | <sup>1</sup> ABAZOV | 18A D0 | $p\bar{p} \rightarrow B_s^0\pi^\pm X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                  |      |                     |        |                                       |
| 5567.8 $\pm 2.9^{+0.9}_{-1.9}$                                                                                                                                 | 133  | <sup>2</sup> ABAZOV | 16E D0 | $p\bar{p} \rightarrow B_s^0\pi^\pm X$ |
| <sup>1</sup> From the combined analysis of $B_s^0 \rightarrow J/\psi\phi$ and $B_s^0 \rightarrow D_s^\pm\mu^\mp X$ decays.                                     |      |                     |        |                                       |
| <sup>2</sup> Assumes $X(5568)^\pm \rightarrow B_s\pi^\pm$ decay. If $X(5568)^\pm \rightarrow B_s^*\pi^\pm$ decay is assumed, the mass shifts upward by 49 MeV. |      |                     |        |                                       |

### X(5568) $^\pm$ WIDTH

| VALUE (MeV)                                                                                                                | EVTs | DOCUMENT ID         | TECN   | COMMENT                             |
|----------------------------------------------------------------------------------------------------------------------------|------|---------------------|--------|-------------------------------------|
| <b>18.6<math>^{+7.9+3.5}_{-6.1-3.8}</math></b>                                                                             | 278  | <sup>1</sup> ABAZOV | 18A D0 | $p\bar{p} \rightarrow B_s\pi^\pm X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                              |      |                     |        |                                     |
| 21.9 $\pm 6.4^{+5.0}_{-2.5}$                                                                                               | 133  | ABAZOV              | 16E D0 | $p\bar{p} \rightarrow B_s\pi^\pm X$ |
| <sup>1</sup> From the combined analysis of $B_s^0 \rightarrow J/\psi\phi$ and $B_s^0 \rightarrow D_s^\pm\mu^\mp X$ decays. |      |                     |        |                                     |

### X(5568) $^\pm$ DECAY MODES

| Mode                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|-----------------------------|--------------------------------|
| $\Gamma_1 \quad B_s\pi^\pm$ | seen                           |

| $\Gamma(B_s\pi^\pm)/\Gamma_{\text{total}}$                                    |      |                       |           |                                       | $\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------|------|-----------------------|-----------|---------------------------------------|-------------------|
| VALUE                                                                         | EVTs | DOCUMENT ID           | TECN      | COMMENT                               |                   |
| seen                                                                          | 145  | <sup>1</sup> ABAZOV   | 18A D0    | $p\bar{p} \rightarrow B_s^0\pi^\pm X$ |                   |
| <b>seen</b>                                                                   | 133  | <sup>2</sup> ABAZOV   | 16E D0    | $p\bar{p} \rightarrow B_s^0\pi^\pm X$ |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |           |                                       |                   |
| not seen                                                                      |      | <sup>3</sup> AABOUD   | 18L ATLS  | $pp \rightarrow B_s^0\pi^\pm X$       |                   |
| not seen                                                                      |      | <sup>4</sup> AALTONEN | 18A CDF   | $p\bar{p} \rightarrow B_s^0\pi^\pm X$ |                   |
| not seen                                                                      |      | <sup>5</sup> SIRUNYAN | 18J CMS   | $pp \rightarrow B_s^0\pi^\pm X$       |                   |
| not seen                                                                      |      | <sup>6</sup> AAIJ     | 16AI LHCB | $pp \rightarrow B_s^0\pi^\pm X$       |                   |

<sup>1</sup> With  $B_s$  mesons reconstructed in decays to  $D_s^\pm\mu^\mp X$ .

<sup>2</sup> Seen in  $p\bar{p}$  collisions at 1.96 TeV at a rate of  $(8.6 \pm 1.9 \pm 1.4)\%$  relative to inclusive  $B_s$  production in the kinematic region  $10 < p_T(B_s) < 30$  GeV/c, with  $B_s$  mesons reconstructed in decays to  $J/\psi\phi$ . An alternative possibility,  $X(5568)^\pm \rightarrow B_s^*\pi^\pm$  with a missing  $\gamma$ , could not be ruled out.

NODE=MXXX046

NODE=MXXX046

NODE=M232

NODE=M232

NODE=M232M

NODE=M232M

NODE=M232M;LINKAGE=B

NODE=M232M;LINKAGE=A

NODE=M232W

NODE=M232W

NODE=M232W;LINKAGE=B

NODE=M232215;NODE=M232

DESIG=1

NODE=M232R01

NODE=M232R01

OCCUR=2

NODE=M232R01;LINKAGE=F

NODE=M232R01;LINKAGE=A

- <sup>3</sup> Not seen in  $24.4 \text{ fb}^{-1}$  of  $pp$  collision data at  $\sqrt{s} = 7$  and 8 TeV with  $B_s$  mesons reconstructed in decays to  $J/\psi\phi$ . An upper limit on the production rate times branching fraction for  $X(5568)^\pm \rightarrow B_s \pi^\pm$  relative to inclusive  $B_s$  production is less than 1.5% at  $p_T(B_s) > 10 \text{ GeV}/c$  and less than 1.6% at  $p_T(B_s) > 15 \text{ GeV}/c$  at 95% CL.
- <sup>4</sup> Not seen in  $9.6 \text{ fb}^{-1}$  of  $p\bar{p}$  collision data at  $\sqrt{s} = 1.96 \text{ TeV}$  with  $B_s$  mesons reconstructed in decays to  $J/\psi\phi$ . An upper limit on the production rate times branching fraction for  $X(5568)^\pm \rightarrow B_s \pi^\pm$  relative to inclusive  $B_s$  production is less than 6.7% at 95% CL.
- <sup>5</sup> Not seen in  $19.7 \text{ fb}^{-1}$  of  $pp$  collisions data at  $\sqrt{s} = 8 \text{ TeV}$  with  $B_s$  mesons reconstructed in decays to  $J/\psi\phi$ . An upper limit on the production rate times branching fraction for  $X(5568)^\pm \rightarrow B_s \pi^\pm$  relative to inclusive  $B_s$  production is less than 1.1% at  $p_T(B_s) > 10 \text{ GeV}/c$  and less than 1.0% at  $p_T(B_s) > 15 \text{ GeV}/c$  at 95%CL.
- <sup>6</sup> Not seen in  $3 \text{ fb}^{-1}$  of  $pp$  collision data at  $\sqrt{s} = 7$  and 8 TeV in a scan over the  $X(5568)$  mass and width, with  $B_s$  mesons reconstructed in decays to  $D_s^- \pi^+$  or  $J/\psi\phi$ . An upper limit on the production rate times branching fraction for  $X(5568)^\pm \rightarrow B_s \pi^\pm$  relative to inclusive  $B_s$  production is less than 2.1% at  $p_T(B_s) > 10 \text{ GeV}/c$  at 90% CL.

NODE=M232R01;LINKAGE=E

NODE=M232R01;LINKAGE=D

NODE=M232R01;LINKAGE=C

NODE=M232R01;LINKAGE=B

 **$X(5568)^\pm$  REFERENCES**

|          |      |                |                             |                 |
|----------|------|----------------|-----------------------------|-----------------|
| AABOUD   | 18L  | PRL 120 202007 | M. Aaboud <i>et al.</i>     | (ATLAS Collab.) |
| AALTONEN | 18A  | PRL 120 202006 | T. Aaltonen <i>et al.</i>   | (CDF Collab.)   |
| ABAZOV   | 18A  | PR D97 092004  | V.M. Abazov <i>et al.</i>   | (D0 Collab.)    |
| SIRUNYAN | 18J  | PRL 120 202005 | A.M. Sirunyan <i>et al.</i> | (CMS Collab.)   |
| AAIJ     | 16AI | PRL 117 152003 | R. Aaij <i>et al.</i>       | (LHCb Collab.)  |
| ABAZOV   | 16E  | PRL 117 022003 | V.M. Abazov <i>et al.</i>   | (D0 Collab.)    |

NODE=M232

REFID=58829  
REFID=58828  
REFID=58937  
REFID=58827  
REFID=57549  
REFID=57453

$$B_{s1}(5830)^0$$

$$I(J^P) = 0(1^+)$$

$I, J, P$  need confirmation.

Quantum numbers shown are quark-model predictions.

NODE=M187

NODE=M187

 **$B_{s1}(5830)^0$  MASS**

NODE=M187M

NODE=M187M

| VALUE (MeV)                                                                                                                                                                                                               | DOCUMENT ID           | TECN     | COMMENT               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------|-----------------------|
| <b>5828.70<math>\pm</math>0.20 OUR FIT</b>                                                                                                                                                                                |                       |          |                       |
| <b>5828.65<math>\pm</math>0.24 OUR AVERAGE</b>                                                                                                                                                                            |                       |          |                       |
| 5828.78 $\pm$ 0.09 $\pm$ 0.29                                                                                                                                                                                             | SIRUNYAN              | 18DF CMS | $pp$ at 8 TeV         |
| 5828.40 $\pm$ 0.04 $\pm$ 0.41                                                                                                                                                                                             | <sup>1</sup> AAIJ     | 130 LHCb | $pp$ at 7 TeV         |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                             |                       |          |                       |
| 5829.4 $\pm$ 0.7                                                                                                                                                                                                          | <sup>2</sup> AALTONEN | 08K CDF  | Repl. by AALTONEN 14I |
| <sup>1</sup> Uses $B_{s1}(5830)^0 \rightarrow B^{*+} K^-$ decay.                                                                                                                                                          |                       |          |                       |
| <sup>2</sup> Uses two-body decays into $K^-$ and $B^+$ mesons reconstructed as $B^+ \rightarrow J/\psi K^+$ , $J/\psi \rightarrow \mu^+ \mu^-$ or $B^+ \rightarrow \bar{D}^0 \pi^+$ , $\bar{D}^0 \rightarrow K^+ \pi^-$ . |                       |          |                       |

NODE=M187M;LINKAGE=AI

NODE=M187M;LINKAGE=AA

$$m_{B_{s1}^0} - m_{B^{*+}}$$

NODE=M187DM

NODE=M187DM

| VALUE (MeV)                                                                                                                                                                                                               | DOCUMENT ID           | TECN    | COMMENT                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------|------------------------|
| <b>504.00<math>\pm</math>0.17 OUR FIT</b>                                                                                                                                                                                 |                       |         |                        |
| <b>504.03<math>\pm</math>0.12<math>\pm</math>0.15</b>                                                                                                                                                                     | <sup>1</sup> AALTONEN | 14I CDF | $p\bar{p}$ at 1.96 TeV |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                             |                       |         |                        |
| 504.41 $\pm$ 0.21 $\pm$ 0.14                                                                                                                                                                                              | <sup>2</sup> AALTONEN | 08K CDF | Repl. by AALTONEN 14I  |
| <sup>1</sup> AALTONEN 14I reports $m_{B_{s1}(5830)^0} - m_{B^{*+}} - m_{K^-} = 10.35 \pm 0.12 \pm 0.15 \text{ MeV}$ which we adjusted by the $K^-$ mass.                                                                  |                       |         |                        |
| <sup>2</sup> Uses two-body decays into $K^-$ and $B^+$ mesons reconstructed as $B^+ \rightarrow J/\psi K^+$ , $J/\psi \rightarrow \mu^+ \mu^-$ or $B^+ \rightarrow \bar{D}^0 \pi^+$ , $\bar{D}^0 \rightarrow K^+ \pi^-$ . |                       |         |                        |

NODE=M187DM;LINKAGE=AL

NODE=M187DM;LINKAGE=AA

 **$B_{s1}(5830)^0$  WIDTH**

NODE=M187W

NODE=M187W

| VALUE (MeV)                                      | DOCUMENT ID | TECN    | COMMENT                |
|--------------------------------------------------|-------------|---------|------------------------|
| <b>0.5<math>\pm</math>0.3<math>\pm</math>0.3</b> | AALTONEN    | 14I CDF | $p\bar{p}$ at 1.96 TeV |

**$B_{s1}(5830)^0$  DECAY MODES**

NODE=M187215;NODE=M187

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $B^{*+} K^-$   | seen                           |
| $\Gamma_2$ $B^{*0} K_S^0$ |                                |

DESIG=1

DESIG=2

 **$B_{s1}(5830)^0$  BRANCHING RATIOS**

NODE=M187220

| $\Gamma(B^{*+} K^-)/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$                       |
|--------------------------------------------|-----------------------------------------|
| VALUE                                      | DOCUMENT ID TECN COMMENT                |
| seen                                       | AALTONEN 08K CDF $p\bar{p}$ at 1.96 TeV |

NODE=M187R01

NODE=M187R01

| $\Gamma(B^{*0} K_S^0)/\Gamma(B^{*+} K^-)$ | $\Gamma_2/\Gamma_1$                          |
|-------------------------------------------|----------------------------------------------|
| VALUE                                     | DOCUMENT ID TECN COMMENT                     |
| $0.49 \pm 0.12 \pm 0.07$                  | <sup>1</sup> SIRUNYAN 18DF CMS $pp$ at 8 TeV |

NODE=M187R00

NODE=M187R00

<sup>1</sup> With the branching fractions  $B(B^+ \rightarrow J/\psi K^+) = (1.026 \pm 0.031) \times 10^{-3}$  and  $B(B^0 \rightarrow J/\psi K^{*0}) = (1.28 \pm 0.05) \times 10^{-3}$ .

NODE=M187R00;LINKAGE=A

 **$B_{s1}(5830)^0$  REFERENCES**

NODE=M187

|                             |                             |                |
|-----------------------------|-----------------------------|----------------|
| SIRUNYAN 18DF EPJ C78 939   | A.M. Sirunyan <i>et al.</i> | (CMS Collab.)  |
| AALTONEN 14I PR D90 012013  | T. Aaltonen <i>et al.</i>   | (CDF Collab.)  |
| AAIJ 13O PRL 110 151803     | R. Aaij <i>et al.</i>       | (LHCb Collab.) |
| AALTONEN 08K PRL 100 082001 | T. Aaltonen <i>et al.</i>   | (CDF Collab.)  |

REFID=59328

REFID=56029

REFID=54968

REFID=52235

NODE=M186

**$B_{s2}^*(5840)^0$**

$I(J^P) = 0(2^+)$   
 $I, J, P$  need confirmation.

Quantum numbers shown are quark-model predictions.

NODE=M186

 **$B_{s2}^*(5840)^0$  MASS**

NODE=M186M

| VALUE (MeV)                                                                                                                                                                                                               | DOCUMENT ID                   | TECN                   | COMMENT |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|------------------------|---------|
| <b>5839.86 <math>\pm</math> 0.12 OUR FIT</b>                                                                                                                                                                              |                               |                        |         |
| <b>5839.92 <math>\pm</math> 0.14 OUR AVERAGE</b>                                                                                                                                                                          |                               |                        |         |
| 5839.86 $\pm$ 0.09 $\pm$ 0.17                                                                                                                                                                                             | SIRUNYAN 18DF CMS             | $pp$ at 8 TeV          |         |
| 5839.99 $\pm$ 0.05 $\pm$ 0.20                                                                                                                                                                                             | AAIJ 13O LHCb                 | $pp$ at 7 TeV          |         |
| 5839.6 $\pm$ 1.1 $\pm$ 0.7                                                                                                                                                                                                | <sup>1</sup> ABAZOV 08E D0    | $p\bar{p}$ at 1.96 TeV |         |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                             |                               |                        |         |
| 5839.7 $\pm$ 0.7                                                                                                                                                                                                          | <sup>2</sup> AALTONEN 08K CDF | Repl. by AALTONEN 14I  |         |
| <sup>1</sup> Observed in $B_{s2}^{*0} \rightarrow B^+ K^-$ . Measured production rate of $B_{s2}^{*0}$ relative to $B^+$ to be $(1.15 \pm 0.23 \pm 0.13)\%$ .                                                             |                               |                        |         |
| <sup>2</sup> Uses two-body decays into $K^-$ and $B^+$ mesons reconstructed as $B^+ \rightarrow J/\psi K^+$ , $J/\psi \rightarrow \mu^+ \mu^-$ or $B^+ \rightarrow \bar{D}^0 \pi^+$ , $\bar{D}^0 \rightarrow K^+ \pi^-$ . |                               |                        |         |

NODE=M186M;LINKAGE=AB

NODE=M186M;LINKAGE=AA

 **$m_{B_{s2}^{*0}} - m_{B_{s1}^0}$** 

NODE=M186DM

| VALUE (MeV)                                                                                                                                                                                                               | DOCUMENT ID                   | TECN                  | COMMENT |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------------|---------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                             |                               |                       |         |
| 10.5 $\pm$ 0.6                                                                                                                                                                                                            | <sup>1</sup> AALTONEN 08K CDF | Repl. by AALTONEN 14I |         |
| <sup>1</sup> Uses two-body decays into $K^-$ and $B^+$ mesons reconstructed as $B^+ \rightarrow J/\psi K^+$ , $J/\psi \rightarrow \mu^+ \mu^-$ or $B^+ \rightarrow \bar{D}^0 \pi^+$ , $\bar{D}^0 \rightarrow K^+ \pi^-$ . |                               |                       |         |

NODE=M186DM

NODE=M186DM;LINKAGE=AA

 **$m_{B_{s2}^{*0}} - m_{B^+}$** 

NODE=M186DM2

| VALUE (MeV)                                               | DOCUMENT ID                   | TECN                   | COMMENT |
|-----------------------------------------------------------|-------------------------------|------------------------|---------|
| <b>560.52 <math>\pm</math> 0.14 OUR FIT</b>               |                               |                        |         |
| <b>560.41 <math>\pm</math> 0.13 <math>\pm</math> 0.14</b> | <sup>1</sup> AALTONEN 14I CDF | $p\bar{p}$ at 1.96 TeV |         |

NODE=M186DM2

<sup>1</sup> AALTONEN 14l reports  $m_{B_{s2}^*(5840)^0} - m_{B^+} - m_{K^-} = 66.73 \pm 0.13 \pm 0.14$  MeV which we adjusted by the  $K^-$  mass.

NODE=M186DM2;LINKAGE=AL

### $B_{s2}^*(5840)^0$ WIDTH

NODE=M186W

| VALUE (MeV)                                                         | DOCUMENT ID       | TECN     | COMMENT                |
|---------------------------------------------------------------------|-------------------|----------|------------------------|
| <b>1.49±0.27 OUR AVERAGE</b>                                        |                   |          |                        |
| 1.52±0.34±0.30                                                      | SIRUNYAN          | 18DF CMS | $p\bar{p}$ at 8 TeV    |
| 1.4 ±0.4 ±0.2                                                       | AALTONEN          | 14l CDF  | $p\bar{p}$ at 1.96 TeV |
| 1.56±0.13±0.47                                                      | <sup>1</sup> AAIJ | 130 LHCb | $p\bar{p}$ at 7 TeV    |
| <sup>1</sup> Uses $B_{s2}^*(5840)^0 \rightarrow B^{*+} K^-$ decays. |                   |          |                        |

NODE=M186W

NODE=M186W;LINKAGE=A1

### $B_{s2}^*(5840)^0$ DECAY MODES

NODE=M186215;NODE=M186

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $B^+ K^-$      | <b>DEFINED AS 1</b>            |
| $\Gamma_2$ $B^{*+} K^-$   | 0.093±0.018                    |
| $\Gamma_3$ $B^0 K_S^0$    | 0.43 ±0.11                     |
| $\Gamma_4$ $B^{*0} K_S^0$ | 0.04 ±0.04                     |

DESIG=1

DESIG=2

DESIG=4

DESIG=3

### $B_{s2}^*(5840)^0$ BRANCHING RATIOS

NODE=M186220

| $\Gamma(B^+ K^-)/\Gamma_{\text{total}}$                                                                       | $\Gamma_1/\Gamma$                                 |
|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| VALUE                                                                                                         |                                                   |
| <b>seen</b>                                                                                                   | AALTONEN 08K CDF $p\bar{p}$ at 1.96 TeV           |
| <b>seen</b>                                                                                                   | <sup>1</sup> ABAZOV 08E D0 $p\bar{p}$ at 1.96 TeV |
| <sup>1</sup> Measured production rate of $B_{s2}^{*0}$ relative to $B^+$ to be $(1.15 \pm 0.23 \pm 0.13)\%$ . |                                                   |

NODE=M186R01  
NODE=M186R01

NODE=M186R01;LINKAGE=AB

| $\Gamma(B^{*+} K^-)/\Gamma(B^+ K^-)$ | $\Gamma_2/\Gamma_1$               |
|--------------------------------------|-----------------------------------|
| VALUE                                |                                   |
| <b>0.093±0.013±0.012</b>             | AAIJ 130 LHCb $p\bar{p}$ at 7 TeV |

NODE=M186R02  
NODE=M186R02

| $\Gamma(B^{*0} K_S^0)/\Gamma(B^0 K_S^0)$                                                                       | $\Gamma_4/\Gamma_3$                                |
|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| VALUE                                                                                                          |                                                    |
| <b>0.093±0.086±0.014</b>                                                                                       | <sup>1</sup> SIRUNYAN 18DF CMS $p\bar{p}$ at 8 TeV |
| <sup>1</sup> With the branching fraction $B(B^0 \rightarrow J/\psi K^{*0}) = (1.28 \pm 0.05) \times 10^{-3}$ . |                                                    |

NODE=M186R00  
NODE=M186R00

NODE=M186R00;LINKAGE=A

| $\Gamma(B^0 K_S^0)/\Gamma(B^+ K^-)$                                                                                                                                                    | $\Gamma_3/\Gamma_1$                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| VALUE                                                                                                                                                                                  |                                                    |
| <b>0.432±0.077±0.078</b>                                                                                                                                                               | <sup>1</sup> SIRUNYAN 18DF CMS $p\bar{p}$ at 8 TeV |
| <sup>1</sup> With the branching fractions $B(B^+ \rightarrow J/\psi K^+) = (1.026 \pm 0.031) \times 10^{-3}$ and $B(B^0 \rightarrow J/\psi K^{*0}) = (1.28 \pm 0.05) \times 10^{-3}$ . |                                                    |

NODE=M186R03  
NODE=M186R03

NODE=M186R03;LINKAGE=A

| $\Gamma(B^{*+} K^-)/\Gamma(B^+ K^-)$                                                                          | $\Gamma_2/\Gamma_1$                                |
|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| VALUE                                                                                                         |                                                    |
| <b>0.081±0.021±0.015</b>                                                                                      | <sup>1</sup> SIRUNYAN 18DF CMS $p\bar{p}$ at 8 TeV |
| <sup>1</sup> With the branching fraction $B(B^+ \rightarrow J/\psi K^+) = (1.026 \pm 0.031) \times 10^{-3}$ . |                                                    |

NODE=M186R04  
NODE=M186R04

NODE=M186R04;LINKAGE=A

### $B_{s2}^*(5840)^0$ REFERENCES

NODE=M186

|          |      |                |                             |                |
|----------|------|----------------|-----------------------------|----------------|
| SIRUNYAN | 18DF | EPJ C78 939    | A.M. Sirunyan <i>et al.</i> | (CMS Collab.)  |
| AALTONEN | 14l  | PR D90 012013  | T. Aaltonen <i>et al.</i>   | (CDF Collab.)  |
| AAIJ     | 130  | PRL 110 151803 | R. Aaij <i>et al.</i>       | (LHCb Collab.) |
| AALTONEN | 08K  | PRL 100 082001 | T. Aaltonen <i>et al.</i>   | (CDF Collab.)  |
| ABAZOV   | 08E  | PRL 100 082002 | V.M. Abazov <i>et al.</i>   | (D0 Collab.)   |

REFID=59328  
REFID=56029  
REFID=54968  
REFID=52235  
REFID=52232



$B_{sJ}^*(5850)$ 
 $I(J^P) = ?(??)$   
 $I, J, P$  need confirmation.

OMITTED FROM SUMMARY TABLE

Signal can be interpreted as coming from  $\bar{b}s$  states. Needs confirmation.

NODE=M153

NODE=M153

 $B_{sJ}^*(5850)$  MASS

| VALUE (MeV)      | EVTS | DOCUMENT ID | TECN     | COMMENT                   |
|------------------|------|-------------|----------|---------------------------|
| <b>5853 ± 15</b> | 141  | AKERS       | 95E OPAL | $E_{cm}^{ee} = 88-94$ GeV |

NODE=M153M

NODE=M153M

 $B_{sJ}^*(5850)$  WIDTH

| VALUE (MeV)    | EVTS | DOCUMENT ID | TECN     | COMMENT                   |
|----------------|------|-------------|----------|---------------------------|
| <b>47 ± 22</b> | 141  | AKERS       | 95E OPAL | $E_{cm}^{ee} = 88-94$ GeV |

NODE=M153W

NODE=M153W

 $B_{sJ}^*(5850)$  REFERENCESAKERS 95E ZPHY C66 19 R. Akers *et al.* (OPAL Collab.)

NODE=M153

REFID=44182

# BOTTOM, CHARMED MESONS

## ( $B = C = \pm 1$ )

 $B_c^+ = c\bar{b}, B_c^- = \bar{c}b,$  similarly for  $B_c^{*'}s$ 

NODE=MXXX049

NODE=MXXX049

 $B_c(2S)^\pm$  $I(J^P) = 0(0^-)$ 

Quantum numbers neither measured nor confirmed.

NODE=M217

NODE=M217

 $B_c(2S)^\pm$  MASS

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID             | TECN       | COMMENT              |
|-------------------------------------------------------------------------------|------|-------------------------|------------|----------------------|
| <b>6871.2 ± 1.0 OUR AVERAGE</b>                                               |      |                         |            |                      |
| [6871.6 ± 1.1 MeV OUR 2020 AVERAGE]                                           |      |                         |            |                      |
| 6871.7 ± 1.3 ± 0.3                                                            | 24   | <sup>1,2</sup> AAIJ     | 19Y LHCb   | $pp$ at 7, 8, 13 TeV |
| 6870.6 ± 1.4 ± 0.3                                                            | 51   | <sup>3,4</sup> SIRUNYAN | 19M CMS    | $pp$ at 13 TeV       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                         |            |                      |
| not seen                                                                      |      | <sup>5</sup> AAIJ       | 18AL LHCb  | $pp$ at 8 TeV        |
| 6842 ± 4 ± 5                                                                  | 57   | <sup>6,7</sup> AAD      | 14AQ ATLAS | $pp$ at 7, 8 TeV     |

NODE=M217M

NODE=M217M  
NEWSYCLP=A  
SYCLP=A

<sup>1</sup> AAIJ 19Y observed  $B_c(2S)^+$  in the decay mode  $B_c(2S)^+ \rightarrow B_c^+ \pi^+ \pi^-$  ( $B_c^+ \rightarrow J/\psi \pi^+$ ) with 2.2 (3.2) global (local) standard deviations significance.

<sup>2</sup> AAIJ 19Y reports mass difference measurement of  $M(B_c(2S)^+) - M(B_c^+) = 597.2 \pm 1.3 \pm 0.1$  MeV. We have adjusted this measurement with our best value of  $M(B_c^+) = 6274.47 \pm 0.32$  MeV. The first uncertainty of the  $M(B_c(2S)^+)$  value is a total of uncertainties reported by the experiment and the second one comes from our best value of  $M(B_c^+)$ .

<sup>3</sup> SIRUNYAN 19M observed  $B_c(2S)^+$  in the decay mode  $B_c(2S)^+ \rightarrow B_c^+ \pi^+ \pi^-$  ( $B_c^+ \rightarrow J/\psi \pi^+$ ) with 6.5 standard deviations significance.

<sup>4</sup> SIRUNYAN 19M reports mass difference measurement of  $M(B_c(2S)^+) - M(B_c^+) = 596.1 \pm 1.2 \pm 0.8$  MeV. We have adjusted this measurement with our best value of  $M(B_c^+) = 6274.47 \pm 0.32$  MeV. The first uncertainty of the  $M(B_c(2S)^+)$  value is a total of uncertainties reported by the experiment and the second one comes from our best value of  $M(B_c^+)$ .

<sup>5</sup> AAIJ 18AL reports an upper limit on the ratio of production cross sections for  $[\sigma(B_c(2S)^+)/\sigma(B_c^+)] \cdot B(B_c(2S)^+ \rightarrow B_c^+ \pi^+ \pi^-) < 0.04-0.09$  at 95% CL for the mass value reported by AAD 14AQ.

NODE=M217M;LINKAGE=E

NODE=M217M;LINKAGE=F

NODE=M217M;LINKAGE=B

NODE=M217M;LINKAGE=D

NODE=M217M;LINKAGE=A

<sup>6</sup>Observed in the decay mode  $B_c(2S)^+ \rightarrow B_c^+ \pi^+ \pi^-$  ( $B_c^+ \rightarrow J/\psi \pi^+$ ) with 5.2 standard deviations significance.

<sup>7</sup> Might be the  $B_c^*(2S)$ .

NODE=M217M;LINKAGE=AA

NODE=M217M;LINKAGE=C

NODE=M217215;NODE=M217

DESIG=1

NODE=M217225

NODE=M217R01  
NODE=M217R01

NODE=M217R01;LINKAGE=AA  
NODE=M217R01;LINKAGE=A

NODE=M217

REFID=59795  
REFID=59639  
REFID=59246  
REFID=56117

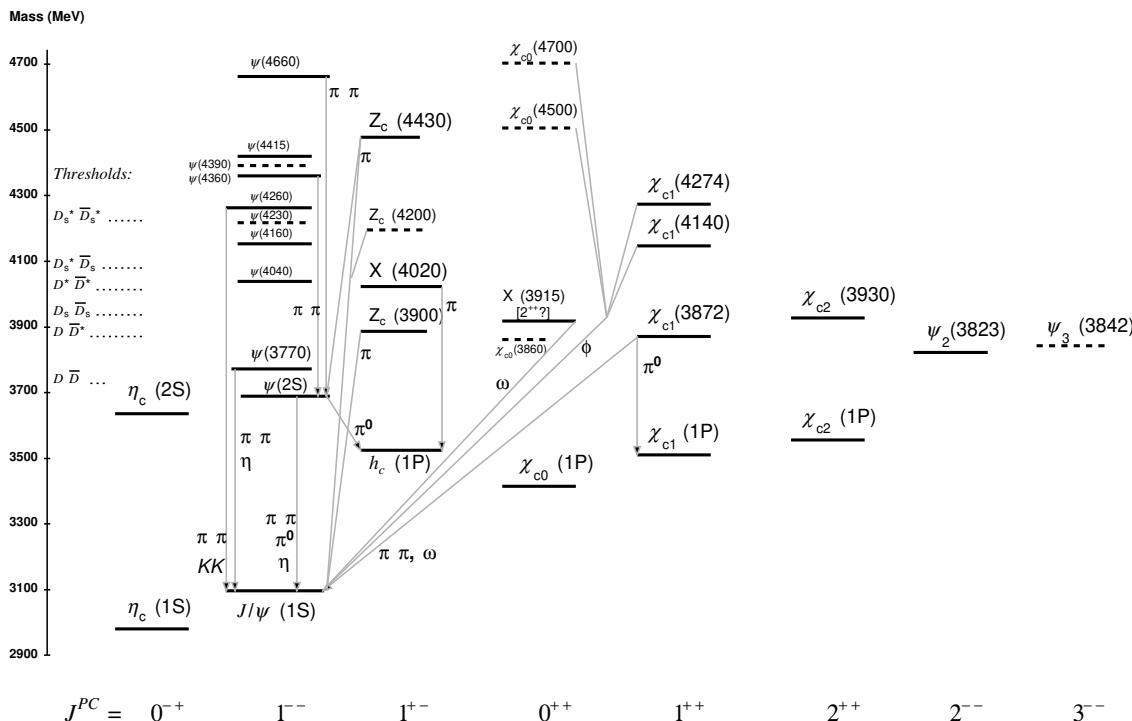
**See the related review(s):**

## Spectroscopy of Mesons Containing Two Heavy Quarks

NODE=MXXX025

NODE=M826

Updated August 2019.



The level scheme of meson states containing a minimal quark content of  $c\bar{c}$ . The name of a state is determined by its quantum numbers  $I^G J^{PC}$  (see the review “Naming Scheme for Hadrons”). States with unestablished quantum numbers are called  $X$  and are drawn according to our best estimate of their likely  $J^{PC}$ . States included in the Summary Tables are shown with solid lines; selected states not in the Summary Tables, but with assigned quantum numbers, are shown with dotted lines. The arrows indicate the most dominant hadronic transitions. Single photon transitions, including  $\psi(nS) \rightarrow \gamma\eta_c(mS)$ ,  $\psi(nS) \rightarrow \gamma\chi_{cJ}(1P)$ , and  $\chi_{cJ}(1P) \rightarrow \gamma J/\psi$ , are omitted for clarity. For orientation, the location of the thresholds related to a pair of ground state open charm mesons is indicated in the figure.

|                                                                   |      |                          |           |                                                                   |                                                       |  |            |
|-------------------------------------------------------------------|------|--------------------------|-----------|-------------------------------------------------------------------|-------------------------------------------------------|--|------------|
| <b><math>\eta_c(1S)</math></b>                                    |      |                          |           |                                                                   | $I^G(J^{PC}) = 0^+(0^-+)$                             |  | NODE=M026  |
| <b><math>\eta_c(1S)</math> MASS</b>                               |      |                          |           |                                                                   |                                                       |  | NODE=M026M |
| VALUE (MeV)                                                       | EVTs | DOCUMENT ID              | TECN      | COMMENT                                                           |                                                       |  | NODE=M026M |
| <b>2983.9 ± 0.4 OUR AVERAGE</b>                                   |      |                          |           |                                                                   | Error includes scale factor of 1.2. [2983.9 ± 0.5 MeV |  | NEW        |
| OUR 2020 AVERAGE Scale factor = 1.3]                              |      |                          |           |                                                                   |                                                       |  |            |
| 2983.9 ± 0.7 ± 0.1                                                |      | <sup>1</sup> AAIJ        | 20H LHCb  | $pp \rightarrow bX \rightarrow p\bar{p}X$                         |                                                       |  |            |
| 2985.9 ± 0.7 ± 2.1                                                | 1705 | ABLIKIM                  | 19AV BES3 | $J/\psi \rightarrow \gamma\omega\omega$                           |                                                       |  |            |
| 2984.6 ± 0.7 ± 2.2                                                | 2673 | XU                       | 18 BELL   | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$                        |                                                       |  |            |
| 2986.7 ± 0.5 ± 0.9                                                | 11k  | <sup>2</sup> AAIJ        | 17AD LHCb | $pp \rightarrow B^+X \rightarrow p\bar{p}K^+X$                    |                                                       |  |            |
| 2982.8 ± 1.0 ± 0.5                                                | 6.4k | <sup>3</sup> AAIJ        | 17BB LHCb | $pp \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$                 |                                                       |  |            |
| 2982.2 ± 1.5 ± 0.1                                                | 2.0k | <sup>4</sup> AAIJ        | 15BI LHCb | $pp \rightarrow \eta_c(1S)X$                                      |                                                       |  |            |
| 2983.5 ± 1.4 $\begin{smallmatrix} +1.6 \\ -3.6 \end{smallmatrix}$ |      | <sup>5</sup> ANASHIN     | 14 KEDR   | $J/\psi \rightarrow \gamma\eta_c$                                 |                                                       |  |            |
| 2979.8 ± 0.8 ± 3.5                                                | 4.5k | <sup>6,7</sup> LEES      | 14E BABR  | $\gamma\gamma \rightarrow K^+K^-\pi^0$                            |                                                       |  |            |
| 2984.1 ± 1.1 ± 2.1                                                | 900  | <sup>6,7,8</sup> LEES    | 14E BABR  | $\gamma\gamma \rightarrow K^+K^-\eta$                             |                                                       |  | OCCUR=2    |
| 2984.3 ± 0.6 ± 0.6                                                |      | <sup>9,10</sup> ABLIKIM  | 12F BES3  | $\psi(2S) \rightarrow \gamma\eta_c$                               |                                                       |  |            |
| 2984.49 ± 1.16 ± 0.52                                             | 832  | <sup>6</sup> ABLIKIM     | 12N BES3  | $\psi(2S) \rightarrow \pi^0\gamma \text{ hadrons}$                |                                                       |  |            |
| 2982.7 ± 1.8 ± 2.2                                                | 486  | ZHANG                    | 12A BELL  | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$                        |                                                       |  |            |
| 2984.5 ± 0.8 ± 3.1                                                | 11k  | DEL-AMO-SA..11M          | BABR      | $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$                  |                                                       |  |            |
| 2985.4 ± 1.5 $\begin{smallmatrix} +0.5 \\ -2.0 \end{smallmatrix}$ | 920  | <sup>10</sup> VINOKUROVA | 11 BELL   | $B^\pm \rightarrow K^\pm(K_S^0 K^\pm \pi^\mp)$                    |                                                       |  |            |
| 2982.2 ± 0.4 ± 1.6                                                | 14k  | <sup>11</sup> LEES       | 10 BABR   | $10.6 e^+e^- \rightarrow e^+e^-K_S^0 K^\pm \pi^\mp$               |                                                       |  |            |
| 2985.8 ± 1.5 ± 3.1                                                | 0.9k | AUBERT                   | 08AB BABR | $B \rightarrow \eta_c(1S)K^{(*)} \rightarrow K\bar{K}\pi K^{(*)}$ |                                                       |  |            |
| 2986.1 ± 1.0 ± 2.5                                                | 7.5k | UEHARA                   | 08 BELL   | $\gamma\gamma \rightarrow \eta_c \rightarrow \text{hadrons}$      |                                                       |  |            |
| 2970 ± 5 ± 6                                                      | 501  | <sup>12</sup> ABE        | 07 BELL   | $e^+e^- \rightarrow J/\psi(c\bar{c})$                             |                                                       |  |            |
| 2971 ± 3 $\begin{smallmatrix} +2 \\ -1 \end{smallmatrix}$         | 195  | WU                       | 06 BELL   | $B^+ \rightarrow p\bar{p}K^+$                                     |                                                       |  |            |
| 2974 ± 7 $\begin{smallmatrix} +2 \\ -1 \end{smallmatrix}$         | 20   | WU                       | 06 BELL   | $B^+ \rightarrow \Lambda\bar{\Lambda}K^+$                         |                                                       |  | OCCUR=2    |
| 2981.8 ± 1.3 ± 1.5                                                | 592  | ASNER                    | 04 CLEO   | $\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$ |                                                       |  |            |
| 2984.1 ± 2.1 ± 1.0                                                | 190  | <sup>13</sup> AMBROGIANI | 03 E835   | $\bar{p}p \rightarrow \eta_c \rightarrow \gamma\gamma$            |                                                       |  |            |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |      |       |                 |      |                                                                        |         |
|-----------------------|------|-------|-----------------|------|------------------------------------------------------------------------|---------|
| 2982.5 ± 0.4 ± 1.4    | 12k  | 14    | DEL-AMO-SA..11M | BABR | $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$                         | OCCUR=2 |
| 2982.2 ± 0.6          |      | 15    | MITCHELL        | 09   | CLEO $e^+e^- \rightarrow \gamma X$                                     |         |
| 2982 ± 5              | 270  | 16    | AUBERT          | 06E  | BABR $B^\pm \rightarrow K^\pm X_{c\bar{c}}$                            |         |
| 2982.5 ± 1.1 ± 0.9    | 2.5k | 17    | AUBERT          | 04D  | BABR $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K\bar{K}\pi$     |         |
| 2977.5 ± 1.0 ± 1.2    |      | 15,18 | BAI             | 03   | BES $J/\psi \rightarrow \gamma\eta_c$                                  |         |
| 2979.6 ± 2.3 ± 1.6    | 180  | 19    | FANG            | 03   | BELL $B \rightarrow \eta_c K$                                          |         |
| 2976.3 ± 2.3 ± 1.2    |      | 15,20 | BAI             | 00F  | BES $J/\psi, \psi(2S) \rightarrow \gamma\eta_c$                        |         |
| 2976.6 ± 2.9 ± 1.3    | 140  | 15,21 | BAI             | 00F  | BES $J/\psi \rightarrow \gamma\eta_c$                                  | OCCUR=2 |
| 2980.4 ± 2.3 ± 0.6    |      | 22    | BRANDENB...     | 00B  | CLE2 $\gamma\gamma \rightarrow \eta_c \rightarrow K^\pm K_S^0 \pi^\mp$ |         |
| 2975.8 ± 3.9 ± 1.2    |      | 21    | BAI             | 99B  | BES Sup. by BAI 00F                                                    |         |
| 2999 ± 8              | 25   |       | ABREU           | 980  | DLPH $e^+e^- \rightarrow e^+e^- + \text{hadrons}$                      |         |
| 2988.3 + 3.3<br>- 3.1 |      |       | ARMSTRONG       | 95F  | E760 $\bar{p}p \rightarrow \gamma\gamma$                               |         |
| 2974.4 ± 1.9          |      | 15,23 | BISELLO         | 91   | DM2 $J/\psi \rightarrow \eta_c \gamma$                                 |         |
| 2969 ± 4 ± 4          | 80   | 15    | BAI             | 90B  | MRK3 $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$                       | OCCUR=3 |
| 2956 ± 12 ± 12        |      | 15    | BAI             | 90B  | MRK3 $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$                   |         |
| 2982.6 + 2.7<br>- 2.3 | 12   |       | BAGLIN          | 87B  | SPEC $\bar{p}p \rightarrow \gamma\gamma$                               |         |
| 2980.2 ± 1.6          |      | 15,23 | BALTRUSAIT..86  | MRK3 | $J/\psi \rightarrow \eta_c \gamma$                                     |         |
| 2984 ± 2.3 ± 4.0      |      | 15    | GAISER          | 86   | CBAL $J/\psi \rightarrow \gamma X, \psi(2S) \rightarrow \gamma X$      |         |
| 2976 ± 8              |      | 15,24 | BALTRUSAIT..84  | MRK3 | $J/\psi \rightarrow 2\phi\gamma$                                       |         |
| 2982 ± 8              | 18   | 25    | HIMEL           | 80B  | MRK2 $e^+e^-$                                                          |         |
| 2980 ± 9              |      | 25    | PARTRIDGE       | 80B  | CBAL $e^+e^-$                                                          |         |

<sup>1</sup> AAIJ 20H report  $m_{J/\psi} - m_{\eta_c(1S)} = 113.0 \pm 0.7 \pm 0.1$  MeV. We use the current value  $m_{J/\psi} = 3096.900 \pm 0.006$  MeV to obtain the quoted mass.

NODE=M026M;LINKAGE=H

<sup>2</sup> AAIJ 17AD report  $m_{J/\psi} - m_{\eta_c(1S)} = 110.2 \pm 0.5 \pm 0.9$  MeV. We use the current value  $m_{J/\psi} = 3096.900 \pm 0.006$  MeV to obtain the quoted mass.

NODE=M026M;LINKAGE=F

<sup>3</sup> From a fit of the  $\phi\phi$  invariant mass with the mass and width of  $\eta_c(1S)$  as free parameters.

NODE=M026M;LINKAGE=G

<sup>4</sup> AAIJ 15BI reports  $m_{J/\psi} - m_{\eta_c(1S)} = 114.7 \pm 1.5 \pm 0.1$  MeV from a sample of  $\eta_c(1S)$  and  $J/\psi$  produced in  $b$ -hadron decays. We have used current value of  $m_{J/\psi} = 3096.900 \pm 0.006$  MeV to arrive at the quoted  $m_{\eta_c(1S)}$  result.

NODE=M026M;LINKAGE=D

<sup>5</sup> Taking into account an asymmetric photon lineshape.

NODE=M026M;LINKAGE=E

<sup>6</sup> With floating width.

NODE=M026M;LINKAGE=AL

<sup>7</sup> Ignoring possible interference with the non-resonant  $0^-$  amplitude.

NODE=M026M;LINKAGE=LS

<sup>8</sup> Using both,  $\eta \rightarrow \gamma\gamma$  and  $\eta \rightarrow \pi^+\pi^-\pi^0$  decays.

NODE=M026M;LINKAGE=EL

<sup>9</sup> From a simultaneous fit to six decay modes of the  $\eta_c$ .

NODE=M026M;LINKAGE=BL

<sup>10</sup> Accounts for interference with non-resonant continuum.

NODE=M026M;LINKAGE=VA

<sup>11</sup> Taking into account interference with the non-resonant  $J^P = 0^-$  amplitude.

NODE=M026M;LINKAGE=LE

<sup>12</sup> From a fit of the  $J/\psi$  recoil mass spectrum. Supersedes ABE,K 02 and ABE 04G.

NODE=M026M;LINKAGE=EB

<sup>13</sup> Using mass of  $\psi(2S) = 3686.00$  MeV.

NODE=M026M;LINKAGE=BG

<sup>14</sup> Not independent from the measurements reported by LEES 10.

NODE=M026M;LINKAGE=DE

<sup>15</sup> MITCHELL 09 observes a significant asymmetry in the lineshapes of  $\psi(2S) \rightarrow \gamma\eta_c$  and  $J/\psi \rightarrow \gamma\eta_c$  transitions. If ignored, this asymmetry could lead to significant bias whenever the mass and width are measured in  $\psi(2S)$  or  $J/\psi$  radiative decays.

NODE=M026M;LINKAGE=MI

<sup>16</sup> From the fit of the kaon momentum spectrum. Systematic errors not evaluated.

NODE=M026M;LINKAGE=AU

<sup>17</sup> Superseded by LEES 10.

NODE=M026M;LINKAGE=UB

<sup>18</sup> From a simultaneous fit of five decay modes of the  $\eta_c$ .

NODE=M026M;LINKAGE=AK

<sup>19</sup> Superseded by VINOKUROVA 11.

NODE=M026M;LINKAGE=FA

<sup>20</sup> Weighted average of the  $\psi(2S)$  and  $J/\psi(1S)$  samples. Using an  $\eta_c$  width of 13.2 MeV.

NODE=M026M;LINKAGE=KZ

<sup>21</sup> Average of several decay modes. Using an  $\eta_c$  width of 13.2 MeV.

NODE=M026M;LINKAGE=C1

<sup>22</sup> Superseded by ASNER 04.

NODE=M026M;LINKAGE=NN

<sup>23</sup> Average of several decay modes.

NODE=M026M;LINKAGE=A

<sup>24</sup>  $\eta_c \rightarrow \phi\phi$ .

NODE=M026M;LINKAGE=B

<sup>25</sup> Mass adjusted by us to correspond to  $J/\psi(1S)$  mass = 3097 MeV.

NODE=M026M;LINKAGE=M

## $\eta_c(1S)$ WIDTH

NODE=M026W

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID                  | TECN      | COMMENT                                                                            |
|-------------------------------------------------------------------------------|------|------------------------------|-----------|------------------------------------------------------------------------------------|
| <b>32.0± 0.7 OUR FIT</b>                                                      |      |                              |           |                                                                                    |
| <b>32.1± 0.8 OUR AVERAGE</b> Error includes scale factor of 1.1.              |      |                              |           |                                                                                    |
| 33.8± 1.6±4.1                                                                 | 1705 | ABLIKIM                      | 19AV BES3 | $J/\psi \rightarrow \gamma \omega \omega$                                          |
| 30.8 <sup>+</sup> <sub>-</sub> 2.3 <sub>2.2</sub> ±2.9                        | 2673 | XU                           | 18 BELL   | $e^+e^- \rightarrow e^+e^- \eta' \pi^+ \pi^-$                                      |
| 34.0± 1.9±1.3                                                                 | 11k  | AAIJ                         | 17AD LHCb | $pp \rightarrow B^+ X \rightarrow p \bar{p} K^+ X$                                 |
| 31.4± 3.5±2.0                                                                 | 6.4k | <sup>1</sup> AAIJ            | 17BB LHCb | $pp \rightarrow b \bar{b} X \rightarrow 2(K^+ K^-) X$                              |
| 27.2± 3.1 <sup>+</sup> <sub>-</sub> 5.4 <sub>2.6</sub>                        |      | <sup>2</sup> ANASHIN         | 14 KEDR   | $J/\psi \rightarrow \gamma \eta_c$                                                 |
| 25.2± 2.6±2.4                                                                 | 4.5k | <sup>3,4</sup> LEES          | 14E BABR  | $\gamma \gamma \rightarrow K^+ K^- \pi^0$                                          |
| 34.8± 3.1±4.0                                                                 | 900  | <sup>3,4,5</sup> LEES        | 14E BABR  | $\gamma \gamma \rightarrow K^+ K^- \eta$                                           |
| 32.0± 1.2±1.0                                                                 |      | <sup>6,7</sup> ABLIKIM       | 12F BES3  | $\psi(2S) \rightarrow \gamma \eta_c$                                               |
| 36.4± 3.2±1.7                                                                 | 832  | <sup>3</sup> ABLIKIM         | 12N BES3  | $\psi(2S) \rightarrow \pi^0 \gamma \text{ hadrons}$                                |
| 37.8 <sup>+</sup> <sub>-</sub> 5.8 <sub>5.3</sub> ±3.1                        | 486  | ZHANG                        | 12A BELL  | $e^+e^- \rightarrow e^+e^- \eta' \pi^+ \pi^-$                                      |
| 36.2± 2.8±3.0                                                                 | 11k  | DEL-AMO-SA..11M              | BABR      | $\gamma \gamma \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$                              |
| 35.1± 3.1 <sup>+</sup> <sub>-</sub> 1.0 <sub>1.6</sub>                        | 920  | <sup>7</sup> VINOKUROVA      | 11 BELL   | $B^\pm \rightarrow K^\pm (K_S^0 K^\pm \pi^\mp)$                                    |
| 31.7± 1.2±0.8                                                                 | 14k  | <sup>8</sup> LEES            | 10 BABR   | $10.6 e^+e^- \rightarrow e^+e^- K_S^0 K^\pm \pi^\mp$                               |
| 36.3 <sup>+</sup> <sub>-</sub> 3.7 <sub>3.6</sub> ±4.4                        | 0.9k | AUBERT                       | 08AB BABR | $B \rightarrow \eta_c(1S) K^{(*)} \rightarrow K \bar{K} \pi K^{(*)}$               |
| 28.1± 3.2±2.2                                                                 | 7.5k | UEHARA                       | 08 BELL   | $\gamma \gamma \rightarrow \eta_c \rightarrow \text{hadrons}$                      |
| 48 <sup>+</sup> <sub>-</sub> 8 <sub>7</sub> ±5                                | 195  | WU                           | 06 BELL   | $B^+ \rightarrow p \bar{p} K^+$                                                    |
| 40 ±19 ±5                                                                     | 20   | WU                           | 06 BELL   | $B^+ \rightarrow \Lambda \bar{\Lambda} K^+$                                        |
| 24.8± 3.4±3.5                                                                 | 592  | ASNER                        | 04 CLEO   | $\gamma \gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$                 |
| 20.4 <sup>+</sup> <sub>-</sub> 7.7 <sub>6.7</sub> ±2.0                        | 190  | AMBROGIANI                   | 03 E835   | $\bar{p} p \rightarrow \eta_c \rightarrow \gamma \gamma$                           |
| 23.9 <sup>+</sup> <sub>-</sub> 12.6 <sub>7.1</sub>                            |      | ARMSTRONG                    | 95F E760  | $\bar{p} p \rightarrow \gamma \gamma$                                              |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                              |           |                                                                                    |
| 32.1± 1.1±1.3                                                                 | 12k  | <sup>9</sup> DEL-AMO-SA..11M | BABR      | $\gamma \gamma \rightarrow K_S^0 K^\pm \pi^\mp$                                    |
| 34.3± 2.3±0.9                                                                 | 2.5k | <sup>10</sup> AUBERT         | 04D BABR  | $\gamma \gamma \rightarrow \eta_c(1S) \rightarrow K \bar{K} \pi$                   |
| 17.0± 3.7±7.4                                                                 |      | <sup>11</sup> BAI            | 03 BES    | $J/\psi \rightarrow \gamma \eta_c$                                                 |
| 29 ± 8 ±6                                                                     | 180  | <sup>12</sup> FANG           | 03 BELL   | $B \rightarrow \eta_c K$                                                           |
| 11.0± 8.1±4.1                                                                 |      | <sup>13</sup> BAI            | 00F BES   | $J/\psi \rightarrow \gamma \eta_c \text{ and } \psi(2S) \rightarrow \gamma \eta_c$ |
| 27.0± 5.8±1.4                                                                 |      | <sup>14</sup> BRANDENB...    | 00B CLE2  | $\gamma \gamma \rightarrow \eta_c \rightarrow K^\pm K_S^0 \pi^\mp$                 |
| 7.0 <sup>+</sup> <sub>-</sub> 7.5 <sub>7.0</sub>                              | 12   | BAGLIN                       | 87B SPEC  | $\bar{p} p \rightarrow \gamma \gamma$                                              |
| 10.1 <sup>+</sup> <sub>-</sub> 33.0 <sub>8.2</sub>                            | 23   | <sup>15</sup> BALTRUSAIT..86 | MRK3      | $J/\psi \rightarrow \gamma p \bar{p}$                                              |
| 11.5± 4.5                                                                     |      | GAISER                       | 86 CBAL   | $J/\psi \rightarrow \gamma X, \psi(2S) \rightarrow \gamma X$                       |
| < 40 90% CL                                                                   | 18   | HIMEL                        | 80B MRK2  | $e^+e^-$                                                                           |
| < 20 90% CL                                                                   |      | PARTRIDGE                    | 80B CBAL  | $e^+e^-$                                                                           |

<sup>1</sup> From a fit of the  $\phi\phi$  invariant mass with the mass and width of  $\eta_c(1S)$  as free parameters.

<sup>2</sup> Taking into account an asymmetric photon lineshape.

<sup>3</sup> With floating mass.

<sup>4</sup> Ignoring possible interference with the non-resonant  $0^-$  amplitude.

<sup>5</sup> Using both,  $\eta \rightarrow \gamma\gamma$  and  $\eta \rightarrow \pi^+ \pi^- \pi^0$  decays.

<sup>6</sup> From a simultaneous fit to six decay modes of the  $\eta_c$ .

<sup>7</sup> Accounts for interference with non-resonant continuum.

<sup>8</sup> Taking into account interference with the non-resonant  $J^P = 0^-$  amplitude.

<sup>9</sup> Not independent from the measurements reported by LEES 10.

<sup>10</sup> Superseded by LEES 10.

<sup>11</sup> From a simultaneous fit of five decay modes of the  $\eta_c$ .

<sup>12</sup> Superseded by VINOKUROVA 11.

<sup>13</sup> From a fit to the 4-prong invariant mass in  $\psi(2S) \rightarrow \gamma \eta_c$  and  $J/\psi(1S) \rightarrow \gamma \eta_c$  decays.

<sup>14</sup> Superseded by ASNER 04.

<sup>15</sup> Positive and negative errors correspond to 90% confidence level.

NODE=M026W

OCCUR=2

OCCUR=2

OCCUR=2

NODE=M026W;LINKAGE=B  
 NODE=M026W;LINKAGE=A  
 NODE=M026W;LINKAGE=AL  
 NODE=M026W;LINKAGE=LS  
 NODE=M026W;LINKAGE=EL  
 NODE=M026W;LINKAGE=BL  
 NODE=M026W;LINKAGE=VA  
 NODE=M026W;LINKAGE=LE  
 NODE=M026W;LINKAGE=DE  
 NODE=M026W;LINKAGE=UB  
 NODE=M026W;LINKAGE=AK  
 NODE=M026W;LINKAGE=FA  
 NODE=M026W;LINKAGE=KZ  
 NODE=M026W;LINKAGE=NN  
 NODE=M026W;LINKAGE=L

## $\eta_c(1S)$ DECAY MODES

NODE=M026215;NODE=M026

| Mode | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|------|--------------------------------|------------------|
|------|--------------------------------|------------------|

**Decays involving hadronic resonances**

|               |                                      |                                      |     |                   |
|---------------|--------------------------------------|--------------------------------------|-----|-------------------|
| $\Gamma_1$    | $\eta'(958)\pi\pi$                   | ( 4.1 $\pm$ 1.7 ) %                  |     | NODE=M026;CLUMP=A |
| $\Gamma_2$    | $\rho\rho$                           | ( 1.8 $\pm$ 0.5 ) %                  |     | DESIG=24          |
| $\Gamma_3$    | $K^*(892)^0 K^- \pi^+ + \text{c.c.}$ | ( 2.0 $\pm$ 0.7 ) %                  |     | DESIG=19          |
| $\Gamma_4$    | $K^*(892)\bar{K}^*(892)$             | ( 6.9 $\pm$ 1.3 ) $\times 10^{-3}$   |     | DESIG=26          |
| $\Gamma_5$    | $K^*(892)^0 K^*(892)^0 \pi^+ \pi^-$  | ( 1.1 $\pm$ 0.5 ) %                  |     | DESIG=18          |
| $\Gamma_6$    | $\phi K^+ K^-$                       | ( 2.9 $\pm$ 1.4 ) $\times 10^{-3}$   |     | DESIG=57          |
| $\Gamma_7$    | $\phi\phi$                           | ( 1.74 $\pm$ 0.19 ) $\times 10^{-3}$ |     | DESIG=28          |
| $\Gamma_8$    | $\phi 2(\pi^+ \pi^-)$                | < 4 $\times 10^{-3}$                 | 90% | DESIG=17          |
| $\Gamma_9$    | $a_0(980)\pi$                        | < 2 %                                | 90% | DESIG=58          |
| $\Gamma_{10}$ | $a_2(1320)\pi$                       | < 2 %                                | 90% | DESIG=21          |
| $\Gamma_{11}$ | $K^*(892)\bar{K} + \text{c.c.}$      | < 1.28 %                             | 90% | DESIG=22          |
| $\Gamma_{12}$ | $f_2(1270)\eta$                      | < 1.1 %                              | 90% | DESIG=40          |
| $\Gamma_{13}$ | $\omega\omega$                       | ( 2.9 $\pm$ 0.8 ) $\times 10^{-3}$   |     | DESIG=23          |
| $\Gamma_{14}$ | $\omega\phi$                         | < 2.5 $\times 10^{-4}$               | 90% | DESIG=20          |
| $\Gamma_{15}$ | $f_2(1270)f_2(1270)$                 | ( 9.8 $\pm$ 2.5 ) $\times 10^{-3}$   |     | DESIG=47          |
| $\Gamma_{16}$ | $f_2(1270)f_2'(1525)$                | ( 9.5 $\pm$ 3.2 ) $\times 10^{-3}$   |     | DESIG=46          |
| $\Gamma_{17}$ | $f_0(980)\eta$                       | seen                                 |     | DESIG=59          |
| $\Gamma_{18}$ | $f_0(1500)\eta$                      | seen                                 |     | DESIG=70          |
| $\Gamma_{19}$ | $f_0(2200)\eta$                      | seen                                 |     | DESIG=71          |
| $\Gamma_{20}$ | $a_0(980)\pi$                        | seen                                 |     | DESIG=72          |
| $\Gamma_{21}$ | $a_0(1320)\pi$                       | seen                                 |     | DESIG=73          |
| $\Gamma_{22}$ | $a_0(1450)\pi$                       | seen                                 |     | DESIG=74          |
| $\Gamma_{23}$ | $a_0(1950)\pi$                       | seen                                 |     | DESIG=75          |
| $\Gamma_{24}$ | $K_0^*(1430)\bar{K}$                 | seen                                 |     | DESIG=79          |
| $\Gamma_{25}$ | $K_2^*(1430)\bar{K}$                 | seen                                 |     | DESIG=76          |
| $\Gamma_{26}$ | $K_0^*(1950)\bar{K}$                 | seen                                 |     | DESIG=77          |
|               |                                      |                                      |     | DESIG=78          |

**Decays into stable hadrons**

|               |                                            |                                      |     |                   |
|---------------|--------------------------------------------|--------------------------------------|-----|-------------------|
| $\Gamma_{27}$ | $K\bar{K}\pi$                              | ( 7.3 $\pm$ 0.4 ) %                  |     | NODE=M026;CLUMP=B |
| $\Gamma_{28}$ | $K\bar{K}\eta$                             | ( 1.36 $\pm$ 0.15 ) %                |     | DESIG=14          |
| $\Gamma_{29}$ | $\eta\pi^+\pi^-$                           | ( 1.7 $\pm$ 0.6 ) %                  |     | DESIG=25          |
| $\Gamma_{30}$ | $\eta 2(\pi^+ \pi^-)$                      | ( 4.4 $\pm$ 1.6 ) %                  |     | DESIG=16          |
| $\Gamma_{31}$ | $K^+ K^- \pi^+ \pi^-$                      | ( 6.6 $\pm$ 1.1 ) $\times 10^{-3}$   |     | DESIG=61          |
| $\Gamma_{32}$ | $K^+ K^- \pi^+ \pi^- \pi^0$                | ( 3.5 $\pm$ 0.6 ) %                  |     | DESIG=15          |
| $\Gamma_{33}$ | $K^0 K^- \pi^+ \pi^- \pi^+ + \text{c.c.}$  | ( 5.6 $\pm$ 1.9 ) %                  |     | DESIG=60          |
| $\Gamma_{34}$ | $K^+ K^- 2(\pi^+ \pi^-)$                   | ( 7.5 $\pm$ 2.4 ) $\times 10^{-3}$   |     | DESIG=62          |
| $\Gamma_{35}$ | $2(K^+ K^-)$                               | ( 1.43 $\pm$ 0.30 ) $\times 10^{-3}$ |     | DESIG=55          |
| $\Gamma_{36}$ | $\pi^+ \pi^- \pi^0$                        | < 5 $\times 10^{-4}$                 | 90% | DESIG=27          |
| $\Gamma_{37}$ | $\pi^+ \pi^- \pi^0 \pi^0$                  | ( 4.7 $\pm$ 1.4 ) %                  |     | DESIG=81          |
| $\Gamma_{38}$ | $2(\pi^+ \pi^-)$                           | ( 9.1 $\pm$ 1.2 ) $\times 10^{-3}$   |     | DESIG=63          |
| $\Gamma_{39}$ | $2(\pi^+ \pi^- \pi^0)$                     | (15.8 $\pm$ 2.3 ) %                  |     | DESIG=64          |
| $\Gamma_{40}$ | $3(\pi^+ \pi^-)$                           | ( 1.7 $\pm$ 0.4 ) %                  |     | DESIG=56          |
| $\Gamma_{41}$ | $p\bar{p}$                                 | ( 1.44 $\pm$ 0.14 ) $\times 10^{-3}$ |     | DESIG=12          |
| $\Gamma_{42}$ | $p\bar{p}\pi^0$                            | ( 3.6 $\pm$ 1.5 ) $\times 10^{-3}$   |     | DESIG=65          |
| $\Gamma_{43}$ | $\Lambda\bar{\Lambda}$                     | ( 1.06 $\pm$ 0.23 ) $\times 10^{-3}$ |     | DESIG=45          |
| $\Gamma_{44}$ | $K^+ \bar{p} \Lambda + \text{c.c.}$        | ( 2.5 $\pm$ 0.4 ) $\times 10^{-3}$   |     | DESIG=82          |
| $\Gamma_{45}$ | $\bar{\Lambda}(1520)\Lambda + \text{c.c.}$ | ( 3.1 $\pm$ 1.3 ) $\times 10^{-3}$   |     | DESIG=83          |
| $\Gamma_{46}$ | $\Sigma^+ \bar{\Sigma}^-$                  | ( 2.1 $\pm$ 0.6 ) $\times 10^{-3}$   |     | DESIG=66          |
| $\Gamma_{47}$ | $\Xi^- \bar{\Xi}^+$                        | ( 9.0 $\pm$ 2.6 ) $\times 10^{-4}$   |     | DESIG=67          |
| $\Gamma_{48}$ | $\pi^+ \pi^- p\bar{p}$                     | ( 5.3 $\pm$ 2.1 ) $\times 10^{-3}$   |     | DESIG=13          |

**Radiative decays**

|               |                |                                      |  |                   |
|---------------|----------------|--------------------------------------|--|-------------------|
| $\Gamma_{49}$ | $\gamma\gamma$ | ( 1.61 $\pm$ 0.12 ) $\times 10^{-4}$ |  | NODE=M026;CLUMP=C |
|               |                |                                      |  | DESIG=31          |

**Charge conjugation (C), Parity (P),  
Lepton family number (LF) violating modes**

|               |               |         |                        |     |                   |
|---------------|---------------|---------|------------------------|-----|-------------------|
| $\Gamma_{50}$ | $\pi^+ \pi^-$ | $P, CP$ | < 1.1 $\times 10^{-4}$ | 90% | NODE=M026;CLUMP=D |
| $\Gamma_{51}$ | $\pi^0 \pi^0$ | $P, CP$ | < 4 $\times 10^{-5}$   | 90% | DESIG=51          |
| $\Gamma_{52}$ | $K^+ K^-$     | $P, CP$ | < 6 $\times 10^{-4}$   | 90% | DESIG=52          |
| $\Gamma_{53}$ | $K_S^0 K_S^0$ | $P, CP$ | < 3.1 $\times 10^{-4}$ | 90% | DESIG=53          |
|               |               |         |                        | 90% | DESIG=54          |

## CONSTRAINED FIT INFORMATION

An overall fit to the total width, 8 combinations of partial widths obtained from integrated cross section, and 19 branching ratios uses 93 measurements and one constraint to determine 13 parameters. The overall fit has a  $\chi^2 = 117.8$  for 81 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \cdot \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |          |       |          |          |          |          |          |          |          |          |
|----------|----------|-------|----------|----------|----------|----------|----------|----------|----------|----------|
| $x_7$    | 16       |       |          |          |          |          |          |          |          |          |
| $x_{15}$ | 3        | 5     |          |          |          |          |          |          |          |          |
| $x_{27}$ | 18       | 35    | 6        |          |          |          |          |          |          |          |
| $x_{28}$ | 9        | 17    | 3        | 47       |          |          |          |          |          |          |
| $x_{31}$ | 10       | 18    | 3        | 21       | 10       |          |          |          |          |          |
| $x_{35}$ | 7        | 13    | 2        | 21       | 10       | 8        |          |          |          |          |
| $x_{38}$ | 12       | 22    | 4        | 25       | 12       | 14       | 10       |          |          |          |
| $x_{41}$ | 11       | 20    | 4        | 27       | 13       | 12       | 10       | 15       |          |          |
| $x_{43}$ | 3        | 5     | 1        | 6        | 3        | 3        | 2        | 4        | 23       |          |
| $x_{49}$ | -27      | -51   | -9       | -59      | -28      | -32      | -23      | -38      | -38      | -9       |
| $\Gamma$ | -1       | -3    | 0        | -3       | -1       | -2       | -1       | -2       | 6        | 1        |
|          | $x_4$    | $x_7$ | $x_{15}$ | $x_{27}$ | $x_{28}$ | $x_{31}$ | $x_{35}$ | $x_{38}$ | $x_{41}$ | $x_{43}$ |
| $\Gamma$ | -27      |       |          |          |          |          |          |          |          |          |
|          | $x_{49}$ |       |          |          |          |          |          |          |          |          |

| Mode                                  | Rate (MeV)            |          |
|---------------------------------------|-----------------------|----------|
| $\Gamma_4$ $K^*(892) \bar{K}^*(892)$  | 0.22 $\pm$ 0.04       | DESIG=18 |
| $\Gamma_7$ $\phi \phi$                | 0.056 $\pm$ 0.006     | DESIG=17 |
| $\Gamma_{15}$ $f_2(1270) f_2(1270)$   | 0.31 $\pm$ 0.08       | DESIG=46 |
| $\Gamma_{27}$ $K \bar{K} \pi$         | 2.32 $\pm$ 0.14       | DESIG=14 |
| $\Gamma_{28}$ $K \bar{K} \eta$        | 0.43 $\pm$ 0.05       | DESIG=25 |
| $\Gamma_{31}$ $K^+ K^- \pi^+ \pi^-$   | 0.210 $\pm$ 0.035     | DESIG=15 |
| $\Gamma_{35}$ $2(K^+ K^-)$            | 0.046 $\pm$ 0.010     | DESIG=27 |
| $\Gamma_{38}$ $2(\pi^+ \pi^-)$        | 0.29 $\pm$ 0.04       | DESIG=11 |
| $\Gamma_{41}$ $\rho \bar{\rho}$       | 0.046 $\pm$ 0.005     | DESIG=12 |
| $\Gamma_{43}$ $\Lambda \bar{\Lambda}$ | 0.034 $\pm$ 0.008     | DESIG=45 |
| $\Gamma_{49}$ $\gamma \gamma$         | 0.00515 $\pm$ 0.00035 | DESIG=31 |

## $\eta_c(1S)$ PARTIAL WIDTHS

NODE=M026217

 $\Gamma(\gamma\gamma)$  $\Gamma_{49}$ 

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**5.15  $\pm$  0.35 OUR FIT**[5.06  $\pm$  0.34 keV OUR 2020 FIT]

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                        |              |                            |          |                                                                   |
|----------------------------------------|--------------|----------------------------|----------|-------------------------------------------------------------------|
| 5.8 $\pm$ 1.1                          | 486          | <sup>1</sup> ZHANG         | 12A BELL | $e^+ e^- \rightarrow e^+ e^- \eta' \pi^+ \pi^-$                   |
| 5.2 $\pm$ 1.2                          | 273 $\pm$ 43 | <sup>2,3</sup> AUBERT      | 06E BABR | $B^\pm \rightarrow K^\pm X_{c\bar{c}}$                            |
| 5.5 $\pm$ 1.2 $\pm$ 1.8                | 57 $\pm$ 33  | <sup>4</sup> KUO           | 05 BELL  | $\gamma\gamma \rightarrow \rho \bar{\rho}$                        |
| 7.4 $\pm$ 0.4 $\pm$ 2.3                |              | <sup>5</sup> ASNER         | 04 CLEO  | $\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$ |
| 13.9 $\pm$ 2.0 $\pm$ 3.0               | 41           | <sup>6</sup> ABDALLAH      | 03J DLPH | $\gamma\gamma \rightarrow \eta_c$                                 |
| 3.8 $\pm$ 1.1 $\pm$ 1.9<br>- 1.0 - 1.0 | 190          | <sup>7</sup> AMBROGIANI    | 03 E835  | $\bar{p} p \rightarrow \eta_c \rightarrow \gamma\gamma$           |
| 7.6 $\pm$ 0.8 $\pm$ 2.3                |              | <sup>5,8</sup> BRANDENB... | 00B CLE2 | $\gamma\gamma \rightarrow \eta_c \rightarrow K^\pm K_S^0 \pi^\mp$ |
| 6.9 $\pm$ 1.7 $\pm$ 2.1                | 76           | <sup>9</sup> ACCIARRI      | 99T L3   | $e^+ e^- \rightarrow e^+ e^- \eta_c$                              |
| 27 $\pm$ 16 $\pm$ 10                   | 5            | <sup>5</sup> SHIRAI        | 98 AMY   | 58 $e^+ e^-$                                                      |

NODE=M026W1  
 NODE=M026W1  
 NEW

|                         |    |      |           |          |                                        |
|-------------------------|----|------|-----------|----------|----------------------------------------|
| 6.7 $\pm$ 2.4 $\pm$ 2.3 |    | 4    | ARMSTRONG | 95F E760 | $\bar{p}p \rightarrow \gamma\gamma$    |
| 11.3 $\pm$ 4.2          |    | 10   | ALBRECHT  | 94H ARG  | $e^+e^- \rightarrow e^+e^-\eta_c$      |
| 8.0 $\pm$ 2.3 $\pm$ 2.4 | 17 | 11   | ADRIANI   | 93N L3   | $e^+e^- \rightarrow e^+e^-\eta_c$      |
| 5.9 $\pm$ 2.1 $\pm$ 1.9 |    | 7    | CHEN      | 90B CLEO | $e^+e^- \rightarrow e^+e^-\eta_c$      |
| 6.4 $\pm$ 5.0 $\pm$ 3.4 |    | 12   | AIHARA    | 88D TPC  | $e^+e^- \rightarrow e^+e^-X$           |
| 4.3 $\pm$ 3.4 $\pm$ 2.4 |    | 4    | BAGLIN    | 87B SPEC | $\bar{p}p \rightarrow \gamma\gamma$    |
| 28 $\pm$ 15             |    | 5,13 | BERGER    | 86 PLUT  | $\gamma\gamma \rightarrow K\bar{K}\pi$ |

<sup>1</sup> Assuming there is no interference with the non-resonant background.  
<sup>2</sup> Calculated by us using  $\Gamma(\eta_c \rightarrow K\bar{K}\pi) \times \Gamma(\eta_c \rightarrow \gamma\gamma) / \Gamma = 0.44 \pm 0.05$  keV from PDG 06 and  $B(\eta_c \rightarrow K\bar{K}\pi) = (8.5 \pm 1.8)\%$  from AUBERT 06E.  
<sup>3</sup> Systematic errors not evaluated.  
<sup>4</sup> Normalized to  $B(\eta_c \rightarrow \rho\bar{\rho}) = (1.3 \pm 0.4) \times 10^{-3}$ .  
<sup>5</sup> Normalized to  $B(\eta_c \rightarrow K^\pm K_S^0 \pi^\mp)$ .  
<sup>6</sup> Average of  $K_S^0 K^\pm \pi^\mp$ ,  $\pi^+ \pi^- K^+ K^-$ , and  $2(K^+ K^-)$  decay modes.  
<sup>7</sup> Normalized to the sum of  $B(\eta_c \rightarrow K^\pm K_S^0 \pi^\mp)$ ,  $B(\eta_c \rightarrow K^+ K^- \pi^+ \pi^-)$ , and  $B(\eta_c \rightarrow 2\pi^+ 2\pi^-)$ .  
<sup>8</sup> Superseded by ASNER 04.  
<sup>9</sup> Normalized to the sum of 9 branching ratios.  
<sup>10</sup> Normalized to the sum of  $B(\eta_c \rightarrow K^\pm K_S^0 \pi^\mp)$ ,  $B(\eta_c \rightarrow \phi\phi)$ ,  $B(\eta_c \rightarrow K^+ K^- \pi^+ \pi^-)$ , and  $B(\eta_c \rightarrow 2\pi^+ 2\pi^-)$ .  
<sup>11</sup> Superseded by ACCIARRI 99T.  
<sup>12</sup> Normalized to the sum of  $B(\eta_c \rightarrow K^\pm K_S^0 \pi^\mp)$ ,  $B(\eta_c \rightarrow 2K^+ 2K^-)$ ,  $B(\eta_c \rightarrow K^+ K^- \pi^+ \pi^-)$ , and  $B(\eta_c \rightarrow 2\pi^+ 2\pi^-)$ .  
<sup>13</sup> Re-evaluated by AIHARA 88D.

NODE=M026W1;LINKAGE=ZH  
 NODE=M026W1;LINKAGE=AU

NODE=M026W1;LINKAGE=NS  
 NODE=M026W1;LINKAGE=N3  
 NODE=M026W1;LINKAGE=N2  
 NODE=M026W;LINKAGE=FF  
 NODE=M026W1;LINKAGE=N6

NODE=M026W1;LINKAGE=NN  
 NODE=M026W1;LINKAGE=N1  
 NODE=M026W1;LINKAGE=N5

NODE=M026W1;LINKAGE=WD  
 NODE=M026W1;LINKAGE=N4

NODE=M026W1;LINKAGE=A

### $\eta_c(1S) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$

NODE=M026220

| $\Gamma(\eta'(958)\pi\pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |      |                    |      |                                                 | $\Gamma_1 \Gamma_{49} / \Gamma$ |
|--------------------------------------------------------------------------------|------|--------------------|------|-------------------------------------------------|---------------------------------|
| VALUE (eV)                                                                     | EVTS | DOCUMENT ID        | TECN | COMMENT                                         |                                 |
| <b>98.1 <math>\pm</math> 3.9 <math>\pm</math> 11.7</b>                         | 2673 | XU                 | 18   | BELL $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |                                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • •  |      |                    |      |                                                 |                                 |
| 75.8 $\pm$ 6.3 $\pm$ 8.4                                                       | 486  | <sup>1</sup> ZHANG | 12A  | BELL $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$ |                                 |

<sup>1</sup> Superseded by XU 18.

NODE=M026G10  
 NODE=M026G10

NODE=M026G10;LINKAGE=A

| $\Gamma(\rho\rho) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$        |     |        |             |      | $\Gamma_2 \Gamma_{49} / \Gamma$               |
|-------------------------------------------------------------------------------|-----|--------|-------------|------|-----------------------------------------------|
| VALUE (eV)                                                                    | CL% | EVTS   | DOCUMENT ID | TECN | COMMENT                                       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |        |             |      |                                               |
| <39                                                                           | 90  | < 1556 | UEHARA      | 08   | BELL $\gamma\gamma \rightarrow 2(\pi^+\pi^-)$ |

NODE=M026G09  
 NODE=M026G09

| $\Gamma(K^*(892)\bar{K}^*(892)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |               |             |      |                                                    | $\Gamma_4 \Gamma_{49} / \Gamma$ |
|--------------------------------------------------------------------------------------|---------------|-------------|------|----------------------------------------------------|---------------------------------|
| VALUE (eV)                                                                           | EVTS          | DOCUMENT ID | TECN | COMMENT                                            |                                 |
| <b>36 <math>\pm</math> 6 OUR FIT</b>                                                 |               |             |      |                                                    |                                 |
| <b>32.4 <math>\pm</math> 4.2 <math>\pm</math> 5.8</b>                                | 882 $\pm$ 115 | UEHARA      | 08   | BELL $\gamma\gamma \rightarrow \pi^+\pi^- K^+ K^-$ |                                 |

NODE=M026G08  
 NODE=M026G08

| $\Gamma(\phi\phi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$        |              |                  |      |                                            | $\Gamma_7 \Gamma_{49} / \Gamma$ |
|-------------------------------------------------------------------------------|--------------|------------------|------|--------------------------------------------|---------------------------------|
| VALUE (eV)                                                                    | EVTS         | DOCUMENT ID      | TECN | COMMENT                                    |                                 |
| <b>9.0 <math>\pm</math> 0.8 OUR FIT</b>                                       |              |                  |      |                                            |                                 |
| <b>7.75 <math>\pm</math> 0.66 <math>\pm</math> 0.62</b>                       | 386 $\pm$ 31 | <sup>1</sup> LIU | 12B  | BELL $\gamma\gamma \rightarrow 2(K^+ K^-)$ |                                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |              |                  |      |                                            |                                 |
| 6.8 $\pm$ 1.2 $\pm$ 1.3                                                       | 132 $\pm$ 23 | UEHARA           | 08   | BELL $\gamma\gamma \rightarrow 2(K^+ K^-)$ |                                 |

<sup>1</sup> Supersedes UEHARA 08. Using  $B(\phi \rightarrow K^+ K^-) = (48.9 \pm 0.5)\%$ .

NODE=M026G07  
 NODE=M026G07

NODE=M026G07;LINKAGE=LI

| $\Gamma(\omega\omega) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |             |                  |      |                                                    | $\Gamma_{13} \Gamma_{49} / \Gamma$ |
|----------------------------------------------------------------------------|-------------|------------------|------|----------------------------------------------------|------------------------------------|
| VALUE (eV)                                                                 | EVTS        | DOCUMENT ID      | TECN | COMMENT                                            |                                    |
| <b>8.67 <math>\pm</math> 2.86 <math>\pm</math> 0.96</b>                    | 85 $\pm$ 29 | <sup>1</sup> LIU | 12B  | BELL $\gamma\gamma \rightarrow 2(\pi^+\pi^-\pi^0)$ |                                    |

<sup>1</sup> Using  $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7)\%$ .

NODE=M026G03  
 NODE=M026G03

NODE=M026G03;LINKAGE=LI



$$\Gamma(\omega\phi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{14}\Gamma_{49}/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                  |     |                                                           |
|-------|----|------------------|-----|-----------------------------------------------------------|
| <0.49 | 90 | <sup>1</sup> LIU | 12B | BELL $\gamma\gamma \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |
|-------|----|------------------|-----|-----------------------------------------------------------|

<sup>1</sup> Using  $B(\phi \rightarrow K^+ K^-) = (48.9 \pm 0.5)\%$  and  $B(\omega \rightarrow \pi^+ \pi^- \pi^0) = (89.2 \pm 0.7)\%$ .

NODE=M026G04  
NODE=M026G04

NODE=M026G04;LINKAGE=LI

$$\Gamma(f_2(1270)f_2(1270)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{15}\Gamma_{49}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**50 ± 13 OUR FIT**

|                     |            |        |    |                                                |
|---------------------|------------|--------|----|------------------------------------------------|
| <b>69 ± 17 ± 12</b> | 3182 ± 766 | UEHARA | 08 | BELL $\gamma\gamma \rightarrow 2(\pi^+ \pi^-)$ |
|---------------------|------------|--------|----|------------------------------------------------|

NODE=M026G19  
NODE=M026G19

$$\Gamma(f_2(1270)f_2'(1525)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{16}\Gamma_{49}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                    |            |        |    |                                                     |
|--------------------|------------|--------|----|-----------------------------------------------------|
| <b>49 ± 9 ± 13</b> | 1128 ± 206 | UEHARA | 08 | BELL $\gamma\gamma \rightarrow \pi^+ \pi^- K^+ K^-$ |
|--------------------|------------|--------|----|-----------------------------------------------------|

NODE=M026G20  
NODE=M026G20

$$\Gamma(K\bar{K}\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{27}\Gamma_{49}/\Gamma$$

| VALUE (keV) | CL% EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|----------|-------------|------|---------|
|-------------|----------|-------------|------|---------|

**0.374 ± 0.021 OUR FIT**

[0.369 ± 0.020 keV OUR 2020 FIT]

**0.407 ± 0.027 OUR AVERAGE** Error includes scale factor of 1.2.

|                       |     |                   |    |                                                             |
|-----------------------|-----|-------------------|----|-------------------------------------------------------------|
| 0.374 ± 0.009 ± 0.031 | 14k | <sup>1</sup> LEES | 10 | BABR $10.6 e^+ e^- \rightarrow e^+ e^- K_S^0 K^\pm \pi^\mp$ |
|-----------------------|-----|-------------------|----|-------------------------------------------------------------|

|                       |  |                      |    |                                                                        |
|-----------------------|--|----------------------|----|------------------------------------------------------------------------|
| 0.407 ± 0.022 ± 0.028 |  | <sup>2,3</sup> ASNER | 04 | CLEO $\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$ |
|-----------------------|--|----------------------|----|------------------------------------------------------------------------|

|                    |    |                         |     |                                                     |
|--------------------|----|-------------------------|-----|-----------------------------------------------------|
| 0.60 ± 0.12 ± 0.09 | 41 | <sup>3,4</sup> ABDALLAH | 03J | DLPH $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$ |
|--------------------|----|-------------------------|-----|-----------------------------------------------------|

|                    |  |                     |    |                                                                       |
|--------------------|--|---------------------|----|-----------------------------------------------------------------------|
| 1.47 ± 0.87 ± 0.27 |  | <sup>3</sup> SHIRAI | 98 | AMY $\gamma\gamma \rightarrow \eta_c \rightarrow K^\pm K_S^0 \pi^\mp$ |
|--------------------|--|---------------------|----|-----------------------------------------------------------------------|

|             |  |                       |     |                                                    |
|-------------|--|-----------------------|-----|----------------------------------------------------|
| 0.84 ± 0.21 |  | <sup>3</sup> ALBRECHT | 94H | ARG $\gamma\gamma \rightarrow K^\pm K_S^0 \pi^\mp$ |
|-------------|--|-----------------------|-----|----------------------------------------------------|

|                                        |  |                   |     |                                                            |
|----------------------------------------|--|-------------------|-----|------------------------------------------------------------|
| 0.60 <sup>+0.23</sup> <sub>-0.20</sub> |  | <sup>3</sup> CHEN | 90B | CLEO $\gamma\gamma \rightarrow \eta_c K^\pm K_S^0 \pi^\mp$ |
|----------------------------------------|--|-------------------|-----|------------------------------------------------------------|

|                    |    |                          |    |                                             |
|--------------------|----|--------------------------|----|---------------------------------------------|
| 1.06 ± 0.41 ± 0.27 | 11 | <sup>3</sup> BRAUNSCH... | 89 | TASS $\gamma\gamma \rightarrow K\bar{K}\pi$ |
|--------------------|----|--------------------------|----|---------------------------------------------|

|                                             |   |                     |    |                                             |
|---------------------------------------------|---|---------------------|----|---------------------------------------------|
| 1.5 <sup>+0.60</sup> <sub>-0.45</sub> ± 0.3 | 7 | <sup>3</sup> BERGER | 86 | PLUT $\gamma\gamma \rightarrow K\bar{K}\pi$ |
|---------------------------------------------|---|---------------------|----|---------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |     |                               |      |                                                |
|-----------------------|-----|-------------------------------|------|------------------------------------------------|
| 0.386 ± 0.008 ± 0.021 | 12k | <sup>5</sup> DEL-AMO-SA...11M | BABR | $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$ |
|-----------------------|-----|-------------------------------|------|------------------------------------------------|

|                       |  |                            |     |                                                                        |
|-----------------------|--|----------------------------|-----|------------------------------------------------------------------------|
| 0.418 ± 0.044 ± 0.022 |  | <sup>3,6</sup> BRANDENB... | 00B | CLE2 $\gamma\gamma \rightarrow \eta_c \rightarrow K^\pm K_S^0 \pi^\mp$ |
|-----------------------|--|----------------------------|-----|------------------------------------------------------------------------|

|       |    |                      |    |                                                     |
|-------|----|----------------------|----|-----------------------------------------------------|
| <0.63 | 95 | <sup>3</sup> BEHREND | 89 | CELL $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$ |
|-------|----|----------------------|----|-----------------------------------------------------|

|      |    |         |     |                                             |
|------|----|---------|-----|---------------------------------------------|
| <4.4 | 95 | ALTHOFF | 85B | TASS $\gamma\gamma \rightarrow K\bar{K}\pi$ |
|------|----|---------|-----|---------------------------------------------|

<sup>1</sup> From the corrected and unfolded mass spectrum.

<sup>2</sup> Calculated by us from the value reported in ASNER 04 that assumes  $B(\eta_c \rightarrow K\bar{K}\pi) = 5.5 \pm 1.7\%$

<sup>3</sup> We have multiplied  $K^\pm K_S^0 \pi^\mp$  measurement by 3 to obtain  $K\bar{K}\pi$ .

<sup>4</sup> Calculated by us from the value reported in ABDALLAH 03J, which uses  $B(\eta_c \rightarrow K_S^0 K^\pm \pi^\mp) = (1.5 \pm 0.4)\%$ .

<sup>5</sup> Not independent from the measurements reported by LEES 10.

<sup>6</sup> Superseded by ASNER 04.

NODE=M026G14;LINKAGE=LE  
NODE=M026G14;LINKAGE=AA

NODE=M026G14;LINKAGE=C  
NODE=M026G;LINKAGE=BB

NODE=M026G14;LINKAGE=DE  
NODE=M026G14;LINKAGE=NN

$$\Gamma(K^+ K^- \pi^+ \pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{31}\Gamma_{49}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**34 ± 5 OUR FIT**

[35 ± 5 eV OUR 2020 FIT]

**27 ± 6 OUR AVERAGE**

|                  |            |        |    |                                                     |
|------------------|------------|--------|----|-----------------------------------------------------|
| 25.7 ± 3.2 ± 4.9 | 2019 ± 248 | UEHARA | 08 | BELL $\gamma\gamma \rightarrow \pi^+ \pi^- K^+ K^-$ |
|------------------|------------|--------|----|-----------------------------------------------------|

|                |    |                       |     |                                                     |
|----------------|----|-----------------------|-----|-----------------------------------------------------|
| 280 ± 100 ± 60 | 42 | <sup>1</sup> ABDALLAH | 03J | DLPH $\gamma\gamma \rightarrow \pi^+ \pi^- K^+ K^-$ |
|----------------|----|-----------------------|-----|-----------------------------------------------------|

|               |            |          |     |                                                    |
|---------------|------------|----------|-----|----------------------------------------------------|
| 170 ± 80 ± 20 | 13.9 ± 6.6 | ALBRECHT | 94H | ARG $\gamma\gamma \rightarrow \pi^+ \pi^- K^+ K^-$ |
|---------------|------------|----------|-----|----------------------------------------------------|

<sup>1</sup> Calculated by us from the value reported in ABDALLAH 03J, which uses  $B(\eta_c \rightarrow \pi^+ \pi^- K^+ K^-) = (2.0 \pm 0.7)\%$ .

NODE=M026G15  
NODE=M026G15  
NEW

NODE=M026G;LINKAGE=CC

$$\Gamma(K^+ K^- \pi^+ \pi^- \pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{32}\Gamma_{49}/\Gamma$$

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |     |                               |      |                                                      |
|-----------------------|-----|-------------------------------|------|------------------------------------------------------|
| 0.190 ± 0.006 ± 0.028 | 11k | <sup>1</sup> DEL-AMO-SA...11M | BABR | $\gamma\gamma \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |
|-----------------------|-----|-------------------------------|------|------------------------------------------------------|

<sup>1</sup> Not independent from other measurements reported in DEL-AMO-SANCHEZ 11M.

NODE=M026G02  
NODE=M026G02

NODE=M026G02;LINKAGE=DE

$\Gamma(2(K^+K^-)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{35}\Gamma_{49}/\Gamma$ 

| VALUE (eV)                   | EVTS      | DOCUMENT ID           | TECN     | COMMENT                              |
|------------------------------|-----------|-----------------------|----------|--------------------------------------|
| <b>7.3 ± 1.5 OUR FIT</b>     |           |                       |          |                                      |
| [7.4 ± 1.5 eV OUR 2020 FIT]  |           |                       |          |                                      |
| <b>5.8 ± 1.9 OUR AVERAGE</b> |           |                       |          |                                      |
| 5.6 ± 1.1 ± 1.6              | 216 ± 42  | UEHARA                | 08 BELL  | $\gamma\gamma \rightarrow 2(K^+K^-)$ |
| 350 ± 90 ± 60                | 46        | <sup>1</sup> ABDALLAH | 03J DLPH | $\gamma\gamma \rightarrow 2(K^+K^-)$ |
| 231 ± 90 ± 23                | 9.1 ± 3.3 | <sup>2</sup> ALBRECHT | 94H ARG  | $\gamma\gamma \rightarrow 2(K^+K^-)$ |

<sup>1</sup> Calculated by us from the value reported in ABDALLAH 03J, which uses  $B(\eta_c \rightarrow 2(K^+K^-)) = (2.1 \pm 1.2)\%$ .

<sup>2</sup> Includes all topological modes except  $\eta_c \rightarrow \phi\phi$ .

NODE=M026G27  
NODE=M026G27  
NEW

NODE=M026G;LINKAGE=DD

NODE=M026G;LINKAGE=EE

 $\Gamma(2(\pi^+\pi^-)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{38}\Gamma_{49}/\Gamma$ 

| VALUE (eV)                | EVTS       | DOCUMENT ID | TECN    | COMMENT                                  |
|---------------------------|------------|-------------|---------|------------------------------------------|
| <b>47 ± 6 OUR FIT</b>     |            |             |         |                                          |
| [49 ± 6 eV OUR 2020 FIT]  |            |             |         |                                          |
| <b>42 ± 6 OUR AVERAGE</b> |            |             |         |                                          |
| 40.7 ± 3.7 ± 5.3          | 5381 ± 492 | UEHARA      | 08 BELL | $\gamma\gamma \rightarrow 2(\pi^+\pi^-)$ |
| 180 ± 70 ± 20             | 21.4 ± 8.6 | ALBRECHT    | 94H ARG | $\gamma\gamma \rightarrow 2(\pi^+\pi^-)$ |

NODE=M026G11  
NODE=M026G11  
NEW

 $\Gamma(p\bar{p}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{41}\Gamma_{49}/\Gamma$ 

| VALUE (eV)                                         | EVTS     | DOCUMENT ID      | TECN    | COMMENT                             |
|----------------------------------------------------|----------|------------------|---------|-------------------------------------|
| <b>7.4 ± 0.7 OUR FIT</b>                           |          |                  |         |                                     |
| <b>7.20 ± 1.53<sup>+0.67</sup><sub>-0.75</sub></b> | 157 ± 33 | <sup>1</sup> KUO | 05 BELL | $\gamma\gamma \rightarrow p\bar{p}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                           |     |                         |          |                                     |
|-------------------------------------------|-----|-------------------------|----------|-------------------------------------|
| 4.6 <sup>+1.3</sup> <sub>-1.1</sub> ± 0.4 | 190 | <sup>1</sup> AMBROGIANI | 03 E835  | $\bar{p}p \rightarrow \gamma\gamma$ |
| 8.1 <sup>+2.9</sup> <sub>-2.0</sub>       |     | <sup>1</sup> ARMSTRONG  | 95F E760 | $\bar{p}p \rightarrow \gamma\gamma$ |

<sup>1</sup> Not independent from the  $\Gamma_{\gamma\gamma}$  reported by the same experiment.

NODE=M026G01  
NODE=M026G01

NODE=M026G01;LINKAGE=GG

 $\Gamma(K_S^0 K_S^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{53}\Gamma_{49}/\Gamma$ 

| VALUE (eV)                                                                    | CL% | DOCUMENT ID         | TECN    | COMMENT                                |
|-------------------------------------------------------------------------------|-----|---------------------|---------|----------------------------------------|
| <b>&lt;1.6</b>                                                                | 90  | <sup>1</sup> UEHARA | 13 BELL | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                     |         |                                        |
| <0.29                                                                         | 90  | <sup>2</sup> UEHARA | 13 BELL | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

<sup>1</sup> Taking into account interference with the non-resonant continuum.

<sup>2</sup> Neglecting interference with the non-resonant continuum.

NODE=M026G05  
NODE=M026G05

OCCUR=2

NODE=M026G05;LINKAGE=U1  
NODE=M026G05;LINKAGE=U2

 $\eta_c(1S)$  BRANCHING RATIOS

NODE=M026225

## HADRONIC DECAYS

NODE=M026305

 $\Gamma(\eta'(958)\pi\pi)/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

| VALUE                | EVTS | DOCUMENT ID                 | TECN | COMMENT                            |
|----------------------|------|-----------------------------|------|------------------------------------|
| <b>0.041 ± 0.017</b> | 14   | <sup>1</sup> BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \eta_c \gamma$ |

<sup>1</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R14  
NODE=M026R14

NODE=M026R14;LINKAGE=E

 $\Gamma(\rho\rho)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| <u>VALUE (units <math>10^{-3}</math>)</u> | <u>CL%</u> | <u>EVTS</u>          | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u>                                      |
|-------------------------------------------|------------|----------------------|--------------------|-------------|-----------------------------------------------------|
| <b>18 ± 5 OUR AVERAGE</b>                 |            |                      |                    |             |                                                     |
| 12.6 ± 3.8 ± 5.1                          | 72         | <sup>1</sup> ABLIKIM | 05L                | BES2        | $J/\psi \rightarrow \pi^+ \pi^- \pi^+ \pi^- \gamma$ |
| 26.0 ± 2.4 ± 8.8                          | 113        | <sup>1</sup> BISELLO | 91                 | DM2         | $J/\psi \rightarrow \gamma \rho^0 \rho^0$           |
| 23.6 ± 10.6 ± 8.2                         | 32         | <sup>1</sup> BISELLO | 91                 | DM2         | $J/\psi \rightarrow \gamma \rho^+ \rho^-$           |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                             |      |                                    |
|-----|----|-----------------------------|------|------------------------------------|
| <14 | 90 | <sup>1</sup> BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \eta_c \gamma$ |
|-----|----|-----------------------------|------|------------------------------------|

<sup>1</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$ . Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

NODE=M026R9  
NODE=M026R9

OCCUR=2

NODE=M026R9;LINKAGE=E

 $\Gamma(K^*(892)^0 K^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE               | EVTS | DOCUMENT ID                   | TECN | COMMENT                            |
|---------------------|------|-------------------------------|------|------------------------------------|
| <b>0.02 ± 0.007</b> | 63   | <sup>1,2</sup> BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \eta_c \gamma$ |

<sup>1</sup> BALTRUSAITIS 86 has an error according to Partridge.

<sup>2</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R16  
NODE=M026R16

NODE=M026R;LINKAGE=03  
NODE=M026R16;LINKAGE=E

$\Gamma(K^*(892)\bar{K}^*(892))/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**69±13 OUR FIT**[(70 ± 13) × 10<sup>-4</sup> OUR 2020 FIT]**91±26 OUR AVERAGE**

|           |    |                             |      |      |                                                  |
|-----------|----|-----------------------------|------|------|--------------------------------------------------|
| 108±25±44 | 60 | <sup>1</sup> ABLIKIM        | 05L  | BES2 | $J/\psi \rightarrow K^+ K^- \pi^+ \pi^- \gamma$  |
| 82±28±27  | 14 | <sup>1</sup> BISELLO        | 91   | DM2  | $e^+ e^- \rightarrow \gamma K^+ K^- \pi^+ \pi^-$ |
| 90±50     | 9  | <sup>1</sup> BALTRUSAIT..86 | MRK3 |      | $J/\psi \rightarrow \eta_c \gamma$               |

<sup>1</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ . Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

NODE=M026R8  
 NODE=M026R8  
 NEW

NODE=M026R8;LINKAGE=E

 $\Gamma(K^*(892)^0 \bar{K}^*(892)^0 \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**113±47±24** 45 <sup>1</sup> ABLIKIM 06A BES2  $J/\psi \rightarrow K^{*0} \bar{K}^{*0} \pi^+ \pi^- \gamma$ 

<sup>1</sup> ABLIKIM 06A reports  $[\Gamma(\eta_c(1S) \rightarrow K^*(892)^0 \bar{K}^*(892)^0 \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (1.91 \pm 0.64 \pm 0.48) \times 10^{-4}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R25  
 NODE=M026R25

NODE=M026R25;LINKAGE=AB

 $\Gamma(\phi K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.9<sup>+0.9</sup><sub>-0.8</sub>±1.1** 14.1<sup>+4.4</sup><sub>-3.7</sub> <sup>1</sup> HUANG 03 BELL  $B^+ \rightarrow (\phi K^+ K^-) K^+$ 

<sup>1</sup> Using  $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$  from FANG 03 and  $B(\eta_c \rightarrow K \bar{K} \pi) = (5.5 \pm 1.7) \times 10^{-2}$ .

NODE=M026R21  
 NODE=M026R21

NODE=M026R;LINKAGE=BB

 $\Gamma(\phi\phi)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**17.4± 1.9 OUR FIT**[(17.7 ± 1.9) × 10<sup>-4</sup> OUR 2020 FIT]**28 ± 4 OUR AVERAGE**

|                                       |      |                      |     |      |                                                 |
|---------------------------------------|------|----------------------|-----|------|-------------------------------------------------|
| 26 <sup>+4</sup> <sub>-8</sub> ± 5    | 1.2k | <sup>1</sup> ABLIKIM | 17P | BES3 | $J/\psi \rightarrow K^+ K^- K^+ K^- \gamma$     |
| 25.3± 5.1± 9.1                        | 72   | <sup>2</sup> ABLIKIM | 05L | BES2 | $J/\psi \rightarrow K^+ K^- K^+ K^- \gamma$     |
| 26 ± 9                                | 357  | <sup>2</sup> BAI     | 04  | BES  | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 31 ± 7 ± 10                           | 19   | <sup>2</sup> BISELLO | 91  | DM2  | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 30 <sup>+18</sup> <sub>-12</sub> ± 10 | 5    | <sup>2</sup> BISELLO | 91  | DM2  | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |
| 74 ± 18 ± 24                          | 80   | <sup>2</sup> BAI     | 90B | MRK3 | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 67 ± 21 ± 24                          |      | <sup>2</sup> BAI     | 90B | MRK3 | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

18 <sup>+8</sup><sub>-6</sub> ± 7 7 <sup>3</sup> HUANG 03 BELL  $B^+ \rightarrow (\phi\phi) K^+$ 

<sup>1</sup> ABLIKIM 17P reports  $[\Gamma(\eta_c(1S) \rightarrow \phi\phi)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (4.3 \pm 0.5^{+0.5}_{-1.2}) \times 10^{-5}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ . Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

<sup>3</sup> Using  $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$  from FANG 03 and  $B(\eta_c \rightarrow K \bar{K} \pi) = (5.5 \pm 1.7) \times 10^{-2}$ .

NODE=M026R7  
 NODE=M026R7

NEW

OCCUR=2

OCCUR=3

NODE=M026R7;LINKAGE=A

NODE=M026R;LINKAGE=E

NODE=M026R7;LINKAGE=BB

 $\Gamma(\phi\phi)/\Gamma(K\bar{K}\pi)$  $\Gamma_7/\Gamma_{27}$ 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.0240±0.0025 OUR FIT**

[0.0243 ± 0.0025 OUR 2020 FIT]

**0.044 <sup>+0.012</sup><sub>-0.010</sub> OUR AVERAGE**

|                                                   |   |                    |     |      |                                    |
|---------------------------------------------------|---|--------------------|-----|------|------------------------------------|
| 0.055 ± 0.014 ± 0.005                             |   | AUBERT,B           | 04B | BABR | $B^\pm \rightarrow K^\pm \eta_c$   |
| 0.032 <sup>+0.014</sup> <sub>-0.010</sub> ± 0.009 | 7 | <sup>1</sup> HUANG | 03  | BELL | $B^\pm \rightarrow K^\pm \phi\phi$ |

<sup>1</sup> Using  $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$  from FANG 03 and  $B(\eta_c \rightarrow K \bar{K} \pi) = (5.5 \pm 1.7) \times 10^{-2}$ .

NODE=M026R39  
 NODE=M026R39  
 NEW

NODE=M026R39;LINKAGE=BB

$\Gamma(\phi\phi)/\Gamma(p\bar{p})$  $\Gamma_7/\Gamma_{41}$ 

| VALUE                 | EVTS | DOCUMENT ID       | TECN      | COMMENT                                           |
|-----------------------|------|-------------------|-----------|---------------------------------------------------|
| <b>1.79±0.14±0.32</b> | 6.4k | <sup>1</sup> AAIJ | 17BB LHCB | $pp \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$ |

<sup>1</sup> Using inputs from AAIJ 15AS and AAIJ 15BI and  $\Gamma(b \rightarrow J/\psi(1S)\text{anything})/\Gamma_{\text{total}} = (1.16 \pm 0.10)\%$  and  $\Gamma(J/\psi(1S) \rightarrow p\bar{p})/\Gamma_{\text{total}} = (2.120 \pm 0.029) \times 10^{-3}$  from PDG 16.

NODE=M026R52  
NODE=M026R52

NODE=M026R52;LINKAGE=A

 $\Gamma(\phi 2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                       |
|--------------------------|-----|----------------------|----------|-----------------------------------------------|
| <b>&lt;40</b>            | 90  | <sup>1</sup> ABLIKIM | 06A BES2 | $J/\psi \rightarrow \phi 2(\pi^+\pi^-)\gamma$ |

<sup>1</sup> ABLIKIM 06A reports  $[\Gamma(\eta_c(1S) \rightarrow \phi 2(\pi^+\pi^-))/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))]$   $< 0.603 \times 10^{-4}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$ .

NODE=M026R26  
NODE=M026R26

NODE=M026R26;LINKAGE=AB

 $\Gamma(a_0(980)\pi)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

| VALUE           | CL% | DOCUMENT ID                   | TECN | COMMENT                           |
|-----------------|-----|-------------------------------|------|-----------------------------------|
| <b>&lt;0.02</b> | 90  | <sup>1,2</sup> BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \eta_c\gamma$ |

<sup>1</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$ .

<sup>2</sup> We are assuming  $B(a_0(980) \rightarrow \eta\pi) > 0.5$ .

NODE=M026R11  
NODE=M026R11

NODE=M026R11;LINKAGE=E

NODE=M026R11;LINKAGE=F

 $\Gamma(a_2(1320)\pi)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE           | CL% | DOCUMENT ID                 | TECN | COMMENT                           |
|-----------------|-----|-----------------------------|------|-----------------------------------|
| <b>&lt;0.02</b> | 90  | <sup>1</sup> BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \eta_c\gamma$ |

<sup>1</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R12  
NODE=M026R12

NODE=M026R12;LINKAGE=E

 $\Gamma(K^*(892)\bar{K} + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE             | CL% | DOCUMENT ID          | TECN   | COMMENT                                         |
|-------------------|-----|----------------------|--------|-------------------------------------------------|
| <b>&lt;0.0128</b> | 90  | BISELLO              | 91 DM2 | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ |
| <0.0132           | 90  | <sup>1</sup> BISELLO | 91 DM2 | $J/\psi \rightarrow \gamma K^+ K^- \pi^0$       |

<sup>1</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R17  
NODE=M026R17

OCCUR=2

NODE=M026R17;LINKAGE=E

 $\Gamma(f_2(1270)\eta)/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE            | CL% | DOCUMENT ID                 | TECN | COMMENT                           |
|------------------|-----|-----------------------------|------|-----------------------------------|
| <b>&lt;0.011</b> | 90  | <sup>1</sup> BALTRUSAIT..86 | MRK3 | $J/\psi \rightarrow \eta_c\gamma$ |

<sup>1</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R13  
NODE=M026R13

NODE=M026R13;LINKAGE=E

 $\Gamma(\omega\omega)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTS | DOCUMENT ID          | TECN      | COMMENT                                 |
|--------------------------|-----|------|----------------------|-----------|-----------------------------------------|
| <b>2.9±0.5±0.6</b>       |     | 1705 | <sup>1</sup> ABLIKIM | 19AV BES3 | $J/\psi \rightarrow \gamma\omega\omega$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                             |          |                                               |
|------|----|-----------------------------|----------|-----------------------------------------------|
| <6.3 | 90 | <sup>2</sup> ABLIKIM        | 05L BES2 | $J/\psi \rightarrow 2(\pi^+\pi^-\pi^0)\gamma$ |
| <6.3 | 90 | <sup>2</sup> BISELLO        | 91 DM2   | $J/\psi \rightarrow \gamma\omega\omega$       |
| <3.1 | 90 | <sup>2</sup> BALTRUSAIT..86 | MRK3     | $J/\psi \rightarrow \eta_c\gamma$             |

<sup>1</sup> ABLIKIM 19AV reports  $[\Gamma(\eta_c(1S) \rightarrow \omega\omega)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] = (4.90 \pm 0.17 \pm 0.77) \times 10^{-5}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.,

<sup>2</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$ . Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

NODE=M026R10  
NODE=M026R10

NODE=M026R10;LINKAGE=C

NODE=M026R10;LINKAGE=E

 $\Gamma(\omega\phi)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE                             | CL% | DOCUMENT ID          | TECN     | COMMENT                                             |
|-----------------------------------|-----|----------------------|----------|-----------------------------------------------------|
| <b>&lt; 2.5 × 10<sup>-4</sup></b> | 90  | <sup>1</sup> ABLIKIM | 17P BES3 | $J/\psi \rightarrow \pi^+\pi^-\pi^0 K^+ K^- \gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                        |    |                      |          |                                                     |
|------------------------|----|----------------------|----------|-----------------------------------------------------|
| <17 × 10 <sup>-4</sup> | 90 | <sup>2</sup> ABLIKIM | 05L BES2 | $J/\psi \rightarrow \pi^+\pi^-\pi^0 K^+ K^- \gamma$ |
|------------------------|----|----------------------|----------|-----------------------------------------------------|

<sup>1</sup> Using  $B(J/\psi \rightarrow \gamma\eta_c) = 0.017 \pm 0.004$ .

<sup>2</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R22  
NODE=M026R22

NODE=M026R22;LINKAGE=A

NODE=M026R22;LINKAGE=E

$\Gamma(f_2(1270)f_2(1270))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.98 ± 0.25 OUR FIT**

|                                               |             |                      |         |                                           |
|-----------------------------------------------|-------------|----------------------|---------|-------------------------------------------|
| 0.77 <sup>+0.25</sup> <sub>-0.30</sub> ± 0.17 | 91.2 ± 19.8 | <sup>1</sup> ABLIKIM | 04M BES | $J/\psi \rightarrow \gamma 2\pi^+ 2\pi^-$ |
|-----------------------------------------------|-------------|----------------------|---------|-------------------------------------------|

<sup>1</sup> ABLIKIM 04M reports  $[\Gamma(\eta_c(1S) \rightarrow f_2(1270)f_2(1270))/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (1.3 \pm 0.3^{+0.3}_{-0.4}) \times 10^{-4}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R19  
NODE=M026R19

NODE=M026R19;LINKAGE=AB

 $\Gamma(f_0(980)\eta)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |      |     |                                                        |
|------|------|-----|--------------------------------------------------------|
| seen | LEES | 14E | BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta$ |
|------|------|-----|--------------------------------------------------------|

NODE=M026R41  
NODE=M026R41

 $\Gamma(f_0(1500)\eta)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |      |     |                                                        |
|------|------|-----|--------------------------------------------------------|
| seen | LEES | 14E | BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta$ |
|------|------|-----|--------------------------------------------------------|

NODE=M026R42  
NODE=M026R42

 $\Gamma(f_0(2200)\eta)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |      |     |                                                        |
|------|------|-----|--------------------------------------------------------|
| seen | LEES | 14E | BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta$ |
|------|------|-----|--------------------------------------------------------|

NODE=M026R43  
NODE=M026R43

 $\Gamma(a_0(980)\pi)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |      |     |                                                         |
|------|------|-----|---------------------------------------------------------|
| seen | LEES | 14E | BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$ |
|------|------|-----|---------------------------------------------------------|

NODE=M026R44  
NODE=M026R44

 $\Gamma(a_0(1320)\pi)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |      |     |                                                         |
|------|------|-----|---------------------------------------------------------|
| seen | LEES | 14E | BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$ |
|------|------|-----|---------------------------------------------------------|

NODE=M026R45  
NODE=M026R45

 $\Gamma(a_0(1450)\pi)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |      |     |                                                         |
|------|------|-----|---------------------------------------------------------|
| seen | LEES | 14E | BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$ |
|------|------|-----|---------------------------------------------------------|

NODE=M026R46  
NODE=M026R46

 $\Gamma(a_0(1950)\pi)/\Gamma_{\text{total}}$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

|      |     |                   |     |                                                                      |
|------|-----|-------------------|-----|----------------------------------------------------------------------|
| seen | 12k | <sup>1</sup> LEES | 16A | BABR $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K \bar{K} \pi$ |
|------|-----|-------------------|-----|----------------------------------------------------------------------|

<sup>1</sup> From a model-independant partial wave analysis.

NODE=M026R00  
NODE=M026R00

NODE=M026R00;LINKAGE=A

 $\Gamma(K_0^*(1430)\bar{K})/\Gamma_{\text{total}}$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

|      |     |                   |     |                                                                      |
|------|-----|-------------------|-----|----------------------------------------------------------------------|
| seen | 12k | <sup>1</sup> LEES | 16A | BABR $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K \bar{K} \pi$ |
|------|-----|-------------------|-----|----------------------------------------------------------------------|

|      |  |      |     |                                                              |
|------|--|------|-----|--------------------------------------------------------------|
| seen |  | LEES | 14E | BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta/\pi^0$ |
|------|--|------|-----|--------------------------------------------------------------|

<sup>1</sup> From a model-independant partial wave analysis.

NODE=M026R47  
NODE=M026R47

NODE=M026R47;LINKAGE=A

 $\Gamma(K_2^*(1430)\bar{K})/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |      |     |                                                         |
|------|------|-----|---------------------------------------------------------|
| seen | LEES | 14E | BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \pi^0$ |
|------|------|-----|---------------------------------------------------------|

NODE=M026R48  
NODE=M026R48

 $\Gamma(K_0^*(1950)\bar{K})/\Gamma_{\text{total}}$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

|      |     |                   |     |                                                                      |
|------|-----|-------------------|-----|----------------------------------------------------------------------|
| seen | 12k | <sup>1</sup> LEES | 16A | BABR $\gamma\gamma \rightarrow \eta_c(1S) \rightarrow K \bar{K} \pi$ |
|------|-----|-------------------|-----|----------------------------------------------------------------------|

|      |  |      |     |                                                              |
|------|--|------|-----|--------------------------------------------------------------|
| seen |  | LEES | 14E | BABR Dalitz anal. of $\eta_c \rightarrow K^+ K^- \eta/\pi^0$ |
|------|--|------|-----|--------------------------------------------------------------|

<sup>1</sup> From a Dalitz plot analysis using an isobar model.

NODE=M026R49  
NODE=M026R49

NODE=M026R49;LINKAGE=A

 $\Gamma(K \bar{K} \pi)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**7.3 ± 0.4 OUR FIT****6.9 ± 0.5 OUR AVERAGE**

$[(6.9 \pm 0.4) \times 10^{-2}]$  OUR 2020 AVERAGE]

|                 |     |                      |           |                                 |
|-----------------|-----|----------------------|-----------|---------------------------------|
| 6.9 ± 0.7 ± 0.6 | 146 | <sup>1</sup> ABLIKIM | 19AP BES3 | $h_c \rightarrow \gamma \eta_c$ |
|-----------------|-----|----------------------|-----------|---------------------------------|

|                 |     |                      |           |                                 |
|-----------------|-----|----------------------|-----------|---------------------------------|
| 7.8 ± 0.6 ± 0.6 | 267 | <sup>2</sup> ABLIKIM | 19AP BES3 | $h_c \rightarrow \gamma \eta_c$ |
|-----------------|-----|----------------------|-----------|---------------------------------|

|                 |    |                        |          |                                                   |
|-----------------|----|------------------------|----------|---------------------------------------------------|
| 6.3 ± 1.3 ± 1.4 | 55 | <sup>3,4</sup> ABLIKIM | 12N BES3 | $\psi(2S) \rightarrow \pi^0 \gamma K^+ K^- \pi^0$ |
|-----------------|----|------------------------|----------|---------------------------------------------------|

NEW

OCCUR=2

|                                      |      |                               |      |      |                                                         |         |
|--------------------------------------|------|-------------------------------|------|------|---------------------------------------------------------|---------|
| 7.9 ±1.4 ±1.8                        | 107  | <sup>5,6</sup> ABLIKIM        | 12N  | BES3 | $\psi(2S) \rightarrow \pi^0 \gamma K_S^0 K^\mp \pi^\pm$ | OCCUR=2 |
| 8.5 ±1.8                             |      | <sup>7</sup> AUBERT           | 06E  | BABR | $B^\pm \rightarrow K^\pm X_{c\bar{c}}^0$                |         |
| 5.1 ±2.1                             | 0.6k | <sup>8</sup> BAI              | 04   | BES  | $J/\psi \rightarrow \gamma K^\pm \pi^\mp K_S^0$         |         |
| 6.90±1.42±1.32                       | 33   | <sup>8</sup> BISELLO          | 91   | DM2  | $J/\psi \rightarrow \gamma K^+ K^- \pi^0$               |         |
| 5.43±0.94±0.94                       | 68   | <sup>8</sup> BISELLO          | 91   | DM2  | $J/\psi \rightarrow \gamma K^\pm \pi^\mp K_S^0$         | OCCUR=2 |
| 4.8 ±1.7                             | 95   | <sup>8,9</sup> BALTRUSAIT..86 | MRK3 |      | $J/\psi \rightarrow \eta_c \gamma$                      |         |
| 16.1 <sup>+9.2</sup> <sub>-7.3</sub> |      | <sup>10,11</sup> HIMEL        | 80B  | MRK2 | $\psi(2S) \rightarrow \eta_c \gamma$                    |         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 10.7 90% CL <sup>8,12</sup> PARTRIDGE 80B CBAL  $J/\psi \rightarrow \eta_c \gamma$

<sup>1</sup> ABLIKIM 19AP quotes  $B(\eta_c \rightarrow K^+ K^- \pi^0) = (1.15 \pm 0.12 \pm 0.10) \times 10^{-2}$  which we multiply by 6 to account for isospin symmetry.

<sup>2</sup> ABLIKIM 19AP quotes  $B(\eta_c \rightarrow K_S^0 K^\pm \pi^\mp) = (2.60 \pm 0.21 \pm 0.20) \times 10^{-2}$  which we multiply by 3 to account for isospin symmetry.

<sup>3</sup> ABLIKIM 12N quotes  $B(\psi(2S) \rightarrow \pi^0 h_c) \cdot B(h_c \rightarrow \gamma \eta_c) \cdot B(\eta_c \rightarrow K^+ K^- \pi^0) = (4.54 \pm 0.76 \pm 0.48) \times 10^{-6}$  which we multiply by 6 to account for isospin symmetry.

<sup>4</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow K \bar{K} \pi) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] \times [B(h_c(1P) \rightarrow \gamma \eta_c(1S))] = (27.24 \pm 4.56 \pm 2.88) \times 10^{-6}$  which we divide by our best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

<sup>5</sup> ABLIKIM 12N quotes  $B(\psi(2S) \rightarrow \pi^0 h_c) \cdot B(h_c \rightarrow \gamma \eta_c) \cdot B(\eta_c \rightarrow K_S^0 K^\pm \pi^\mp) = (11.35 \pm 1.25 \pm 1.50) \times 10^{-6}$  which we multiply by 3 to account for isospin symmetry.

<sup>6</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow K \bar{K} \pi) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] \times [B(h_c(1P) \rightarrow \gamma \eta_c(1S))] = (34.05 \pm 3.75 \pm 4.50) \times 10^{-6}$  which we divide by our best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

<sup>7</sup> Determined from the ratio of  $B(B^\pm \rightarrow K^\pm \eta_c) B(\eta_c \rightarrow K \bar{K} \pi) = (7.4 \pm 0.5 \pm 0.7) \times 10^{-5}$  reported in AUBERT, B 04B and  $B(B^\pm \rightarrow K^\pm \eta_c) = (8.7 \pm 1.5) \times 10^{-3}$  reported in AUBERT 06E.

<sup>8</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ . Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

<sup>9</sup> Average from  $K^+ K^- \pi^0$  and  $K^\pm K_S^0 \pi^\mp$  decay channels.

<sup>10</sup>  $K^\pm K_S^0 \pi^\mp$  corrected to  $K \bar{K} \pi$  by factor 3. KS, MR.

<sup>11</sup> Estimated using  $B(\psi(2S) \rightarrow \gamma \eta_c(1S)) = 0.0028 \pm 0.0006$ .

<sup>12</sup>  $K^+ K^- \pi^0$  corrected to  $K \bar{K} \pi$  by factor 6. KS, MR

NODE=M026R4;LINKAGE=C

NODE=M026R4;LINKAGE=F

NODE=M026R4;LINKAGE=BK

NODE=M026R4;LINKAGE=CK

NODE=M026R4;LINKAGE=BL

NODE=M026R4;LINKAGE=CL

NODE=M026R4;LINKAGE=AB

NODE=M026R4;LINKAGE=E

NODE=M026R4;LINKAGE=D

NODE=M026R4;LINKAGE=01

NODE=M026R4;LINKAGE=A

NODE=M026R4;LINKAGE=02

## $\Gamma(\phi K^+ K^-) / \Gamma(K \bar{K} \pi)$

$\Gamma_6 / \Gamma_{27}$

| VALUE                                                 | EVTS | DOCUMENT ID        | TECN | COMMENT                                  |
|-------------------------------------------------------|------|--------------------|------|------------------------------------------|
| <b>0.052<sup>+0.016</sup><sub>-0.014</sub> ±0.014</b> | 7    | <sup>1</sup> HUANG | 03   | BELL $B^\pm \rightarrow K^\pm \phi \phi$ |

<sup>1</sup> Using  $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12 <sup>+0.10</sup><sub>-0.12</sub>) \times 10^{-3}$  from FANG 03 and  $B(\eta_c \rightarrow K \bar{K} \pi) = (5.5 \pm 1.7) \times 10^{-2}$ .

NODE=M026R02  
NODE=M026R02

NODE=M026R02;LINKAGE=BB

## $\Gamma(K \bar{K} \eta) / \Gamma_{\text{total}}$

$\Gamma_{28} / \Gamma$

| VALUE (units 10 <sup>-2</sup> ) | CL% | EVTS                   | DOCUMENT ID | TECN | COMMENT                                          |
|---------------------------------|-----|------------------------|-------------|------|--------------------------------------------------|
| <b>1.36 ±0.15 OUR FIT</b>       |     |                        |             |      |                                                  |
| <b>1.0 ±0.5 ±0.2</b>            | 7   | <sup>1,2</sup> ABLIKIM | 12N         | BES3 | $\psi(2S) \rightarrow \pi^0 \gamma \eta K^+ K^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<3.1 90 <sup>3</sup> BALTRUSAIT..86 MRK3  $J/\psi \rightarrow \eta_c \gamma$

<sup>1</sup> ABLIKIM 12N quotes  $B(\psi(2S) \rightarrow \pi^0 h_c) \cdot B(h_c \rightarrow \gamma \eta_c) \cdot B(\eta_c \rightarrow K^+ K^- \eta) = (2.11 \pm 1.01 \pm 0.32) \times 10^{-6}$  which we multiply by 2 to account for isospin symmetry.

<sup>2</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow K \bar{K} \eta) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] \times [B(h_c(1P) \rightarrow \gamma \eta_c(1S))] = (4.22 \pm 2.02 \pm 0.64) \times 10^{-6}$  which we divide by our best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

<sup>3</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R15;LINKAGE=AK

NODE=M026R15;LINKAGE=AM

NODE=M026R15;LINKAGE=E

$\Gamma(K\bar{K}\eta)/\Gamma(K\bar{K}\pi)$  $\Gamma_{28}/\Gamma_{27}$ 

| VALUE                                                                                                                                                                                                                                                                                            | EVTS | DOCUMENT ID       | TECN     | COMMENT                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------|----------|-----------------------------------------------|
| <b>0.187±0.018 OUR FIT</b>                                                                                                                                                                                                                                                                       |      |                   |          |                                               |
| [0.186 ± 0.018 OUR 2020 FIT]                                                                                                                                                                                                                                                                     |      |                   |          |                                               |
| <b>0.190±0.008±0.017</b>                                                                                                                                                                                                                                                                         | 5.4k | <sup>1</sup> LEES | 14E BABR | $\gamma\gamma \rightarrow K^+ K^- \eta/\pi^0$ |
| <sup>1</sup> LEES 14E reports $B(\eta_c(1S) \rightarrow K^+ K^- \eta)/B(\eta_c(1S) \rightarrow K^+ K^- \pi^0) = 0.571 \pm 0.025 \pm 0.051$ , which we divide by 3 to account for isospin symmetry. It uses both $\eta \rightarrow \gamma\gamma$ and $\eta \rightarrow \pi^+ \pi^- \pi^0$ decays. |      |                   |          |                                               |

NODE=M026R40  
 NODE=M026R40  
 NEW

NODE=M026R40;LINKAGE=LE

 $\Gamma(\eta\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ 

| VALUE (units 10 <sup>-2</sup> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | EVTS | DOCUMENT ID                 | TECN     | COMMENT                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------|----------|------------------------------------------------------|
| <b>1.7±0.6 OUR AVERAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |                             |          | [(1.7 ± 0.5) × 10 <sup>-2</sup> OUR 2020 AVERAGE]    |
| <b>1.7±0.4±0.4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 33   | <sup>1</sup> ABLIKIM        | 12N BES3 | $\psi(2S) \rightarrow \pi^0 \gamma \eta \pi^+ \pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |      |                             |          |                                                      |
| 5.4±2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 75   | <sup>2</sup> BALTRUSAIT..86 | MRK3     | $J/\psi \rightarrow \eta_c \gamma$                   |
| 3.7±1.3±2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 18   | <sup>2</sup> PARTRIDGE      | 80B CBAL | $J/\psi \rightarrow \eta \pi^+ \pi^- \gamma$         |
| <sup>1</sup> ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$ × $[B(h_c(1P) \rightarrow \gamma \eta_c(1S))]$ = (7.22 ± 1.47 ± 1.11) × 10 <sup>-6</sup> which we divide by our best values $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ , $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values. |      |                             |          |                                                      |
| <sup>2</sup> The quoted branching ratios use $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ . Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.                                                                                                                                                                                                                                                                                                                                  |      |                             |          |                                                      |

NODE=M026R6  
 NODE=M026R6

NEW

NODE=M026R6;LINKAGE=AB

NODE=M026R6;LINKAGE=E

 $\Gamma(\eta 2(\pi^+ \pi^-))/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ 

| VALUE (units 10 <sup>-2</sup> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------------------|
| <b>4.4±1.6 OUR AVERAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                      |          | [(4.4 ± 1.3) × 10 <sup>-2</sup> OUR 2020 AVERAGE]       |
| <b>4.4±1.2±1.0</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 39   | <sup>1</sup> ABLIKIM | 12N BES3 | $\psi(2S) \rightarrow \pi^0 \gamma \eta 2(\pi^+ \pi^-)$ |
| <sup>1</sup> ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow \eta 2(\pi^+ \pi^-))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$ × $[B(h_c(1P) \rightarrow \gamma \eta_c(1S))]$ = (19.17 ± 3.77 ± 3.72) × 10 <sup>-6</sup> which we divide by our best values $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ , $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values. |      |                      |          |                                                         |

NODE=M026R05  
 NODE=M026R05

NEW

NODE=M026R05;LINKAGE=AB

 $\Gamma(K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ 

| VALUE (units 10 <sup>-3</sup> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EVTS | DOCUMENT ID                 | TECN     | COMMENT                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------|----------|---------------------------------------------------------|
| <b>6.6± 1.1 OUR FIT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |                             |          |                                                         |
| [(6.9 ± 1.0) × 10 <sup>-3</sup> OUR 2020 FIT]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |                             |          |                                                         |
| <b>11.8± 2.3 OUR AVERAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |      |                             |          | [(11.2 ± 1.9) × 10 <sup>-3</sup> OUR 2020 AVERAGE]      |
| 9.7 ± 2.2±2.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 38   | <sup>1</sup> ABLIKIM        | 12N BES3 | $\psi(2S) \rightarrow \pi^0 \gamma K^+ K^- \pi^+ \pi^-$ |
| 12 ± 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0.4k | <sup>2</sup> BAI            | 04 BES   | $J/\psi \rightarrow \gamma K^+ K^- \pi^+ \pi^-$         |
| 21 ± 7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 110  | <sup>2</sup> BALTRUSAIT..86 | MRK3     | $J/\psi \rightarrow \eta_c \gamma$                      |
| 14 +22<br>- 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      | <sup>3</sup> HIMEL          | 80B MRK2 | $\psi(2S) \rightarrow \eta_c \gamma$                    |
| <sup>1</sup> ABLIKIM 12N reports $[\Gamma(\eta_c(1S) \rightarrow K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$ × $[B(h_c(1P) \rightarrow \gamma \eta_c(1S))]$ = (4.16 ± 0.76 ± 0.59) × 10 <sup>-6</sup> which we divide by our best values $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ , $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values. |      |                             |          |                                                         |
| <sup>2</sup> The quoted branching ratios use $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ . Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.                                                                                                                                                                                                                                                                                                                                     |      |                             |          |                                                         |
| <sup>3</sup> Estimated using $B(\psi(2S) \rightarrow \gamma \eta_c(1S)) = 0.0028 \pm 0.0006$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |      |                             |          |                                                         |

NODE=M026R5  
 NODE=M026R5

NEW

NEW

NODE=M026R5;LINKAGE=AB

NODE=M026R5;LINKAGE=E

NODE=M026R5;LINKAGE=A

 $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma(K\bar{K}\pi)$  $\Gamma_{32}/\Gamma_{27}$ 

| VALUE                                                                                                                                                                                                                                                                                                     | EVTS | DOCUMENT ID                  | TECN | COMMENT                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------------|------|------------------------------------------------------|
| <b>0.477±0.017±0.070</b>                                                                                                                                                                                                                                                                                  | 11k  | <sup>1</sup> DEL-AMO-SA..11M | BABR | $\gamma\gamma \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |
| <sup>1</sup> We have multiplied the value of $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma(K_S^0 K^\pm \pi^\mp)$ reported in DEL-AMO-SANCHEZ 11M by a factor 1/3 to obtain $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma(K\bar{K}\pi)$ . Not independent from other measurements reported in DEL-AMO-SANCHEZ 11M. |      |                              |      |                                                      |

NODE=M026R01  
 NODE=M026R01

NODE=M026R01;LINKAGE=DE

$\Gamma(K^0 K^- \pi^+ \pi^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ VALUE (units  $10^{-2}$ ) EVTS DOCUMENT ID TECN COMMENT**5.6±1.9 OUR AVERAGE**  $[(5.6 \pm 1.5) \times 10^{-2}]$  OUR 2020 AVERAGE]**5.6±1.4±1.3** 43 <sup>1,2</sup> ABLIKIM 12N BES3  $\psi(2S) \rightarrow \pi^0 \gamma K_S^0 K^\mp \pi^\mp 2\pi^\pm$ <sup>1</sup> ABLIKIM 12N quotes  $B(\psi(2S) \rightarrow \pi^0 h_c) \cdot B(h_c \rightarrow \gamma \eta_c) \cdot B(\eta_c \rightarrow K_S^0 K^- \pi^- 2\pi^+)$  =  $(12.01 \pm 2.22 \pm 2.04) \times 10^{-6}$  which we multiply by 2 to take c.c. into account.<sup>2</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow K^0 K^- \pi^+ \pi^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] \times [B(h_c(1P) \rightarrow \gamma \eta_c(1S))] = (24.02 \pm 4.44 \pm 4.08) \times 10^{-6}$  which we divide by our best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.NODE=M026R06  
NODE=M026R06

NEW

NODE=M026R06;LINKAGE=AA

NODE=M026R06;LINKAGE=AB

 $\Gamma(K^+ K^- 2(\pi^+ \pi^-))/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ VALUE (units  $10^{-3}$ ) EVTS DOCUMENT ID TECN COMMENT**7.5±2.4 OUR AVERAGE**8 ±4 ±2 10 <sup>1</sup> ABLIKIM 12N BES3  $\psi(2S) \rightarrow \pi^0 \gamma K^+ K^- 2(\pi^+ \pi^-)$ 7.2±2.4±1.5 100 <sup>2</sup> ABLIKIM 06A BES2  $J/\psi \rightarrow K^+ K^- 2(\pi^+ \pi^-) \gamma$ <sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow K^+ K^- 2(\pi^+ \pi^-))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] \times [B(h_c(1P) \rightarrow \gamma \eta_c(1S))] = (3.60 \pm 1.71 \pm 0.64) \times 10^{-6}$  which we divide by our best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.<sup>2</sup> ABLIKIM 06A reports  $[\Gamma(\eta_c(1S) \rightarrow K^+ K^- 2(\pi^+ \pi^-))/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (1.21 \pm 0.32 \pm 0.24) \times 10^{-4}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.NODE=M026R23  
NODE=M026R23

NODE=M026R23;LINKAGE=AL

NODE=M026R23;LINKAGE=AB

 $\Gamma(2(K^+ K^-))/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ VALUE (units  $10^{-3}$ ) EVTS DOCUMENT ID TECN COMMENT**1.43±0.30 OUR FIT** $[(1.46 \pm 0.30) \times 10^{-3}]$  OUR 2020 FIT]**2.2 ± 1.0 OUR AVERAGE**  $[(2.2 \pm 0.9) \times 10^{-3}]$  OUR 2020 AVERAGE]**2.2 ± 0.9 ±0.5** 7 <sup>1</sup> ABLIKIM 12N BES3  $\psi(2S) \rightarrow \pi^0 \gamma 2(K^+ K^-)$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.4 <sup>+0.5</sup><sub>-0.4</sub> ±0.6 14.5 <sup>+4.6</sup><sub>-3.0</sub> <sup>2</sup> HUANG 03 BELL  $B^+ \rightarrow 2(K^+ K^-) K^+$ 21 ±10 ±6 <sup>3</sup> ALBRECHT 94H ARG  $\gamma \gamma \rightarrow K^+ K^- K^+ K^-$ <sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow 2(K^+ K^-))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] \times [B(h_c(1P) \rightarrow \gamma \eta_c(1S))] = (0.94 \pm 0.37 \pm 0.14) \times 10^{-6}$  which we divide by our best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.<sup>2</sup> Using  $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$  from FANG 03 and  $B(\eta_c \rightarrow K \bar{K} \pi) = (5.5 \pm 1.7) \times 10^{-2}$ .<sup>3</sup> Normalized to the sum of  $B(\eta_c \rightarrow K^\pm K_S^0 \pi^\mp)$ ,  $B(\eta_c \rightarrow \phi \phi)$ ,  $B(\eta_c \rightarrow K^+ K^- \pi^+ \pi^-)$ , and  $B(\eta_c \rightarrow 2\pi^+ 2\pi^-)$ .NODE=M026R20  
NODE=M026R20

NEW

NEW

NODE=M026R20;LINKAGE=AB

NODE=M026R20;LINKAGE=BB

NODE=M026R20;LINKAGE=AL

 $\Gamma(2(K^+ K^-))/\Gamma(K \bar{K} \pi)$  $\Gamma_{35}/\Gamma_{27}$ 

VALUE EVTS DOCUMENT ID TECN COMMENT

**0.020±0.004 OUR FIT****0.024±0.007 OUR AVERAGE**0.023±0.007±0.006 AUBERT,B 04B BABR  $B^\pm \rightarrow K^\pm \eta_c$ 0.026 <sup>+0.009</sup><sub>-0.007</sub> ±0.007 15 <sup>1</sup> HUANG 03 BELL  $B^\pm \rightarrow K^\pm (2K^+ 2K^-)$ <sup>1</sup> Using  $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$  from FANG 03 and  $B(\eta_c \rightarrow K \bar{K} \pi) = (5.5 \pm 1.7) \times 10^{-2}$ .NODE=M026R38  
NODE=M026R38

NODE=M026R38;LINKAGE=BB

 $\Gamma(\pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ 

VALUE CL% DOCUMENT ID TECN COMMENT

**<5 × 10<sup>-4</sup>** 90 <sup>1</sup> ABLIKIM 17AJ BES3  $\psi(2S) \rightarrow \gamma \pi^+ \pi^- \pi^0$ <sup>1</sup> ABLIKIM 17AJ reports  $[\Gamma(\eta_c(1S) \rightarrow \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \eta_c(1S))] < 1.6 \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \eta_c(1S)) = 3.4 \times 10^{-3}$ .NODE=M026R51  
NODE=M026R51

NODE=M026R51;LINKAGE=AA



$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**4.7±1.4 OUR AVERAGE**  $[(4.7 \pm 1.0) \times 10^{-2}]$  OUR 2020 AVERAGE]**4.7±0.9±1.1** 118 <sup>1</sup> ABLIKIM 12N BES3  $\psi(2S) \rightarrow \pi^0\gamma\pi^+\pi^-2\pi^0$ 

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow \pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $\times [B(h_c(1P) \rightarrow \gamma\eta_c(1S))] = (20.31 \pm 2.20 \pm 3.33) \times 10^{-6}$  which we divide by our  
 best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma\eta_c(1S)) =$   
 $(50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the  
 systematic error from using our best values.

 NODE=M026R07  
 NODE=M026R07

NEW

NODE=M026R07;LINKAGE=AB

 $\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{38}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.91±0.12 OUR FIT** $[(0.97 \pm 0.12) \times 10^{-2}]$  OUR 2020 FIT]**1.27±0.23 OUR AVERAGE** $[(1.35 \pm 0.21) \times 10^{-2}]$  OUR 2020 AVERAGE]1.7 ±0.3 ±0.4 100 <sup>1</sup> ABLIKIM 12N BES3  $\psi(2S) \rightarrow \pi^0\gamma 2(\pi^+\pi^-)$ 1.0 ±0.5 542 ± 75 <sup>2</sup> BAI 04 BES  $J/\psi \rightarrow \gamma 2(\pi^+\pi^-)$ 1.05±0.17±0.34 137 <sup>2</sup> BISELLO 91 DM2  $J/\psi \rightarrow \gamma 2\pi^+ 2\pi^-$ 1.3 ±0.6 25 <sup>2</sup> BALTRUSAIT..86 MRK3  $J/\psi \rightarrow \eta_c\gamma$ 2.0 <sup>+1.5</sup><sub>-1.0</sub> <sup>3</sup> HIMEL 80B MRK2  $\psi(2S) \rightarrow \eta_c\gamma$ 

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow 2(\pi^+\pi^-))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $\times [B(h_c(1P) \rightarrow \gamma\eta_c(1S))] = (7.51 \pm 0.85 \pm 1.11) \times 10^{-6}$  which we divide by our  
 best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma\eta_c(1S)) =$   
 $(50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the  
 systematic error from using our best values.

<sup>2</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 0.0127 \pm 0.0036$ . Where  
 relevant, the error in this branching ratio is treated as a common systematic in computing  
 averages.

<sup>3</sup> Estimated using  $B(\psi(2S) \rightarrow \gamma\eta_c(1S)) = 0.0028 \pm 0.0006$ .

 NODE=M026R1  
 NODE=M026R1

NEW

NEW

NODE=M026R1;LINKAGE=AB

NODE=M026R1;LINKAGE=E

NODE=M026R1;LINKAGE=A

 $\Gamma(2(\pi^+\pi^-\pi^0))/\Gamma_{\text{total}}$  $\Gamma_{39}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**15.8±2.3 OUR AVERAGE** $[(16.1 \pm 2.0) \times 10^{-2}]$  OUR 2020 AVERAGE]15.3±1.8±1.8 333 ABLIKIM 19AP BES3  $h_c \rightarrow \gamma\eta_c$ 17 ±3 ±4 175 <sup>1</sup> ABLIKIM 12N BES3  $\psi(2S) \rightarrow \pi^0\gamma 2(\pi^+\pi^-\pi^0)$ 

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow 2(\pi^+\pi^-\pi^0))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $\times [B(h_c(1P) \rightarrow \gamma\eta_c(1S))] = (75.13 \pm 7.42 \pm 9.99) \times 10^{-6}$  which we divide by our  
 best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma\eta_c(1S)) =$   
 $(50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the  
 systematic error from using our best values.

 NODE=M026R08  
 NODE=M026R08

NEW

NODE=M026R08;LINKAGE=AB

 $\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{40}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**17 ±4 OUR AVERAGE** $[(18 \pm 4) \times 10^{-3}]$  OUR 2020 AVERAGE]20 ±5 ±5 51 <sup>1</sup> ABLIKIM 12N BES3  $\psi(2S) \rightarrow \pi^0\gamma 3(\pi^+\pi^-)$ 15.4±3.4±3.3 479 <sup>2</sup> ABLIKIM 06A BES2  $J/\psi \rightarrow 3(\pi^+\pi^-)\gamma$ 

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow 3(\pi^+\pi^-))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $\times [B(h_c(1P) \rightarrow \gamma\eta_c(1S))] = (8.82 \pm 1.57 \pm 1.59) \times 10^{-6}$  which we divide by our  
 best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma\eta_c(1S)) =$   
 $(50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the  
 systematic error from using our best values.

<sup>2</sup> ABLIKIM 06A reports  $[\Gamma(\eta_c(1S) \rightarrow 3(\pi^+\pi^-))/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] =$   
 $(2.59 \pm 0.32 \pm 0.47) \times 10^{-4}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) =$   
 $(1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is  
 the systematic error from using our best value.

 NODE=M026R24  
 NODE=M026R24

NEW

NODE=M026R24;LINKAGE=AL

NODE=M026R24;LINKAGE=AB

$\Gamma(p\bar{p})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**14.4 ± 1.4 OUR FIT**[(14.5 ± 1.4) × 10<sup>-4</sup> OUR 2020 FIT]**12.6 ± 2.1 OUR AVERAGE**[(12.7 ± 2.0) × 10<sup>-4</sup> OUR 2020 AVERAGE]

|                  |          |                  |          |                                               |
|------------------|----------|------------------|----------|-----------------------------------------------|
| 12.0 ± 2.6 ± 1.5 | 34       | ABLIKIM          | 19APBES3 | $h_c \rightarrow \gamma \eta_c$               |
| 15 ± 5 ± 3       | 15       | 1 ABLIKIM        | 12N BES3 | $\psi(2S) \rightarrow \pi^0 \gamma p \bar{p}$ |
| 15 ± 6           | 213 ± 33 | 2 BAI            | 04 BES   | $J/\psi \rightarrow \gamma p \bar{p}$         |
| 10 ± 3 ± 4       | 18       | 2 BISELLO        | 91 DM2   | $J/\psi \rightarrow \gamma p \bar{p}$         |
| 11 ± 6           | 23       | 2 BALTRUSAIT..86 | MRK3     | $J/\psi \rightarrow \eta_c \gamma$            |
| 29 +29<br>-15    | 3        | HIMEL            | 80B MRK2 | $\psi(2S) \rightarrow \eta_c \gamma$          |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                         |     |      |         |                                 |
|-------------------------|-----|------|---------|---------------------------------|
| 13.1 +1.8<br>-2.1 ± 0.9 | 195 | 4 WU | 06 BELL | $B^+ \rightarrow p \bar{p} K^+$ |
|-------------------------|-----|------|---------|---------------------------------|

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow p \bar{p})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] \times [B(h_c(1P) \rightarrow \gamma \eta_c(1S))] = (0.65 \pm 0.19 \pm 0.10) \times 10^{-6}$  which we divide by our best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

<sup>2</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ . Where relevant, the error in this branching ratio is treated as a common systematic in computing averages.

<sup>3</sup> Estimated using  $B(\psi(2S) \rightarrow \gamma \eta_c(1S)) = 0.0028 \pm 0.0006$ .

<sup>4</sup> WU 06 reports  $[\Gamma(\eta_c(1S) \rightarrow p \bar{p})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)] = (1.42 \pm 0.11^{+0.16}_{-0.20}) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.08) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R2

NODE=M026R2

NEW

NEW

NODE=M026R2;LINKAGE=AB

NODE=M026R2;LINKAGE=E

NODE=M026R2;LINKAGE=A

NODE=M026R2;LINKAGE=WU

 $\Gamma(p\bar{p})/\Gamma(K\bar{K}\pi)$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.0198 ± 0.0019 OUR FIT**

[0.0199 ± 0.0019 OUR 2020 FIT]

|                                       |     |      |         |                                     |
|---------------------------------------|-----|------|---------|-------------------------------------|
| <b>0.021 ± 0.002</b> +0.004<br>-0.006 | 195 | 1 WU | 06 BELL | $B^\pm \rightarrow K^\pm p \bar{p}$ |
|---------------------------------------|-----|------|---------|-------------------------------------|

<sup>1</sup> Using  $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12^{+0.10}_{-0.12}) \times 10^{-3}$  from FANG 03 and  $B(\eta_c \rightarrow K \bar{K} \pi) = (5.5 \pm 1.7) \times 10^{-2}$ .

NODE=M026R03

NODE=M026R03

NEW

NODE=M026R03;LINKAGE=BB

 $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\phi\phi)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**0.25 ± 0.04 OUR FIT**[(0.26 ± 0.04) × 10<sup>-5</sup> OUR 2020 FIT]

|                         |        |         |                                         |
|-------------------------|--------|---------|-----------------------------------------|
| <b>4.0</b> +3.5<br>-3.2 | BAGLIN | 89 SPEC | $\bar{p} p \rightarrow K^+ K^- K^+ K^-$ |
|-------------------------|--------|---------|-----------------------------------------|

 $\Gamma_{41}/\Gamma \times \Gamma_7/\Gamma$ 

NODE=M026R33

NODE=M026R33

NEW

 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.36 ± 0.15 OUR AVERAGE** [(0.36 ± 0.13) × 10<sup>-2</sup> OUR 2020 AVERAGE]

|                           |    |           |          |                                                     |
|---------------------------|----|-----------|----------|-----------------------------------------------------|
| <b>0.36 ± 0.13 ± 0.08</b> | 14 | 1 ABLIKIM | 12N BES3 | $\psi(2S) \rightarrow \pi^0 \gamma p \bar{p} \pi^0$ |
|---------------------------|----|-----------|----------|-----------------------------------------------------|

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow p \bar{p} \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] \times [B(h_c(1P) \rightarrow \gamma \eta_c(1S))] = (1.53 \pm 0.49 \pm 0.23) \times 10^{-6}$  which we divide by our best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) = (50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

NODE=M026R09

NODE=M026R09

NEW

NODE=M026R09;LINKAGE=AB

 $\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**10.6 ± 2.3 OUR FIT**[(10.7 ± 2.4) × 10<sup>-4</sup> OUR 2020 FIT]

|                         |   |         |          |  |
|-------------------------|---|---------|----------|--|
| <b>11.8 ± 2.3 ± 2.5</b> | 1 | ABLIKIM | 12B BES3 |  |
|-------------------------|---|---------|----------|--|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                        |    |           |         |                                                    |
|------------------------|----|-----------|---------|----------------------------------------------------|
| 8.7 +2.4<br>-2.3 ± 0.6 | 20 | 2 WU      | 06 BELL | $B^+ \rightarrow \Lambda \bar{\Lambda} K^+$        |
| <20                    | 90 | 3 BISELLO | 91 DM2  | $e^+ e^- \rightarrow \gamma \Lambda \bar{\Lambda}$ |

 $\Gamma_{43}/\Gamma$ 

NODE=M026R18

NODE=M026R18

NEW

<sup>1</sup> ABLIKIM 12B reports  $[\Gamma(\eta_c(1S) \rightarrow \Lambda \bar{\Lambda})/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (0.198 \pm 0.021 \pm 0.032) \times 10^{-4}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R18;LINKAGE=AB

<sup>2</sup> WU 06 reports  $[\Gamma(\eta_c(1S) \rightarrow \Lambda \bar{\Lambda})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)] = (0.95^{+0.25+0.08}_{-0.22-0.11}) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.08) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R18;LINKAGE=WU

<sup>3</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R18;LINKAGE=E

### $\Gamma(\Lambda \bar{\Lambda})/\Gamma(p \bar{p})$

 $\Gamma_{43}/\Gamma_{41}$ 

| VALUE                                                  | DOCUMENT ID | TECN | COMMENT |
|--------------------------------------------------------|-------------|------|---------|
| <b>0.74±0.16 OUR FIT</b><br>[0.73 ± 0.16 OUR 2020 FIT] |             |      |         |

NODE=M026R27  
NODE=M026R27  
NEW

**0.67<sup>+0.19</sup><sub>-0.16</sub>±0.12**

<sup>1</sup> WU 06 BELL  $B^+ \rightarrow p \bar{p} K^+, \Lambda \bar{\Lambda} K^+$

<sup>1</sup> Not independent from other  $\eta_c \rightarrow \Lambda \bar{\Lambda}, p \bar{p}$  branching ratios reported by WU 06.

NODE=M026R27;LINKAGE=WU

### $\Gamma(K^+ \bar{p} \Lambda + \text{c.c.})/\Gamma_{\text{total}}$

 $\Gamma_{44}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                       | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------------------------------------------------------------|------|-------------|------|---------|
| <b>2.5 ± 0.4 OUR AVERAGE</b> [(2.6 ± 0.4) × 10 <sup>-3</sup> OUR 2020 AVERAGE] |      |             |      |         |

NODE=M026R53  
NODE=M026R53  
NEW

**2.50<sup>+0.34+0.17</sup><sub>-0.32-0.18</sub>**

157 <sup>1</sup> LU 19 BELL  $B^+ \rightarrow \bar{p} \Lambda K^+ K^+$

<sup>1</sup> LU 19 reports  $(2.83^{+0.36}_{-0.34} \pm 0.35) \times 10^{-3}$  from a measurement of  $[\Gamma(\eta_c(1S) \rightarrow K^+ \bar{p} \Lambda + \text{c.c.})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)]$  assuming  $B(B^+ \rightarrow \eta_c K^+) = (9.6 \pm 1.1) \times 10^{-4}$ , which we rescale to our best value  $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.08) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R53;LINKAGE=A

### $\Gamma(\bar{\Lambda}(1520) \Lambda + \text{c.c.})/\Gamma_{\text{total}}$

 $\Gamma_{45}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                     | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------------------------------------------------------------------------|------|-------------|------|---------|
| <b>3.1±1.3 OUR AVERAGE</b> [(3.1 ± 1.4) × 10 <sup>-3</sup> OUR 2020 AVERAGE] |      |             |      |         |

NODE=M026R54  
NODE=M026R54  
NEW

**3.1±1.3±0.2**

43 <sup>1</sup> LU 19 BELL  $B^+ \rightarrow \bar{p} \Lambda K^+ K^+$

<sup>1</sup> LU 19 reports  $(3.48 \pm 1.48 \pm 0.46) \times 10^{-3}$  from a measurement of  $[\Gamma(\eta_c(1S) \rightarrow \bar{\Lambda}(1520) \Lambda + \text{c.c.})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)]$  assuming  $B(B^+ \rightarrow \eta_c K^+) = (9.6 \pm 1.1) \times 10^{-4}$ , which we rescale to our best value  $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.08) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R54;LINKAGE=A

### $\Gamma(\Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}$

 $\Gamma_{46}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID              | TECN | COMMENT                                           |
|--------------------------|------|--------------------------|------|---------------------------------------------------|
| <b>2.1±0.3±0.5</b>       | 112  | <sup>1</sup> ABLIKIM 13C | BES3 | $J/\psi \rightarrow \gamma p \bar{p} \pi^0 \pi^0$ |

NODE=M026R28  
NODE=M026R28

<sup>1</sup> ABLIKIM 13C reports  $[\Gamma(\eta_c(1S) \rightarrow \Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (3.60 \pm 0.48 \pm 0.31) \times 10^{-5}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R28;LINKAGE=AB

### $\Gamma(\Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}}$

 $\Gamma_{47}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID              | TECN | COMMENT                                                       |
|--------------------------|------|--------------------------|------|---------------------------------------------------------------|
| <b>0.90±0.18±0.19</b>    | 78   | <sup>1</sup> ABLIKIM 13C | BES3 | $J/\psi \rightarrow \gamma \Lambda \bar{\Lambda} \pi^+ \pi^-$ |

NODE=M026R29  
NODE=M026R29

<sup>1</sup> ABLIKIM 13C reports  $[\Gamma(\eta_c(1S) \rightarrow \Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (1.51 \pm 0.27 \pm 0.14) \times 10^{-5}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R29;LINKAGE=AB

### $\Gamma(\pi^+ \pi^- p \bar{p})/\Gamma_{\text{total}}$

 $\Gamma_{48}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                     | CL% EVTS | DOCUMENT ID | TECN | COMMENT |
|------------------------------------------------------------------------------|----------|-------------|------|---------|
| <b>5.3±2.1 OUR AVERAGE</b> [(5.3 ± 1.8) × 10 <sup>-3</sup> OUR 2020 AVERAGE] |          |             |      |         |

NODE=M026R3  
NODE=M026R3

**5.3±1.7±1.2**

19 <sup>1</sup> ABLIKIM 12N BES3  $\psi(2S) \rightarrow \pi^0 \gamma p \bar{p} \pi^+ \pi^-$

NEW

• • • We do not use the following data for averages, fits, limits, etc. • • •

<12 90 HIMEL 80B MRK2  $\psi(2S) \rightarrow \eta_c \gamma$

<sup>1</sup> ABLIKIM 12N reports  $[\Gamma(\eta_c(1S) \rightarrow \pi^+ \pi^- \rho \bar{\rho})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $\times [B(h_c(1P) \rightarrow \gamma \eta_c(1S))] = (2.30 \pm 0.65 \pm 0.36) \times 10^{-6}$  which we divide by our  
best values  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ ,  $B(h_c(1P) \rightarrow \gamma \eta_c(1S)) =$   
 $(50 \pm 9) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the  
systematic error from using our best values.

NODE=M026R3;LINKAGE=AB

## RADIATIVE DECAYS

NODE=M026310

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{49}/\Gamma$

| VALUE (units $10^{-4}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**1.61±0.12 OUR FIT**[(1.58 ± 0.11) × 10<sup>-4</sup> OUR 2020 FIT]**1.9 <sup>+0.7</sup><sub>-0.6</sub> OUR AVERAGE**

|                                           |                                     |  |                      |     |                                                |
|-------------------------------------------|-------------------------------------|--|----------------------|-----|------------------------------------------------|
| 2.7 ± 0.8 ± 0.6                           |                                     |  | <sup>1</sup> ABLIKIM | 13i | BES3                                           |
| 1.4 <sup>+0.7</sup> <sub>-0.5</sub> ± 0.3 | 1.2 <sup>+2.8</sup> <sub>-1.1</sub> |  | <sup>2</sup> ADAMS   | 08  | CLEO $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                              |    |                        |     |      |                                         |
|----------------------------------------------|----|------------------------|-----|------|-----------------------------------------|
| 2.0 <sup>+0.9</sup> <sub>-0.7</sub> ± 0.1    | 13 | <sup>3</sup> WICHT     | 08  | BELL | $B^\pm \rightarrow K^\pm \gamma\gamma$  |
| 2.80 <sup>+0.67</sup> <sub>-0.58</sub> ± 1.0 |    | <sup>4</sup> ARMSTRONG | 95F | E760 | $\bar{p}p \rightarrow \gamma\gamma$     |
| < 9                                          | 90 | <sup>5</sup> BISELLO   | 91  | DM2  | $J/\psi \rightarrow \gamma\gamma\gamma$ |
| 6 <sup>+4</sup> <sub>-3</sub> ± 4            |    | <sup>4</sup> BAGLIN    | 87B | SPEC | $\bar{p}p \rightarrow \gamma\gamma$     |
| < 18                                         | 90 | <sup>6</sup> BLOOM     | 83  | CBAL | $J/\psi \rightarrow \eta_c \gamma$      |

<sup>1</sup> ABLIKIM 13i reports  $[\Gamma(\eta_c(1S) \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (4.5 \pm 1.2 \pm 0.6) \times 10^{-6}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R31;LINKAGE=AL

<sup>2</sup> ADAMS 08 reports  $[\Gamma(\eta_c(1S) \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma \eta_c(1S))] = (2.4 <sup>+1.1</sup><sub>-0.8</sub> ± 0.3) \times 10^{-6}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = (1.7 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R31;LINKAGE=AD

<sup>3</sup> WICHT 08 reports  $[\Gamma(\eta_c(1S) \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c K^+)] = (2.2 <sup>+0.9</sup><sub>-0.7</sub> <sup>+0.4</sup><sub>-0.2</sub>) \times 10^{-7}$  which we divide by our best value  $B(B^+ \rightarrow \eta_c K^+) = (1.09 \pm 0.08) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M026R31;LINKAGE=WI

<sup>4</sup> Not independent from the values of the total and two-photon width quoted by the same experiment.

NODE=M026R31;LINKAGE=AB

<sup>5</sup> The quoted branching ratios use  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R31;LINKAGE=E

<sup>6</sup> Using  $B(J/\psi(1S) \rightarrow \gamma \eta_c(1S)) = 0.0127 \pm 0.0036$ .

NODE=M026R31;LINKAGE=C

$\Gamma(\gamma\gamma)/\Gamma(K\bar{K}\pi)$   $\Gamma_{49}/\Gamma_{27}$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.22±0.25 OUR FIT**[(2.17 ± 0.23) × 10<sup>-3</sup> OUR 2020 FIT]

|                                                                     |    |                    |    |      |                                        |
|---------------------------------------------------------------------|----|--------------------|----|------|----------------------------------------|
| 3.2 <sup>+1.3</sup> <sub>-1.0</sub> <sup>+0.8</sup> <sub>-0.6</sub> | 13 | <sup>1</sup> WICHT | 08 | BELL | $B^\pm \rightarrow K^\pm \gamma\gamma$ |
|---------------------------------------------------------------------|----|--------------------|----|------|----------------------------------------|

<sup>1</sup> Using  $B(B^+ \rightarrow \eta_c K^+) = (1.25 \pm 0.12 <sup>+0.10</sup><sub>-0.12</sub>) \times 10^{-3}$  from FANG 03 and  $B(\eta_c \rightarrow K\bar{K}\pi) = (5.5 \pm 1.7) \times 10^{-2}$ .

NODE=M026R04;LINKAGE=BB

$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{41}/\Gamma \times \Gamma_{49}/\Gamma$

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.232±0.022 OUR FIT**[(0.230 ± 0.022) × 10<sup>-6</sup> OUR 2020 FIT]**0.26 ± 0.05 OUR AVERAGE** Error includes scale factor of 1.4.

|                                                   |     |            |     |      |                                                        |
|---------------------------------------------------|-----|------------|-----|------|--------------------------------------------------------|
| 0.224 <sup>+0.038</sup> <sub>-0.037</sub> ± 0.020 | 190 | AMBROGIANI | 03  | E835 | $\bar{p}p \rightarrow \eta_c \rightarrow \gamma\gamma$ |
| 0.336 <sup>+0.080</sup> <sub>-0.070</sub>         |     | ARMSTRONG  | 95F | E760 | $\bar{p}p \rightarrow \gamma\gamma$                    |
| 0.68 <sup>+0.42</sup> <sub>-0.31</sub>            | 12  | BAGLIN     | 87B | SPEC | $\bar{p}p \rightarrow \gamma\gamma$                    |

NODE=M026R32

NODE=M026R32

NEW

———— Charge conjugation (C), Parity (P), ————  
 ———— Lepton family number (LF) violating modes ————

$\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{50}/\Gamma$

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                             | CL% | DOCUMENT ID          | TECN     | COMMENT                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|----------|---------------------------------------|
| <b>&lt;11</b>                                                                                                                                                                                                                                                                        | 90  | <sup>1</sup> ABLIKIM | 11G BES3 | $J/\psi \rightarrow \gamma\pi^+\pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                        |     |                      |          |                                       |
| <70                                                                                                                                                                                                                                                                                  | 90  | <sup>2</sup> ABLIKIM | 06B BES2 | $J/\psi \rightarrow \pi^+\pi^-\gamma$ |
| <sup>1</sup> ABLIKIM 11G reports $[\Gamma(\eta_c(1S) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 1.82 \times 10^{-6}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$ . |     |                      |          |                                       |
| <sup>2</sup> ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 1.1 \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$ .  |     |                      |          |                                       |

NODE=M026320

NODE=M026R34  
NODE=M026R34

NODE=M026R34;LINKAGE=AL

NODE=M026R34;LINKAGE=AB

$\Gamma(\pi^0\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{51}/\Gamma$

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                             | CL% | DOCUMENT ID          | TECN     | COMMENT                               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|----------|---------------------------------------|
| <b>&lt; 4</b>                                                                                                                                                                                                                                                                        | 90  | <sup>1</sup> ABLIKIM | 11G BES3 | $J/\psi \rightarrow \gamma\pi^0\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                        |     |                      |          |                                       |
| <40                                                                                                                                                                                                                                                                                  | 90  | <sup>2</sup> ABLIKIM | 06B BES2 | $J/\psi \rightarrow \pi^0\pi^0\gamma$ |
| <sup>1</sup> ABLIKIM 11G reports $[\Gamma(\eta_c(1S) \rightarrow \pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 6.0 \times 10^{-7}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$ .  |     |                      |          |                                       |
| <sup>2</sup> ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \rightarrow \pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 0.71 \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$ . |     |                      |          |                                       |

NODE=M026R35  
NODE=M026R35

NODE=M026R35;LINKAGE=AL

NODE=M026R35;LINKAGE=AB

$\Gamma(K^+K^-)/\Gamma_{\text{total}}$   $\Gamma_{52}/\Gamma$

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                         | CL% | DOCUMENT ID          | TECN     | COMMENT                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|----------|-----------------------------------|
| <b>&lt;60</b>                                                                                                                                                                                                                                                                    | 90  | <sup>1</sup> ABLIKIM | 06B BES2 | $J/\psi \rightarrow K^+K^-\gamma$ |
| <sup>1</sup> ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \rightarrow K^+K^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 0.96 \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$ . |     |                      |          |                                   |

NODE=M026R36  
NODE=M026R36

NODE=M026R36;LINKAGE=AB

$\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{53}/\Gamma$

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                              | CL% | DOCUMENT ID          | TECN     | COMMENT                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|----------|-----------------------------------------|
| <b>&lt;31</b>                                                                                                                                                                                                                                                                         | 90  | <sup>1</sup> ABLIKIM | 06B BES2 | $J/\psi \rightarrow K_S^0 K_S^0 \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                         |     |                      |          |                                         |
| <32                                                                                                                                                                                                                                                                                   | 90  | <sup>2</sup> UEHARA  | 13 BELL  | $\gamma\gamma \rightarrow K_S^0 K_S^0$  |
| < 5.6                                                                                                                                                                                                                                                                                 | 90  | <sup>3</sup> UEHARA  | 13 BELL  | $\gamma\gamma \rightarrow K_S^0 K_S^0$  |
| <sup>1</sup> ABLIKIM 06B reports $[\Gamma(\eta_c(1S) \rightarrow K_S^0 K_S^0)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \gamma\eta_c(1S))] < 0.53 \times 10^{-5}$ which we divide by our best value $B(J/\psi(1S) \rightarrow \gamma\eta_c(1S)) = 1.7 \times 10^{-2}$ . |     |                      |          |                                         |
| <sup>2</sup> Taking into account interference with the non-resonant continuum.                                                                                                                                                                                                        |     |                      |          |                                         |
| <sup>3</sup> Neglecting interference with the non-resonant continuum.                                                                                                                                                                                                                 |     |                      |          |                                         |

NODE=M026R37  
NODE=M026R37

OCCUR=2

NODE=M026R37;LINKAGE=AB

NODE=M026R37;LINKAGE=U1  
NODE=M026R37;LINKAGE=U2

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$J/\psi(1S)$

$$I^G(J^{PC}) = 0^-(1^{--})$$

### $J/\psi(1S)$ MASS

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                | TECN | COMMENT                                                |
|-------------------------------------------------------------------------------|------|----------------------------|------|--------------------------------------------------------|
| <b>3096.900±0.006 OUR AVERAGE</b>                                             |      |                            |      |                                                        |
| 3096.900±0.002±0.006                                                          |      | <sup>1</sup> ANASHIN 15    | KEDR | $e^+e^- \rightarrow \text{hadrons}$                    |
| 3096.89 ±0.09                                                                 | 502  | <sup>2</sup> ARTAMONOV 00  | OLYA | $e^+e^- \rightarrow \text{hadrons}$                    |
| 3096.91 ±0.03 ±0.01                                                           |      | <sup>3</sup> ARMSTRONG 93B | E760 | $\bar{p}p \rightarrow e^+e^-$                          |
| 3096.95 ±0.1 ±0.3                                                             | 193  | BAGLIN 87                  | SPEC | $\bar{p}p \rightarrow e^+e^- X$                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                            |      |                                                        |
| 3096.66 ±0.19 ±0.02                                                           | 6.1k | <sup>4</sup> AAIJ 15Bi     | LHCB | $pp \rightarrow J/\psi X$                              |
| 3096.917±0.010±0.007                                                          |      | AULCHENKO 03               | KEDR | $e^+e^- \rightarrow \text{hadrons}$                    |
| 3097.5 ±0.3                                                                   |      | GRIBUSHIN 96               | FMPS | $515 \pi^- \text{Be} \rightarrow 2\mu X$               |
| 3098.4 ±2.0                                                                   | 38k  | LEMOIGNE 82                | GOLI | $185 \pi^- \text{Be} \rightarrow \gamma \mu^+ \mu^- A$ |
| 3096.93 ±0.09                                                                 | 502  | <sup>5</sup> ZHOLENTZ 80   | REDE | $e^+e^-$                                               |
| 3097.0 ±1                                                                     |      | <sup>6</sup> BRANDELIK 79C | DASP | $e^+e^-$                                               |

<sup>1</sup> Supersedes AULCHENKO 03.

<sup>2</sup> Reanalysis of ZHOLENTZ 80 using new electron mass (COHEN 87) and radiative corrections (KURAEV 85).

<sup>3</sup> Mass central value and systematic error recalculated by us according to Eq.(16) in ARMSTRONG 93B, using the value for the  $\psi(2S)$  mass from AULCHENKO 03.

<sup>4</sup> From a sample of  $\eta_c(1S)$  and  $J/\psi$  produced in  $b$ -hadron decays. Systematic uncertainties not estimated.

<sup>5</sup> Superseded by ARTAMONOV 00.

<sup>6</sup> From a simultaneous fit to  $e^+e^-$ ,  $\mu^+\mu^-$  and hadronic channels assuming  $\Gamma(e^+e^-) = \Gamma(\mu^+\mu^-)$ .

NODE=M070

NODE=M070M

NODE=M070M

NODE=M070M;LINKAGE=A

NODE=M070M;LINKAGE=AR

NODE=M070M;LINKAGE=NW

NODE=M070M;LINKAGE=B

NODE=M070M;LINKAGE=RZ

NODE=M070M;LINKAGE=F

### $J/\psi(1S)$ WIDTH

NODE=M070W

| VALUE (keV)                                                                   | EVTs | DOCUMENT ID                         | TECN     | COMMENT                                              |
|-------------------------------------------------------------------------------|------|-------------------------------------|----------|------------------------------------------------------|
| <b>92.6 ± 1.7 OUR AVERAGE</b>                                                 |      | Error includes scale factor of 1.1. |          | [92.9 ± 2.8 keV OUR 2020 AVERAGE Scale factor = 1.1] |
| 92.45 ± 1.40 ± 1.48                                                           | 13k  | <sup>1</sup> ANASHIN                | 20 KEDR  | $e^+e^-$                                             |
| 96.1 ± 3.2                                                                    |      | <sup>2</sup> ADAMS                  | 06A CLEO | $e^+e^- \rightarrow \mu^+\mu^-\gamma$                |
| 84.4 ± 8.9                                                                    |      | BAI                                 | 95B BES  | $e^+e^-$                                             |
| 91 ± 11 ± 6                                                                   | 5.8k | <sup>3</sup> ARMSTRONG              | 93B E760 | $\bar{p}p \rightarrow e^+e^-$                        |
| 85.5 $\begin{smallmatrix} +6.1 \\ -5.8 \end{smallmatrix}$                     |      | <sup>4</sup> HSUEH                  | 92 RVUE  | See $\Upsilon$ mini-review                           |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                                     |          |                                                      |
| 92.94 ± 1.83                                                                  | 7.8k | <sup>5,6</sup> ANASHIN              | 18A KEDR | $e^+e^-$                                             |
| 94.1 ± 2.7                                                                    |      | <sup>7</sup> ANASHIN                | 10 KEDR  | $3.097 e^+e^- \rightarrow e^+e^-, \mu^+\mu^-$        |
| 93.7 ± 3.5                                                                    |      | <sup>2</sup> AUBERT                 | 04 BABR  | $e^+e^- \rightarrow \mu^+\mu^-\gamma$                |

<sup>1</sup> Based on the same dataset as ANASHIN 18A and correlated to the values reported there

<sup>2</sup> Calculated by us from the reported values of  $\Gamma(e^+e^-) \times B(\mu^+\mu^-)$  using  $B(e^+e^-) = (5.94 \pm 0.06)\%$  and  $B(\mu^+\mu^-) = (5.93 \pm 0.06)\%$ .

<sup>3</sup> The initial-state radiation correction reevaluated by ANDREOTTI 07 in its Ref. [4].

<sup>4</sup> Using data from COFFMAN 92, BALDINI-CELIO 75, BOYARSKI 75, ESPOSITO 75B, BRANDELIK 79C.

<sup>5</sup> Using  $\Gamma(e^+e^-)$  from ANASHIN 18A and  $B(J/\psi(1S) \rightarrow e^+e^-) = (5.971 \pm 0.032)\%$  from PDG 16.

<sup>6</sup> Superseded by ANASHIN 20 that is based on the same dataset .

<sup>7</sup> Assuming  $\Gamma(e^+e^-) = \Gamma(\mu^+\mu^-)$  and using  $\Gamma(e^+e^-)/\Gamma_{\text{total}} = (5.94 \pm 0.06)\%$ .

<sup>1</sup> Based on the same dataset as ANASHIN 18A and correlated to the values reported there

<sup>2</sup> Calculated by us from the reported values of  $\Gamma(e^+e^-) \times B(\mu^+\mu^-)$  using  $B(e^+e^-) = (5.94 \pm 0.06)\%$  and  $B(\mu^+\mu^-) = (5.93 \pm 0.06)\%$ .

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### $J/\psi(1S)$ DECAY MODES

| Mode                                            | Fraction ( $\Gamma_i/\Gamma$ )       | Scale factor/<br>Confidence level |
|-------------------------------------------------|--------------------------------------|-----------------------------------|
| $\Gamma_1$ hadrons                              | (87.7 ± 0.5) %                       |                                   |
| $\Gamma_2$ virtual $\gamma \rightarrow$ hadrons | (13.50 ± 0.30) %                     |                                   |
| $\Gamma_3$ $ggg$                                | (64.1 ± 1.0) %                       |                                   |
| $\Gamma_4$ $\gamma gg$                          | ( 8.8 ± 1.1 ) %                      |                                   |
| $\Gamma_5$ $e^+e^-$                             | ( 5.971 ± 0.032 ) %                  |                                   |
| $\Gamma_6$ $e^+e^-\gamma$                       | [a] ( 8.8 ± 1.4 ) × 10 <sup>-3</sup> |                                   |
| $\Gamma_7$ $\mu^+\mu^-$                         | ( 5.961 ± 0.033 ) %                  |                                   |

### Decays involving hadronic resonances

|                                                                       |                                                                                    |       |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------|-------|
| $\Gamma_8$ $\rho\pi$                                                  | ( 1.69 ± 0.15 ) %                                                                  | S=2.4 |
| $\Gamma_9$ $\rho^0\pi^0$                                              | ( 5.6 ± 0.7 ) × 10 <sup>-3</sup>                                                   |       |
| $\Gamma_{10}$ $\rho(770)^\mp K^\pm K_S^0$                             | ( 1.9 ± 0.4 ) × 10 <sup>-3</sup>                                                   |       |
| $\Gamma_{11}$ $\rho(1450)\pi$                                         |                                                                                    |       |
| $\Gamma_{12}$ $\rho(1450)\pi \rightarrow \pi^+\pi^-\pi^0$             | ( 2.3 ± 0.7 ) × 10 <sup>-3</sup>                                                   |       |
| $\Gamma_{13}$ $\rho(1450)^\pm\pi^\mp \rightarrow K_S^0 K^\pm\pi^\mp$  | ( 3.5 ± 0.6 ) × 10 <sup>-4</sup>                                                   |       |
| $\Gamma_{14}$ $\rho(1450)^0\pi^0 \rightarrow K^+K^-\pi^0$             | ( 2.7 ± 0.6 ) × 10 <sup>-4</sup>                                                   |       |
| $\Gamma_{15}$ $\rho(1450)\eta'(958) \rightarrow \pi^+\pi^-\eta'(958)$ | ( 3.3 ± 0.7 ) × 10 <sup>-6</sup>                                                   |       |
| $\Gamma_{16}$ $\rho(1700)\pi$                                         |                                                                                    |       |
| $\Gamma_{17}$ $\rho(1700)\pi \rightarrow \pi^+\pi^-\pi^0$             | ( 1.7 ± 1.1 ) × 10 <sup>-4</sup>                                                   |       |
| $\Gamma_{18}$ $\rho(2150)\pi$                                         |                                                                                    |       |
| $\Gamma_{19}$ $\rho(2150)\pi \rightarrow \pi^+\pi^-\pi^0$             | ( 8 ± 40 ) × 10 <sup>-6</sup>                                                      |       |
| $\Gamma_{20}$ $\rho_3(1690)\pi \rightarrow \pi^+\pi^-\pi^0$           |                                                                                    |       |
| $\Gamma_{21}$ $a_2(1320)\rho$                                         | ( 1.09 ± 0.22 ) %                                                                  |       |
| $\Gamma_{22}$ $\omega\pi^+\pi^+\pi^-\pi^-$                            | ( 8.5 ± 3.4 ) × 10 <sup>-3</sup>                                                   |       |
| $\Gamma_{23}$ $\omega\pi^+\pi^-\pi^0$                                 | ( 4.0 ± 0.7 ) × 10 <sup>-3</sup>                                                   |       |
| $\Gamma_{24}$ $\omega\pi^+\pi^-$                                      | ( 7.2 ± 1.0 ) × 10 <sup>-3</sup>                                                   |       |
| $\Gamma_{25}$ $\omega f_2(1270)$                                      | ( 4.3 ± 0.6 ) × 10 <sup>-3</sup>                                                   |       |
| $\Gamma_{26}$ $K^*(892)^0 \bar{K}^*(892)^0$                           | ( 2.3 ± 0.6 ) × 10 <sup>-4</sup>                                                   |       |
| $\Gamma_{27}$ $K^*(892)^\pm K^*(892)^\mp$                             | ( 1.00 $\begin{smallmatrix} +0.22 \\ -0.40 \end{smallmatrix}$ ) × 10 <sup>-3</sup> |       |
| $\Gamma_{28}$ $K^*(892)^\pm K^*(700)^\mp$                             | ( 1.1 $\begin{smallmatrix} +1.0 \\ -0.6 \end{smallmatrix}$ ) × 10 <sup>-3</sup>    |       |
| $\Gamma_{29}$ $K_S^0\pi^- K^*(892)^+ + \text{c.c.}$                   | ( 2.0 ± 0.5 ) × 10 <sup>-3</sup>                                                   |       |

NODE=M070W

NEW

NODE=M070W;LINKAGE=C

NODE=M070W;LINKAGE=AA

NODE=M070W;LINKAGE=AN

NODE=M070W;LINKAGE=A

NODE=M070W;LINKAGE=B

NODE=M070W;LINKAGE=D

NODE=M070W;LINKAGE=AS

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DESIG=316

DESIG=43

DESIG=26

DESIG=211

DESIG=24

DESIG=28

DESIG=46

DESIG=256

DESIG=257

DESIG=299

|     |                                                                                             |                                          |                    |
|-----|---------------------------------------------------------------------------------------------|------------------------------------------|--------------------|
| Г30 | $K_S^0 \pi^- K^*(892)^+ + \text{c.c.} \rightarrow K_S^0 K_S^0 \pi^+ \pi^-$                  | $(6.7 \pm 2.2) \times 10^{-4}$           | DESIG=300          |
| Г31 | $K_S^0 K^*(892)^0 \rightarrow \gamma K_S^0 K_S^0$                                           | $(6.3 \pm 0.6_{-0.5}) \times 10^{-6}$    | DESIG=376          |
| Г32 | $K_2^*(1430)^+ K^- + \text{c.c.} \rightarrow K^+ K^- \pi^0$                                 | $(2.69 \pm 0.25_{-0.19}) \times 10^{-4}$ | DESIG=381          |
| Г33 | $K_2^*(1980)^+ K^- + \text{c.c.} \rightarrow K^+ K^- \pi^0$                                 | $(1.10 \pm 0.60_{-0.14}) \times 10^{-5}$ | DESIG=382          |
| Г34 | $K_4^*(2045)^+ K^- + \text{c.c.} \rightarrow K^+ K^- \pi^0$                                 | $(6.2 \pm 2.9_{-1.6}) \times 10^{-6}$    | DESIG=383          |
| Г35 | $\eta K^*(892)^0 \bar{K}^*(892)^0$                                                          | $(1.15 \pm 0.26) \times 10^{-3}$         | DESIG=252          |
| Г36 | $\eta' K^{*\pm} K^\mp$                                                                      | $(1.48 \pm 0.13) \times 10^{-3}$         | DESIG=355          |
| Г37 | $\eta' K^{*0} \bar{K}^0 + \text{c.c.}$                                                      | $(1.66 \pm 0.21) \times 10^{-3}$         | DESIG=357          |
| Г38 | $\eta' h_1(1415) \rightarrow \eta' K^* \bar{K} + \text{c.c.}$                               | $(2.16 \pm 0.31) \times 10^{-4}$         | DESIG=353          |
| Г39 | $\eta' h_1(1415) \rightarrow \eta' K^{*\pm} K^\mp$                                          | $(1.51 \pm 0.23) \times 10^{-4}$         | DESIG=354          |
| Г40 | $K^*(1410) \bar{K} + \text{c.c.}$                                                           |                                          | DESIG=317          |
| Г41 | $K^*(1410) \bar{K} + \text{c.c.} \rightarrow K^\pm K^\mp \pi^0$                             | $(7 \pm 4) \times 10^{-5}$               | DESIG=330          |
| Г42 | $K^*(1410) \bar{K} + \text{c.c.} \rightarrow K_S^0 K^\pm \pi^\mp$                           | $(8 \pm 6) \times 10^{-5}$               | DESIG=318          |
| Г43 | $K_2^*(1430) \bar{K} + \text{c.c.}$                                                         |                                          | DESIG=319          |
| Г44 | $K_2^*(1430) \bar{K} + \text{c.c.} \rightarrow K^\pm K^\mp \pi^0$                           | $(1.0 \pm 0.5) \times 10^{-4}$           | DESIG=321          |
| Г45 | $K_2^*(1430) \bar{K} + \text{c.c.} \rightarrow K_S^0 K^\pm \pi^\mp$                         | $(4.0 \pm 1.0) \times 10^{-4}$           | DESIG=320          |
| Г46 | $K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}$                                              | $(4.67 \pm 0.29) \times 10^{-3}$         | DESIG=48           |
| Г47 | $K^*(892)^+ K_2^*(1430)^- + \text{c.c.}$                                                    | $(3.4 \pm 2.9) \times 10^{-3}$           | DESIG=303          |
| Г48 | $K^*(892)^+ K_2^*(1430)^- + \text{c.c.} \rightarrow K^*(892)^+ K_S^0 \pi^- + \text{c.c.}$   | $(4 \pm 4) \times 10^{-4}$               | DESIG=304          |
| Г49 | $K^*(892)^0 \bar{K}_2(1770)^0 + \text{c.c.} \rightarrow K^*(892)^0 K^- \pi^+ + \text{c.c.}$ | $(6.9 \pm 0.9) \times 10^{-4}$           | DESIG=235          |
| Г50 | $\omega K^*(892) \bar{K} + \text{c.c.}$                                                     | $(6.1 \pm 0.9) \times 10^{-3}$           | DESIG=102          |
| Г51 | $\bar{K} K^*(892) + \text{c.c.}$                                                            |                                          | DESIG=331          |
| Г52 | $\bar{K} K^*(892) + \text{c.c.} \rightarrow K_S^0 K^\pm \pi^\mp$                            | $(5.0 \pm 0.5) \times 10^{-3}$           | DESIG=332          |
| Г53 | $K^+ K^*(892)^- + \text{c.c.}$                                                              | $(6.0 \pm 0.8_{-1.0}) \times 10^{-3}$    | S=2.9<br>DESIG=121 |
| Г54 | $K^+ K^*(892)^- + \text{c.c.} \rightarrow K^+ K^- \pi^0$                                    | $(2.69 \pm 0.13_{-0.20}) \times 10^{-3}$ | DESIG=231          |
| Г55 | $K^+ K^*(892)^- + \text{c.c.} \rightarrow K^0 K^\pm \pi^\mp + \text{c.c.}$                  | $(3.0 \pm 0.4) \times 10^{-3}$           | DESIG=232          |
| Г56 | $K^0 \bar{K}^*(892)^0 + \text{c.c.}$                                                        | $(4.2 \pm 0.4) \times 10^{-3}$           | DESIG=122          |
| Г57 | $K^0 \bar{K}^*(892)^0 + \text{c.c.} \rightarrow K^0 K^\pm \pi^\mp + \text{c.c.}$            | $(3.2 \pm 0.4) \times 10^{-3}$           | DESIG=233          |
| Г58 | $K_1(1400)^\pm K^\mp$                                                                       | $(3.8 \pm 1.4) \times 10^{-3}$           | DESIG=132          |
| Г59 | $\bar{K}^*(892)^0 K^+ \pi^- + \text{c.c.}$                                                  | $(7.7 \pm 1.6) \times 10^{-3}$           | DESIG=214          |
| Г60 | $K^*(892)^\pm K^\mp \pi^0$                                                                  | $(4.1 \pm 1.3) \times 10^{-3}$           | DESIG=343          |
| Г61 | $K^*(892)^0 K_S^0 \pi^0$                                                                    | $(7 \pm 4) \times 10^{-4}$               | DESIG=344          |
| Г62 | $\omega \pi^0 \pi^0$                                                                        | $(3.4 \pm 0.8) \times 10^{-3}$           | DESIG=140          |
| Г63 | $\omega \pi^0 \eta$                                                                         | $(3.4 \pm 1.7) \times 10^{-4}$           | DESIG=360          |
| Г64 | $b_1(1235)^\pm \pi^\mp$                                                                     | [b] $(3.0 \pm 0.5) \times 10^{-3}$       | DESIG=49           |
| Г65 | $\omega K^\pm K_S^0 \pi^\mp$                                                                | [b] $(3.4 \pm 0.5) \times 10^{-3}$       | DESIG=101          |
| Г66 | $b_1(1235)^0 \pi^0$                                                                         | $(2.3 \pm 0.6) \times 10^{-3}$           | DESIG=160          |
| Г67 | $\eta K^\pm K_S^0 \pi^\mp$                                                                  | [b] $(2.2 \pm 0.4) \times 10^{-3}$       | DESIG=230          |
| Г68 | $\phi K^*(892) \bar{K} + \text{c.c.}$                                                       | $(2.18 \pm 0.23) \times 10^{-3}$         | DESIG=104          |
| Г69 | $\omega K \bar{K}$                                                                          | $(1.9 \pm 0.4) \times 10^{-3}$           | DESIG=27           |
| Г70 | $\omega f_0(1710) \rightarrow \omega K \bar{K}$                                             | $(4.8 \pm 1.1) \times 10^{-4}$           | DESIG=130          |
| Г71 | $\phi 2(\pi^+ \pi^-)$                                                                       | $(1.60 \pm 0.32) \times 10^{-3}$         | DESIG=35           |
| Г72 | $\Delta(1232)^{++} \bar{p} \pi^-$                                                           | $(1.6 \pm 0.5) \times 10^{-3}$           | DESIG=70           |



|      |                                                                                 |                                                 |        |                                 |
|------|---------------------------------------------------------------------------------|-------------------------------------------------|--------|---------------------------------|
| Г73  | $\omega\eta$                                                                    | $(1.74 \pm 0.20) \times 10^{-3}$                | S=1.6  | DESIG=30                        |
| Г74  | $\omega\eta'\pi^+\pi^-$                                                         | $(1.12 \pm 0.13) \times 10^{-3}$                |        | DESIG=385                       |
| Г75  | $\phi K\bar{K}$                                                                 | $(1.77 \pm 0.16) \times 10^{-3}$                | S=1.3  | DESIG=36                        |
| Г76  | $\phi K_S^0 K_S^0$                                                              | $(5.9 \pm 1.5) \times 10^{-4}$                  |        | DESIG=305                       |
| Г77  | $\phi f_0(1710) \rightarrow \phi K\bar{K}$                                      | $(3.6 \pm 0.6) \times 10^{-4}$                  |        | DESIG=129                       |
| Г78  | $\phi K^+ K^-$                                                                  | $(8.3 \pm 1.1) \times 10^{-4}$                  |        | DESIG=295                       |
| Г79  | $\phi f_2(1270)$                                                                | $(3.2 \pm 0.6) \times 10^{-4}$                  |        | DESIG=39                        |
| Г80  | $\Delta(1232)^{++}\bar{\Delta}(1232)^{--}$                                      | $(1.10 \pm 0.29) \times 10^{-3}$                |        | DESIG=66                        |
| Г81  | $\Sigma(1385)^-\bar{\Sigma}(1385)^+ \text{ (or c.c.)}$                          | [b] $(1.16 \pm 0.05) \times 10^{-3}$            |        | DESIG=67                        |
| Г82  | $\Sigma(1385)^0\bar{\Sigma}(1385)^0$                                            | $(1.07 \pm 0.08) \times 10^{-3}$                |        | DESIG=309                       |
| Г83  | $K^+ K^- f'_2(1525)$                                                            | $(1.06 \pm 0.35) \times 10^{-3}$                |        | DESIG=308                       |
| Г84  | $\phi f'_2(1525)$                                                               | $(8 \pm 4) \times 10^{-4}$                      | S=2.7  | DESIG=40                        |
| Г85  | $\phi\pi^+\pi^-$                                                                | $(9.4 \pm 1.5) \times 10^{-4}$                  | S=1.7  | DESIG=34                        |
| Г86  | $\phi\pi^0\pi^0$                                                                | $(5.0 \pm 1.0) \times 10^{-4}$                  |        | DESIG=76                        |
| Г87  | $\phi K^\pm K_S^0\pi^\mp$                                                       | [b] $(7.2 \pm 0.8) \times 10^{-4}$              |        | DESIG=103                       |
| Г88  | $\omega f_1(1420)$                                                              | $(6.8 \pm 2.4) \times 10^{-4}$                  |        | DESIG=105                       |
| Г89  | $\phi\eta$                                                                      | $(7.4 \pm 0.8) \times 10^{-4}$                  | S=1.5  | DESIG=37                        |
| Г90  | $\Xi^0\Xi^0$                                                                    | $(1.17 \pm 0.04) \times 10^{-3}$                |        | DESIG=248                       |
| Г91  | $\Xi(1530)^-\Xi^++ \text{ c.c.}$                                                | $(3.18 \pm 0.08) \times 10^{-4}$                |        | DESIG=107                       |
| Г92  | $pK^-\bar{\Sigma}(1385)^0$                                                      | $(5.1 \pm 3.2) \times 10^{-4}$                  |        | DESIG=74                        |
| Г93  | $\omega\pi^0$                                                                   | $(4.5 \pm 0.5) \times 10^{-4}$                  | S=1.4  | DESIG=32                        |
| Г94  | $\omega\pi^0 \rightarrow \pi^+\pi^-\pi^0$                                       | $(1.7 \pm 0.8) \times 10^{-5}$                  |        | DESIG=327                       |
| Г95  | $\phi\eta'(958)$                                                                | $(4.6 \pm 0.5) \times 10^{-4}$                  | S=2.2  | DESIG=38                        |
| Г96  | $\phi f_0(980)$                                                                 | $(3.2 \pm 0.9) \times 10^{-4}$                  | S=1.9  | DESIG=41                        |
| Г97  | $\phi f_0(980) \rightarrow \phi\pi^+\pi^-$                                      | $(2.60 \pm 0.34) \times 10^{-4}$                |        | DESIG=236                       |
| Г98  | $\phi f_0(980) \rightarrow \phi\pi^0\pi^0$                                      | $(1.8 \pm 0.5) \times 10^{-4}$                  |        | DESIG=237                       |
| Г99  | $\phi\eta\eta'$                                                                 | $(2.32 \pm 0.17) \times 10^{-4}$                |        | DESIG=387                       |
| Г100 | $\phi\pi^0 f_0(980) \rightarrow \phi\pi^0\pi^+\pi^-$                            | $(4.5 \pm 1.0) \times 10^{-6}$                  |        | DESIG=278                       |
| Г101 | $\phi\pi^0 f_0(980) \rightarrow \phi\pi^0\rho^0\pi^0$                           | $(1.7 \pm 0.6) \times 10^{-6}$                  |        | DESIG=279                       |
| Г102 | $\eta\phi f_0(980) \rightarrow \eta\phi\pi^+\pi^-$                              | $(3.2 \pm 1.0) \times 10^{-4}$                  |        | DESIG=229                       |
| Г103 | $\phi a_0(980)^0 \rightarrow \phi\eta\pi^0$                                     | $(4.4 \pm 1.4) \times 10^{-6}$                  |        | DESIG=258                       |
| Г104 | $\Xi(1530)^0\Xi^0$                                                              | $(3.2 \pm 1.4) \times 10^{-4}$                  |        | DESIG=108                       |
| Г105 | $\Sigma(1385)^-\bar{\Sigma}^+ \text{ (or c.c.)}$                                | [b] $(3.1 \pm 0.5) \times 10^{-4}$              |        | DESIG=68                        |
| Г106 | $\phi f_1(1285)$                                                                | $(2.6 \pm 0.5) \times 10^{-4}$                  |        | DESIG=106                       |
| Г107 | $\phi f_1(1285) \rightarrow \phi\pi^0 f_0(980) \rightarrow \phi\pi^0\pi^+\pi^-$ | $(9.4 \pm 2.8) \times 10^{-7}$                  |        | DESIG=280                       |
| Г108 | $\phi f_1(1285) \rightarrow \phi\pi^0 f_0(980) \rightarrow \phi\pi^0\pi^0\pi^0$ | $(2.1 \pm 2.2) \times 10^{-7}$                  |        | DESIG=281                       |
| Г109 | $\eta\pi^+\pi^-$                                                                | $(3.8 \pm 0.7) \times 10^{-4}$                  |        | DESIG=239                       |
| Г110 | $\eta\rho$                                                                      | $(1.93 \pm 0.23) \times 10^{-4}$                |        | DESIG=22                        |
| Г111 | $\omega\eta'(958)$                                                              | $(1.89 \pm 0.18) \times 10^{-4}$                |        | DESIG=31                        |
| Г112 | $\omega f_0(980)$                                                               | $(1.4 \pm 0.5) \times 10^{-4}$                  |        | DESIG=150                       |
| Г113 | $\rho\eta'(958)$                                                                | $(8.1 \pm 0.8) \times 10^{-5}$                  | S=1.6  | DESIG=23                        |
| Г114 | $a_2(1320)^\pm\pi^\mp$                                                          | [b] $< 4.3 \times 10^{-3}$                      | CL=90% | DESIG=42                        |
| Г115 | $K\bar{K}_2^*(1430) + \text{c.c.}$                                              | $< 4.0 \times 10^{-3}$                          | CL=90% | DESIG=45                        |
| Г116 | $K_1(1270)^\pm K^\mp$                                                           | $< 3.0 \times 10^{-3}$                          | CL=90% | DESIG=131                       |
| Г117 | $K_1(1270)K_S^0 \rightarrow \gamma K_S^0 K_S^0$                                 | $(8.5 \pm 2.5) \times 10^{-7}$                  |        | DESIG=377                       |
| Г118 | $K_S^0\pi^- K_2^*(1430)^+ + \text{c.c.}$                                        | $(3.6 \pm 1.8) \times 10^{-3}$                  |        | DESIG=301                       |
| Г119 | $K_2^*(1430)^0\bar{K}_2^*(1430)^0$                                              | $< 2.9 \times 10^{-3}$                          | CL=90% | DESIG=47                        |
| Г120 | $\phi\pi^0$                                                                     | $3 \times 10^{-6} \text{ or } 1 \times 10^{-7}$ |        | DESIG=33;OUR EVAL;→ UNCHECKED ← |
| Г121 | $\phi\eta(1405) \rightarrow \phi\eta\pi^+\pi^-$                                 | $(2.0 \pm 1.0) \times 10^{-5}$                  |        | DESIG=128                       |
| Г122 | $\omega f'_2(1525)$                                                             | $< 2.2 \times 10^{-4}$                          | CL=90% | DESIG=29                        |
| Г123 | $\omega X(1835) \rightarrow \omega p\bar{p}$                                    | $< 3.9 \times 10^{-6}$                          | CL=95% | DESIG=263                       |
| Г124 | $\omega X(1835), X \rightarrow \eta'\pi^+\pi^-$                                 | $< 6.2 \times 10^{-5}$                          |        | DESIG=386                       |
| Г125 | $\phi X(1835) \rightarrow \phi p\bar{p}$                                        | $< 2.1 \times 10^{-7}$                          | CL=90% | DESIG=291                       |
| Г126 | $\phi X(1835) \rightarrow \phi\eta\pi^+\pi^-$                                   | $< 2.8 \times 10^{-4}$                          | CL=90% | DESIG=288                       |
| Г127 | $\phi X(1870) \rightarrow \phi\eta\pi^+\pi^-$                                   | $< 6.13 \times 10^{-5}$                         | CL=90% | DESIG=289                       |

|                  |                                                                                      |                                |        |           |
|------------------|--------------------------------------------------------------------------------------|--------------------------------|--------|-----------|
| Γ <sub>128</sub> | $\eta\phi(2170) \rightarrow \eta\phi f_0(980) \rightarrow \eta\phi\pi^+\pi^-$        | $(1.2 \pm 0.4) \times 10^{-4}$ |        | DESIG=287 |
| Γ <sub>129</sub> | $\eta\phi(2170) \rightarrow \eta K^*(892)^0 \bar{K}^*(892)^0$                        | $< 2.52 \times 10^{-4}$        | CL=90% | DESIG=253 |
| Γ <sub>130</sub> | $\Sigma(1385)^0 \bar{\Lambda} + \text{c.c.}$                                         | $< 8.2 \times 10^{-6}$         | CL=90% | DESIG=111 |
| Γ <sub>131</sub> | $\Delta(1232)^+ \bar{p}$                                                             | $< 1 \times 10^{-4}$           | CL=90% | DESIG=112 |
| Γ <sub>132</sub> | $\Lambda(1520) \bar{\Lambda} + \text{c.c.} \rightarrow \gamma \Lambda \bar{\Lambda}$ | $< 4.1 \times 10^{-6}$         | CL=90% | DESIG=260 |
| Γ <sub>133</sub> | $\bar{\Lambda}(1520) \Lambda + \text{c.c.}$                                          | $< 1.80 \times 10^{-3}$        | CL=90% | DESIG=364 |
| Γ <sub>134</sub> | $\Theta(1540) \bar{\Theta}(1540) \rightarrow K_S^0 p K^- \bar{n} + \text{c.c.}$      | $< 1.1 \times 10^{-5}$         | CL=90% | DESIG=205 |
| Γ <sub>135</sub> | $\Theta(1540) K^- \bar{n} \rightarrow K_S^0 p K^- \bar{n}$                           | $< 2.1 \times 10^{-5}$         | CL=90% | DESIG=206 |
| Γ <sub>136</sub> | $\Theta(1540) K_S^0 \bar{p} \rightarrow K_S^0 \bar{p} K^+ n$                         | $< 1.6 \times 10^{-5}$         | CL=90% | DESIG=207 |
| Γ <sub>137</sub> | $\bar{\Theta}(1540) K^+ n \rightarrow K_S^0 \bar{p} K^+ n$                           | $< 5.6 \times 10^{-5}$         | CL=90% | DESIG=208 |
| Γ <sub>138</sub> | $\bar{\Theta}(1540) K_S^0 p \rightarrow K_S^0 p K^- \bar{n}$                         | $< 1.1 \times 10^{-5}$         | CL=90% | DESIG=209 |

### Decays into stable hadrons

|                  |                                                                       |                                    |        |           |
|------------------|-----------------------------------------------------------------------|------------------------------------|--------|-----------|
| Γ <sub>139</sub> | $2(\pi^+\pi^-)\pi^0$                                                  | $(3.73 \pm 0.32) \%$               | S=1.4  | DESIG=9   |
| Γ <sub>140</sub> | $3(\pi^+\pi^-)\pi^0$                                                  | $(2.9 \pm 0.6) \%$                 |        | DESIG=11  |
| Γ <sub>141</sub> | $\pi^+\pi^-\pi^0$                                                     | $(2.10 \pm 0.08) \%$               | S=1.6  | DESIG=7   |
| Γ <sub>142</sub> | $\pi^+\pi^-\pi^0\pi^0\pi^0$                                           | $(2.71 \pm 0.29) \%$               |        | DESIG=358 |
| Γ <sub>143</sub> | $\rho^\pm\pi^\mp\pi^0\pi^0$                                           | $(1.41 \pm 0.22) \%$               |        | DESIG=362 |
| Γ <sub>144</sub> | $\rho^+\rho^-\pi^0$                                                   | $(6.0 \pm 1.1) \times 10^{-3}$     |        | DESIG=363 |
| Γ <sub>145</sub> | $\pi^+\pi^-\pi^0 K^+ K^-$                                             | $(1.20 \pm 0.30) \%$               |        | DESIG=18  |
| Γ <sub>146</sub> | $4(\pi^+\pi^-)\pi^0$                                                  | $(9.0 \pm 3.0) \times 10^{-3}$     |        | DESIG=12  |
| Γ <sub>147</sub> | $\pi^+\pi^- K^+ K^-$                                                  | $(6.86 \pm 0.28) \times 10^{-3}$   |        | DESIG=16  |
| Γ <sub>148</sub> | $\pi^+\pi^- K_S^0 K_L^0$                                              | $(3.8 \pm 0.6) \times 10^{-3}$     |        | DESIG=296 |
| Γ <sub>149</sub> | $\pi^+\pi^- K_S^0 K_S^0$                                              | $(1.68 \pm 0.19) \times 10^{-3}$   |        | DESIG=297 |
| Γ <sub>150</sub> | $\pi^\pm\pi^0 K^\mp K_S^0$                                            | $(5.7 \pm 0.5) \times 10^{-3}$     |        | DESIG=341 |
| Γ <sub>151</sub> | $K^+ K^- K_S^0 K_S^0$                                                 | $(4.2 \pm 0.7) \times 10^{-4}$     |        | DESIG=298 |
| Γ <sub>152</sub> | $\pi^+\pi^- K^+ K^- \eta$                                             | $(4.7 \pm 0.7) \times 10^{-3}$     |        | DESIG=238 |
| Γ <sub>153</sub> | $\pi^0\pi^0 K^+ K^-$                                                  | $(2.13 \pm 0.22) \times 10^{-3}$   |        | DESIG=234 |
| Γ <sub>154</sub> | $\pi^0\pi^0 K_S^0 K_L^0$                                              | $(1.9 \pm 0.4) \times 10^{-3}$     |        | DESIG=337 |
| Γ <sub>155</sub> | $K \bar{K} \pi$                                                       | $(6.1 \pm 1.0) \times 10^{-3}$     |        | DESIG=15  |
| Γ <sub>156</sub> | $K^+ K^- \pi^0$                                                       | $(2.88 \pm 0.12) \times 10^{-3}$   |        | DESIG=334 |
| Γ <sub>157</sub> | $K_S^0 K^\pm \pi^\mp$                                                 | $(5.6 \pm 0.5) \times 10^{-3}$     |        | DESIG=335 |
| Γ <sub>158</sub> | $K_S^0 K_L^0 \pi^0$                                                   | $(2.06 \pm 0.26) \times 10^{-3}$   |        | DESIG=336 |
| Γ <sub>159</sub> | $K^*(892)^0 \bar{K}^0 + \text{c.c.} \rightarrow K_S^0 K_L^0 \pi^0$    | $(1.21 \pm 0.18) \times 10^{-3}$   |        | DESIG=339 |
| Γ <sub>160</sub> | $K_2^*(1430)^0 \bar{K}^0 + \text{c.c.} \rightarrow K_S^0 K_L^0 \pi^0$ | $(4.3 \pm 1.3) \times 10^{-4}$     |        | DESIG=338 |
| Γ <sub>161</sub> | $K_S^0 K_L^0 \eta$                                                    | $(1.45 \pm 0.33) \times 10^{-3}$   |        | DESIG=340 |
| Γ <sub>162</sub> | $2(\pi^+\pi^-)$                                                       | $(3.57 \pm 0.30) \times 10^{-3}$   |        | DESIG=8   |
| Γ <sub>163</sub> | $3(\pi^+\pi^-)$                                                       | $(4.3 \pm 0.4) \times 10^{-3}$     |        | DESIG=10  |
| Γ <sub>164</sub> | $2(\pi^+\pi^-\pi^0)$                                                  | $(1.61 \pm 0.20) \%$               |        | DESIG=210 |
| Γ <sub>165</sub> | $2(\pi^+\pi^-)\eta$                                                   | $(2.26 \pm 0.28) \times 10^{-3}$   |        | DESIG=201 |
| Γ <sub>166</sub> | $3(\pi^+\pi^-)\eta$                                                   | $(7.2 \pm 1.5) \times 10^{-4}$     |        | DESIG=202 |
| Γ <sub>167</sub> | $\pi^+\pi^-\pi^0\pi^0\eta$                                            | $(2.3 \pm 0.5) \times 10^{-3}$     |        | DESIG=359 |
| Γ <sub>168</sub> | $\rho^\pm\pi^\mp\pi^0\eta$                                            | $(1.9 \pm 0.8) \times 10^{-3}$     |        | DESIG=361 |
| Γ <sub>169</sub> | $p \bar{p}$                                                           | $(2.120 \pm 0.029) \times 10^{-3}$ |        | DESIG=50  |
| Γ <sub>170</sub> | $p \bar{p} \pi^0$                                                     | $(1.19 \pm 0.08) \times 10^{-3}$   | S=1.1  | DESIG=52  |
| Γ <sub>171</sub> | $p \bar{p} \pi^+ \pi^-$                                               | $(6.0 \pm 0.5) \times 10^{-3}$     | S=1.3  | DESIG=54  |
| Γ <sub>172</sub> | $p \bar{p} \pi^+ \pi^- \pi^0$                                         | [c] $(2.3 \pm 0.9) \times 10^{-3}$ | S=1.9  | DESIG=55  |
| Γ <sub>173</sub> | $p \bar{p} \eta$                                                      | $(2.00 \pm 0.12) \times 10^{-3}$   |        | DESIG=56  |
| Γ <sub>174</sub> | $p \bar{p} \rho$                                                      | $< 3.1 \times 10^{-4}$             | CL=90% | DESIG=57  |
| Γ <sub>175</sub> | $p \bar{p} \omega$                                                    | $(9.8 \pm 1.0) \times 10^{-4}$     | S=1.3  | DESIG=58  |
| Γ <sub>176</sub> | $p \bar{p} \eta'(958)$                                                | $(1.29 \pm 0.14) \times 10^{-4}$   | S=2.0  | DESIG=59  |

|                  |                                                  |                                    |        |                                 |
|------------------|--------------------------------------------------|------------------------------------|--------|---------------------------------|
| Γ <sub>177</sub> | $p\bar{p}a_0(980) \rightarrow p\bar{p}\pi^0\eta$ | $(6.8 \pm 1.8) \times 10^{-5}$     |        | DESIG=276                       |
| Γ <sub>178</sub> | $p\bar{p}\phi$                                   | $(5.19 \pm 0.33) \times 10^{-5}$   |        | DESIG=127                       |
| Γ <sub>179</sub> | $n\bar{n}$                                       | $(2.09 \pm 0.16) \times 10^{-3}$   |        | DESIG=64                        |
| Γ <sub>180</sub> | $n\bar{n}\pi^+\pi^-$                             | $(4 \pm 4) \times 10^{-3}$         |        | DESIG=65                        |
| Γ <sub>181</sub> | $\Sigma^+\bar{\Sigma}^-$                         | $(1.50 \pm 0.24) \times 10^{-3}$   |        | DESIG=247                       |
| Γ <sub>182</sub> | $\Sigma^0\bar{\Sigma}^0$                         | $(1.172 \pm 0.032) \times 10^{-3}$ | S=1.4  | DESIG=63                        |
| Γ <sub>183</sub> | $2(\pi^+\pi^-)K^+K^-$                            | $(3.1 \pm 1.3) \times 10^{-3}$     |        | DESIG=17                        |
| Γ <sub>184</sub> | $p\bar{n}\pi^-$                                  | $(2.12 \pm 0.09) \times 10^{-3}$   |        | DESIG=53                        |
| Γ <sub>185</sub> | $nN(1440)$                                       | seen                               |        | DESIG=215;OUR EST;→ UNCHECKED ← |
| Γ <sub>186</sub> | $nN(1520)$                                       | seen                               |        | DESIG=216;OUR EST;→ UNCHECKED ← |
| Γ <sub>187</sub> | $nN(1535)$                                       | seen                               |        | DESIG=217;OUR EST;→ UNCHECKED ← |
| Γ <sub>188</sub> | $\Xi^-\bar{\Xi}^+$                               | $(9.7 \pm 0.8) \times 10^{-4}$     | S=1.4  | DESIG=62                        |
| Γ <sub>189</sub> | $\Lambda\bar{\Lambda}$                           | $(1.89 \pm 0.09) \times 10^{-3}$   | S=2.8  | DESIG=60                        |
| Γ <sub>190</sub> | $\Lambda\bar{\Sigma}^-\pi^+(\text{or c.c.})$     | [b] $(8.3 \pm 0.7) \times 10^{-4}$ | S=1.2  | DESIG=71                        |
| Γ <sub>191</sub> | $pK^-\bar{\Lambda}+\text{c.c.}$                  | $(8.6 \pm 1.1) \times 10^{-4}$     |        | DESIG=72                        |
| Γ <sub>192</sub> | $2(K^+K^-)$                                      | $(7.2 \pm 0.8) \times 10^{-4}$     |        | DESIG=19                        |
| Γ <sub>193</sub> | $pK^-\bar{\Sigma}^0$                             | $(2.9 \pm 0.8) \times 10^{-4}$     |        | DESIG=73                        |
| Γ <sub>194</sub> | $K^+K^-$                                         | $(2.86 \pm 0.21) \times 10^{-4}$   |        | DESIG=13                        |
| Γ <sub>195</sub> | $K_S^0 K_L^0$                                    | $(1.95 \pm 0.11) \times 10^{-4}$   | S=2.4  | DESIG=75                        |
| Γ <sub>196</sub> | $\Lambda\bar{\Lambda}\pi^+\pi^-$                 | $(4.3 \pm 1.0) \times 10^{-3}$     |        | DESIG=261                       |
| Γ <sub>197</sub> | $\Lambda\bar{\Lambda}\eta$                       | $(1.62 \pm 0.17) \times 10^{-4}$   |        | DESIG=228                       |
| Γ <sub>198</sub> | $\Lambda\bar{\Lambda}\pi^0$                      | $(3.8 \pm 0.4) \times 10^{-5}$     |        | DESIG=109                       |
| Γ <sub>199</sub> | $\bar{\Lambda}nK_S^0 + \text{c.c.}$              | $(6.5 \pm 1.1) \times 10^{-4}$     |        | DESIG=225                       |
| Γ <sub>200</sub> | $\pi^+\pi^-$                                     | $(1.47 \pm 0.14) \times 10^{-4}$   |        | DESIG=6                         |
| Γ <sub>201</sub> | $\Lambda\bar{\Sigma} + \text{c.c.}$              | $(2.83 \pm 0.23) \times 10^{-5}$   |        | DESIG=61                        |
| Γ <sub>202</sub> | $K_S^0 K_S^0$                                    | $< 1.4 \times 10^{-8}$             | CL=95% | DESIG=14                        |

## Radiative decays

|                  |                                                          |                                        |        |           |
|------------------|----------------------------------------------------------|----------------------------------------|--------|-----------|
| Γ <sub>203</sub> | $3\gamma$                                                | $(1.16 \pm 0.22) \times 10^{-5}$       |        | DESIG=81  |
| Γ <sub>204</sub> | $4\gamma$                                                | $< 9 \times 10^{-6}$                   | CL=90% | DESIG=244 |
| Γ <sub>205</sub> | $5\gamma$                                                | $< 1.5 \times 10^{-5}$                 | CL=90% | DESIG=245 |
| Γ <sub>206</sub> | $\gamma\pi^0\pi^0$                                       | $(1.15 \pm 0.05) \times 10^{-3}$       |        | DESIG=283 |
| Γ <sub>207</sub> | $\gamma\eta\pi^0$                                        | $(2.14 \pm 0.31) \times 10^{-5}$       |        | DESIG=292 |
| Γ <sub>208</sub> | $\gamma a_0(980)^0 \rightarrow \gamma\eta\pi^0$          | $< 2.5 \times 10^{-6}$                 | CL=95% | DESIG=293 |
| Γ <sub>209</sub> | $\gamma a_2(1320)^0 \rightarrow \gamma\eta\pi^0$         | $< 6.6 \times 10^{-6}$                 | CL=95% | DESIG=294 |
| Γ <sub>210</sub> | $\gamma K_S^0 K_S^0$                                     | $(8.1 \pm 0.4) \times 10^{-4}$         |        | DESIG=378 |
| Γ <sub>211</sub> | $\gamma\eta_c(1S)$                                       | $(1.7 \pm 0.4) \%$                     | S=1.5  | DESIG=85  |
| Γ <sub>212</sub> | $\gamma\eta_c(1S) \rightarrow 3\gamma$                   | $(3.8 \pm 1.3 \pm 1.0) \times 10^{-6}$ | S=1.1  | DESIG=246 |
| Γ <sub>213</sub> | $\gamma\eta_c(1S) \rightarrow \gamma\eta\eta\eta'$       | $(4.9 \pm 0.8) \times 10^{-5}$         |        | DESIG=391 |
| Γ <sub>214</sub> | $\gamma\pi^+\pi^-2\pi^0$                                 | $(8.3 \pm 3.1) \times 10^{-3}$         |        | DESIG=99  |
| Γ <sub>215</sub> | $\gamma\eta\pi\pi$                                       | $(6.1 \pm 1.0) \times 10^{-3}$         |        | DESIG=96  |
| Γ <sub>216</sub> | $\gamma\eta_2(1870) \rightarrow \gamma\eta\pi^+\pi^-$    | $(6.2 \pm 2.4) \times 10^{-4}$         |        | DESIG=142 |
| Γ <sub>217</sub> | $\gamma\eta(1405/1475) \rightarrow \gamma K\bar{K}\pi$   | $(2.8 \pm 0.6) \times 10^{-3}$         | S=1.6  | DESIG=89  |
| Γ <sub>218</sub> | $\gamma\eta(1405/1475) \rightarrow \gamma\gamma\rho^0$   | $(7.8 \pm 2.0) \times 10^{-5}$         | S=1.8  | DESIG=171 |
| Γ <sub>219</sub> | $\gamma\eta(1405/1475) \rightarrow \gamma\eta\pi^+\pi^-$ | $(3.0 \pm 0.5) \times 10^{-4}$         |        | DESIG=170 |
| Γ <sub>220</sub> | $\gamma\eta(1405/1475) \rightarrow \gamma\gamma\phi$     | $< 8.2 \times 10^{-5}$                 | CL=95% | DESIG=212 |
| Γ <sub>221</sub> | $\gamma\eta(1405) \rightarrow \gamma\gamma\gamma$        | $< 2.63 \times 10^{-6}$                | CL=90% | DESIG=348 |
| Γ <sub>222</sub> | $\gamma\eta(1475) \rightarrow \gamma\gamma\gamma$        | $< 1.86 \times 10^{-6}$                | CL=90% | DESIG=349 |
| Γ <sub>223</sub> | $\gamma\rho\rho$                                         | $(4.5 \pm 0.8) \times 10^{-3}$         |        | DESIG=94  |
| Γ <sub>224</sub> | $\gamma\rho\omega$                                       | $< 5.4 \times 10^{-4}$                 | CL=90% | DESIG=226 |
| Γ <sub>225</sub> | $\gamma\rho\phi$                                         | $< 8.8 \times 10^{-5}$                 | CL=90% | DESIG=227 |
| Γ <sub>226</sub> | $\gamma\eta'(958)$                                       | $(5.25 \pm 0.07) \times 10^{-3}$       | S=1.3  | DESIG=84  |
| Γ <sub>227</sub> | $\gamma 2\pi^+ 2\pi^-$                                   | $(2.8 \pm 0.5) \times 10^{-3}$         | S=1.9  | DESIG=95  |
| Γ <sub>228</sub> | $\gamma f_2(1270) f_2(1270)$                             | $(9.5 \pm 1.7) \times 10^{-4}$         |        | DESIG=203 |
| Γ <sub>229</sub> | $\gamma f_2(1270) f_2(1270) (\text{non resonant})$       | $(8.2 \pm 1.9) \times 10^{-4}$         |        | DESIG=204 |
| Γ <sub>230</sub> | $\gamma K^+ K^- \pi^+ \pi^-$                             | $(2.1 \pm 0.6) \times 10^{-3}$         |        | DESIG=143 |
| Γ <sub>231</sub> | $\gamma f_4(2050)$                                       | $(2.7 \pm 0.7) \times 10^{-3}$         |        | DESIG=100 |
| Γ <sub>232</sub> | $\gamma\omega\omega$                                     | $(1.61 \pm 0.33) \times 10^{-3}$       |        | DESIG=97  |
| Γ <sub>233</sub> | $\gamma\eta(1405/1475) \rightarrow \gamma\rho^0\rho^0$   | $(1.7 \pm 0.4) \times 10^{-3}$         | S=1.3  | DESIG=124 |

|                  |                                                               |                                          |        |           |
|------------------|---------------------------------------------------------------|------------------------------------------|--------|-----------|
| Г <sub>234</sub> | $\gamma f_2(1270)$                                            | $(1.64 \pm 0.12) \times 10^{-3}$         | S=1.3  | DESIG=86  |
| Г <sub>235</sub> | $\gamma f_2(1270) \rightarrow \gamma K_S^0 K_S^0$             | $(2.58 \pm 0.60_{-0.22}) \times 10^{-5}$ |        | DESIG=373 |
| Г <sub>236</sub> | $\gamma f_0(1370) \rightarrow \gamma K \bar{K}$               | $(4.2 \pm 1.5) \times 10^{-4}$           |        | DESIG=284 |
| Г <sub>237</sub> | $\gamma f_0(1370) \rightarrow \gamma K_S^0 K_S^0$             | $(1.1 \pm 0.4) \times 10^{-5}$           |        | DESIG=368 |
| Г <sub>238</sub> | $\gamma f_0(1500) \rightarrow \gamma K_S^0 K_S^0$             | $(1.59 \pm 0.24_{-0.60}) \times 10^{-5}$ |        | DESIG=369 |
| Г <sub>239</sub> | $\gamma f_0(1710) \rightarrow \gamma K \bar{K}$               | $(9.5 \pm 1.0_{-0.5}) \times 10^{-4}$    | S=1.5  | DESIG=91  |
| Г <sub>240</sub> | $\gamma f_0(1710) \rightarrow \gamma \pi \pi$                 | $(3.8 \pm 0.5) \times 10^{-4}$           |        | DESIG=135 |
| Г <sub>241</sub> | $\gamma f_0(1710) \rightarrow \gamma \omega \omega$           | $(3.1 \pm 1.0) \times 10^{-4}$           |        | DESIG=221 |
| Г <sub>242</sub> | $\gamma f_0(1710) \rightarrow \gamma \eta \eta$               | $(2.4 \pm 1.2_{-0.7}) \times 10^{-4}$    |        | DESIG=266 |
| Г <sub>243</sub> | $\gamma \eta$                                                 | $(1.108 \pm 0.027) \times 10^{-3}$       |        | DESIG=83  |
| Г <sub>244</sub> | $\gamma f_1(1420) \rightarrow \gamma K \bar{K} \pi$           | $(7.9 \pm 1.3) \times 10^{-4}$           |        | DESIG=175 |
| Г <sub>245</sub> | $\gamma f_1(1285)$                                            | $(6.1 \pm 0.8) \times 10^{-4}$           |        | DESIG=88  |
| Г <sub>246</sub> | $\gamma f_1(1510) \rightarrow \gamma \eta \pi^+ \pi^-$        | $(4.5 \pm 1.2) \times 10^{-4}$           |        | DESIG=141 |
| Г <sub>247</sub> | $\gamma f_2'(1525)$                                           | $(5.7 \pm 0.8_{-0.5}) \times 10^{-4}$    | S=1.5  | DESIG=87  |
| Г <sub>248</sub> | $\gamma f_2'(1525) \rightarrow \gamma K_S^0 K_S^0$            | $(8.0 \pm 0.7_{-0.5}) \times 10^{-5}$    |        | DESIG=374 |
| Г <sub>249</sub> | $\gamma f_2'(1525) \rightarrow \gamma \eta \eta$              | $(3.4 \pm 1.4) \times 10^{-5}$           |        | DESIG=268 |
| Г <sub>250</sub> | $\gamma f_2(1640) \rightarrow \gamma \omega \omega$           | $(2.8 \pm 1.8) \times 10^{-4}$           |        | DESIG=222 |
| Г <sub>251</sub> | $\gamma f_2(1910) \rightarrow \gamma \omega \omega$           | $(2.0 \pm 1.4) \times 10^{-4}$           |        | DESIG=223 |
| Г <sub>252</sub> | $\gamma f_0(1750) \rightarrow \gamma K_S^0 K_S^0$             | $(1.11 \pm 0.20_{-0.33}) \times 10^{-5}$ |        | DESIG=370 |
| Г <sub>253</sub> | $\gamma f_0(1710) \rightarrow \gamma \omega \phi$             | $(2.5 \pm 0.6) \times 10^{-4}$           |        | DESIG=262 |
| Г <sub>254</sub> | $\gamma f_2(1810) \rightarrow \gamma \eta \eta$               | $(5.4 \pm 3.5_{-2.4}) \times 10^{-5}$    |        | DESIG=269 |
| Г <sub>255</sub> | $\gamma f_2(1950) \rightarrow \gamma K^*(892) \bar{K}^*(892)$ | $(7.0 \pm 2.2) \times 10^{-4}$           |        | DESIG=144 |
| Г <sub>256</sub> | $\gamma K^*(892) \bar{K}^*(892)$                              | $(4.0 \pm 1.3) \times 10^{-3}$           |        | DESIG=145 |
| Г <sub>257</sub> | $\gamma \phi \phi$                                            | $(4.0 \pm 1.2) \times 10^{-4}$           | S=2.1  | DESIG=98  |
| Г <sub>258</sub> | $\gamma p \bar{p}$                                            | $(3.8 \pm 1.0) \times 10^{-4}$           |        | DESIG=90  |
| Г <sub>259</sub> | $\gamma \eta(2225)$                                           | $(3.14 \pm 0.50_{-0.19}) \times 10^{-4}$ |        | DESIG=126 |
| Г <sub>260</sub> | $\gamma \eta(1760) \rightarrow \gamma \rho^0 \rho^0$          | $(1.3 \pm 0.9) \times 10^{-4}$           |        | DESIG=125 |
| Г <sub>261</sub> | $\gamma \eta(1760) \rightarrow \gamma \omega \omega$          | $(1.98 \pm 0.33) \times 10^{-3}$         |        | DESIG=224 |
| Г <sub>262</sub> | $\gamma \eta(1760) \rightarrow \gamma \gamma \gamma$          | $< 4.80 \times 10^{-6}$                  | CL=90% | DESIG=347 |
| Г <sub>263</sub> | $\gamma X(1835) \rightarrow \gamma \pi^+ \pi^- \eta'$         | $(2.7 \pm 0.6_{-0.8}) \times 10^{-4}$    | S=1.6  | DESIG=213 |
| Г <sub>264</sub> | $\gamma X(1835) \rightarrow \gamma p \bar{p}$                 | $(7.7 \pm 1.5_{-0.9}) \times 10^{-5}$    |        | DESIG=254 |
| Г <sub>265</sub> | $\gamma X(1835) \rightarrow \gamma K_S^0 K_S^0 \eta$          | $(3.3 \pm 2.0_{-1.3}) \times 10^{-5}$    |        | DESIG=282 |
| Г <sub>266</sub> | $\gamma X(1835) \rightarrow \gamma \gamma \phi(1020)$         |                                          |        | DESIG=346 |
| Г <sub>267</sub> | $\gamma X(1835) \rightarrow \gamma \gamma \gamma$             | $< 3.56 \times 10^{-6}$                  | CL=90% | DESIG=350 |
| Г <sub>268</sub> | $\gamma X(2370) \rightarrow \gamma K^+ K^- \eta'$             | $(1.8 \pm 0.7) \times 10^{-5}$           |        | DESIG=388 |
| Г <sub>269</sub> | $\gamma X(2370) \rightarrow \gamma K_S^0 K_S^0 \eta'$         | $(1.2 \pm 0.5) \times 10^{-5}$           |        | DESIG=389 |
| Г <sub>270</sub> | $\gamma X(2370) \rightarrow \gamma \eta \eta \eta'$           | $< 9.2 \times 10^{-6}$                   | CL=90% | DESIG=390 |
| Г <sub>271</sub> | $\gamma X(1840) \rightarrow \gamma 3(\pi^+ \pi^-)$            | $(2.4 \pm 0.7_{-0.8}) \times 10^{-5}$    |        | DESIG=264 |
| Г <sub>272</sub> | $\gamma(K \bar{K} \pi) [J^{PC} = 0^- +]$                      | $(7 \pm 4) \times 10^{-4}$               | S=2.1  | DESIG=176 |
| Г <sub>273</sub> | $\gamma \pi^0$                                                | $(3.56 \pm 0.17) \times 10^{-5}$         |        | DESIG=82  |
| Г <sub>274</sub> | $\gamma p \bar{p} \pi^+ \pi^-$                                | $< 7.9 \times 10^{-4}$                   | CL=90% | DESIG=93  |
| Г <sub>275</sub> | $\gamma \Lambda \bar{\Lambda}$                                | $< 1.3 \times 10^{-4}$                   | CL=90% | DESIG=200 |
| Г <sub>276</sub> | $\gamma f_0(2100) \rightarrow \gamma \eta \eta$               | $(1.13 \pm 0.60_{-0.30}) \times 10^{-4}$ |        | DESIG=267 |
| Г <sub>277</sub> | $\gamma f_0(2100) \rightarrow \gamma \pi \pi$                 | $(6.2 \pm 1.0) \times 10^{-4}$           |        | DESIG=286 |
| Г <sub>278</sub> | $\gamma f_0(2200)$                                            |                                          |        | DESIG=123 |
| Г <sub>279</sub> | $\gamma f_0(2200) \rightarrow \gamma K \bar{K}$               | $(5.9 \pm 1.3) \times 10^{-4}$           |        | DESIG=285 |
| Г <sub>280</sub> | $\gamma f_0(2200) \rightarrow \gamma K_S^0 K_S^0$             | $(2.72 \pm 0.19_{-0.50}) \times 10^{-4}$ |        | DESIG=371 |
| Г <sub>281</sub> | $\gamma f_J(2220)$                                            |                                          |        | DESIG=92  |

|                |                                                   |                   |                  |        |           |
|----------------|---------------------------------------------------|-------------------|------------------|--------|-----------|
| $\Gamma_{282}$ | $\gamma f_J(2220) \rightarrow \gamma \pi \pi$     | $< 3.9$           | $\times 10^{-5}$ | CL=90% | DESIG=136 |
| $\Gamma_{283}$ | $\gamma f_J(2220) \rightarrow \gamma K \bar{K}$   | $< 4.1$           | $\times 10^{-5}$ | CL=90% | DESIG=137 |
| $\Gamma_{284}$ | $\gamma f_J(2220) \rightarrow \gamma p \bar{p}$   | $(1.5 \pm 0.8)$   | $\times 10^{-5}$ |        | DESIG=138 |
| $\Gamma_{285}$ | $\gamma f_0(2330) \rightarrow \gamma K_S^0 K_S^0$ | $(4.9 \pm 0.7)$   | $\times 10^{-5}$ |        | DESIG=372 |
| $\Gamma_{286}$ | $\gamma f_2(2340) \rightarrow \gamma \eta \eta$   | $(5.6 \pm 2.4)$   | $\times 10^{-5}$ |        | DESIG=270 |
| $\Gamma_{287}$ | $\gamma f_2(2340) \rightarrow \gamma K_S^0 K_S^0$ | $(5.5 \pm 4.0)$   | $\times 10^{-5}$ |        | DESIG=375 |
| $\Gamma_{288}$ | $\gamma f_0(1500) \rightarrow \gamma \pi \pi$     | $(1.09 \pm 0.24)$ | $\times 10^{-4}$ |        | DESIG=172 |
| $\Gamma_{289}$ | $\gamma f_0(1500) \rightarrow \gamma \eta \eta$   | $(1.7 \pm 0.6)$   | $\times 10^{-5}$ |        | DESIG=265 |
| $\Gamma_{290}$ | $\gamma A \rightarrow \gamma \text{invisible}$    | $[d] < 1.7$       | $\times 10^{-6}$ | CL=90% | DESIG=251 |
| $\Gamma_{291}$ | $\gamma A^0 \rightarrow \gamma \mu^+ \mu^-$       | $[e] < 5$         | $\times 10^{-6}$ | CL=90% | DESIG=259 |

**Dalitz decays**

|                |                                               |                   |                  |        |                   |
|----------------|-----------------------------------------------|-------------------|------------------|--------|-------------------|
| $\Gamma_{292}$ | $\pi^0 e^+ e^-$                               | $(7.6 \pm 1.4)$   | $\times 10^{-7}$ |        | NODE=M070;CLUMP=G |
| $\Gamma_{293}$ | $\eta e^+ e^-$                                | $(1.43 \pm 0.07)$ | $\times 10^{-5}$ |        | DESIG=271         |
| $\Gamma_{294}$ | $\eta'(958) e^+ e^-$                          | $(6.59 \pm 0.18)$ | $\times 10^{-5}$ |        | DESIG=272         |
| $\Gamma_{295}$ | $\eta U \rightarrow \eta e^+ e^-$             | $< 9.11$          | $\times 10^{-7}$ | CL=90% | DESIG=273         |
| $\Gamma_{296}$ | $\eta'(958) U \rightarrow \eta'(958) e^+ e^-$ | $< 2.0$           | $\times 10^{-7}$ | CL=90% | DESIG=352         |
| $\Gamma_{297}$ | $\phi e^+ e^-$                                | $< 1.2$           | $\times 10^{-7}$ | CL=90% | DESIG=366         |
|                |                                               |                   |                  |        | DESIG=384         |

**Weak decays**

|                |                                        |         |                  |        |                   |
|----------------|----------------------------------------|---------|------------------|--------|-------------------|
| $\Gamma_{298}$ | $D^- e^+ \nu_e + \text{c.c.}$          | $< 1.2$ | $\times 10^{-5}$ | CL=90% | NODE=M070;CLUMP=E |
| $\Gamma_{299}$ | $\bar{D}^0 e^+ e^- + \text{c.c.}$      | $< 8.5$ | $\times 10^{-8}$ | CL=90% | DESIG=218         |
| $\Gamma_{300}$ | $D_s^- e^+ \nu_e + \text{c.c.}$        | $< 1.3$ | $\times 10^{-6}$ | CL=90% | DESIG=219         |
| $\Gamma_{301}$ | $D_s^{*-} e^+ \nu_e + \text{c.c.}$     | $< 1.8$ | $\times 10^{-6}$ | CL=90% | DESIG=220         |
| $\Gamma_{302}$ | $D^- \pi^+ + \text{c.c.}$              | $< 7.5$ | $\times 10^{-5}$ | CL=90% | DESIG=290         |
| $\Gamma_{303}$ | $\bar{D}^0 \bar{K}^0 + \text{c.c.}$    | $< 1.7$ | $\times 10^{-4}$ | CL=90% | DESIG=241         |
| $\Gamma_{304}$ | $\bar{D}^0 \bar{K}^{*0} + \text{c.c.}$ | $< 2.5$ | $\times 10^{-6}$ | CL=90% | DESIG=242         |
| $\Gamma_{305}$ | $D_s^- \pi^+ + \text{c.c.}$            | $< 1.3$ | $\times 10^{-4}$ | CL=90% | DESIG=275         |
| $\Gamma_{306}$ | $D_s^- \rho^+ + \text{c.c.}$           | $< 1.3$ | $\times 10^{-5}$ | CL=90% | DESIG=243         |
|                |                                        |         |                  |        | DESIG=274         |

**Charge conjugation (C), Parity (P),  
Lepton Family number (LF) violating modes**

|                |                                 |    |         |                  |        |                   |
|----------------|---------------------------------|----|---------|------------------|--------|-------------------|
| $\Gamma_{307}$ | $\gamma \gamma$                 | C  | $< 2.7$ | $\times 10^{-7}$ | CL=90% | NODE=M070;CLUMP=D |
| $\Gamma_{308}$ | $\gamma \phi$                   | C  | $< 1.4$ | $\times 10^{-6}$ | CL=90% | DESIG=80          |
| $\Gamma_{309}$ | $e^\pm \mu^\mp$                 | LF | $< 1.6$ | $\times 10^{-7}$ | CL=90% | DESIG=277         |
| $\Gamma_{310}$ | $e^\pm \tau^\mp$                | LF | $< 8.3$ | $\times 10^{-6}$ | CL=90% | DESIG=177         |
| $\Gamma_{311}$ | $\mu^\pm \tau^\mp$              | LF | $< 2.0$ | $\times 10^{-6}$ | CL=90% | DESIG=178         |
| $\Gamma_{312}$ | $\Lambda_c^+ e^- + \text{c.c.}$ |    | $< 6.9$ | $\times 10^{-8}$ | CL=90% | DESIG=179         |
|                |                                 |    |         |                  |        | DESIG=379         |

**Other decays**

|                |           |       |                  |        |                   |
|----------------|-----------|-------|------------------|--------|-------------------|
| $\Gamma_{313}$ | invisible | $< 7$ | $\times 10^{-4}$ | CL=90% | NODE=M070;CLUMP=F |
|                |           |       |                  |        | DESIG=240         |

[a] For  $E_\gamma > 100$  MeV.

[b] The value is for the sum of the charge states or particle/antiparticle states indicated.

[c] Includes  $p \bar{p} \pi^+ \pi^- \gamma$  and excludes  $p \bar{p} \eta$ ,  $p \bar{p} \omega$ ,  $p \bar{p} \eta'$ .

[d] For a narrow state A with mass less than 960 MeV.

[e] For a narrow scalar or pseudoscalar  $A^0$  with mass 0.21–3.0 GeV.**J/ψ(1S) PARTIAL WIDTHS****Γ(hadrons)**

| VALUE (keV)                                                                   | DOCUMENT ID          | TECN     | COMMENT   |
|-------------------------------------------------------------------------------|----------------------|----------|-----------|
| <b>81.37 ± 1.36 ± 1.30</b>                                                    | <sup>1</sup> ANASHIN | 20 KEDR  | $e^+ e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |          |           |
| 74.1 ± 8.1                                                                    | BAI                  | 95B BES  | $e^+ e^-$ |
| 59 ± 24                                                                       | BALDINI-...          | 75 FRAG  | $e^+ e^-$ |
| 59 ± 14                                                                       | BOYARSKI             | 75 MRK1  | $e^+ e^-$ |
| 50 ± 25                                                                       | ESPOSITO             | 75B FRAM | $e^+ e^-$ |

<sup>1</sup> Based on the same dataset as ANASHIN 18A and correlated to the values reported there**Γ<sub>1</sub>**NODE=M070W3  
NODE=M070W3

NODE=M070W3;LINKAGE=A

$\Gamma(e^+e^-)$  $\Gamma_5$ 

| VALUE (keV)                                                                   | EVTS | DOCUMENT ID   | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------|------|---------------|----------|---------------------------------------------|
| <b>5.53 <math>\pm 0.10</math> OUR AVERAGE</b>                                 |      |               |          |                                             |
| 5.550 $\pm 0.056 \pm 0.089$                                                   | 1,2  | ANASHIN       | 18A KEDR | $e^+e^-$                                    |
| 5.36 $^{+0.29}_{-0.28}$                                                       | 3    | HSUEH         | 92 RVUE  | See $\mathcal{T}$ mini-review               |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |               |          |                                             |
| 5.58 $\pm 0.05 \pm 0.08$                                                      | 4    | ABLIKIM       | 16Q BES3 | $3.773 e^+e^- \rightarrow \mu^+\mu^-\gamma$ |
| 5.71 $\pm 0.16$                                                               | 13k  | 5 ADAMS       | 06A CLEO | $e^+e^- \rightarrow \mu^+\mu^-\gamma$       |
| 5.57 $\pm 0.19$                                                               | 7.8k | 5 AUBERT      | 04 BABR  | $e^+e^- \rightarrow \mu^+\mu^-\gamma$       |
| 5.14 $\pm 0.39$                                                               |      | BAI           | 95B BES  | $e^+e^-$                                    |
| 4.72 $\pm 0.35$                                                               |      | ALEXANDER     | 89 RVUE  | See $\mathcal{T}$ mini-review               |
| 4.4 $\pm 0.6$                                                                 |      | 3 BRANDELIK   | 79C DASP | $e^+e^-$                                    |
| 4.6 $\pm 0.8$                                                                 |      | 6 BALDINI-... | 75 FRAG  | $e^+e^-$                                    |
| 4.8 $\pm 0.6$                                                                 |      | BOYARSKI      | 75 MRK1  | $e^+e^-$                                    |
| 4.6 $\pm 1.0$                                                                 |      | ESPOSITO      | 75B FRAM | $e^+e^-$                                    |

<sup>1</sup> From the cross sections of  $e^+e^- \rightarrow e^+e^-$  and  $e^+e^- \rightarrow$  hadrons near the  $J/\psi(1S)$  peak.

<sup>2</sup> Based on the same dataset as ANASHIN 20 and correlated to the values reported there.

<sup>3</sup> From a simultaneous fit to  $e^+e^-$ ,  $\mu^+\mu^-$ , and hadronic channels assuming  $\Gamma(e^+e^-) = \Gamma(\mu^+\mu^-)$ .

<sup>4</sup> Using  $B(J/\psi \rightarrow \mu^+\mu^-) = (5.973 \pm 0.007 \pm 0.037)\%$  from ABLIKIM 13R.

<sup>5</sup> Calculated by us from the reported values of  $\Gamma(e^+e^-) \times B(\mu^+\mu^-)$  using  $B(\mu^+\mu^-) = (5.93 \pm 0.06)\%$ .

<sup>6</sup> Assuming equal partial widths for  $e^+e^-$  and  $\mu^+\mu^-$ .

NODE=M070W1  
NODE=M070W1

OCCUR=4

NODE=M070W1;LINKAGE=D

NODE=M070W1;LINKAGE=E  
NODE=M070W1;LINKAGE=F

NODE=M070W1;LINKAGE=A  
NODE=M070W1;LINKAGE=AA

NODE=M070W1;LINKAGE=B

 $\Gamma(\mu^+\mu^-)$  $\Gamma_7$ 

| VALUE (keV)                                                                   | DOCUMENT ID | TECN     | COMMENT  |
|-------------------------------------------------------------------------------|-------------|----------|----------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |          |          |
| 5.13 $\pm 0.52$                                                               | BAI         | 95B BES  | $e^+e^-$ |
| 4.8 $\pm 0.6$                                                                 | BOYARSKI    | 75 MRK1  | $e^+e^-$ |
| 5 $\pm 1$                                                                     | ESPOSITO    | 75B FRAM | $e^+e^-$ |

NODE=M070W2  
NODE=M070W2

 $\Gamma(\gamma\gamma)$  $\Gamma_{307}$ 

| VALUE (eV)     | CL% | DOCUMENT ID | TECN     | COMMENT  |
|----------------|-----|-------------|----------|----------|
| <b>&lt;5.4</b> | 90  | BRANDELIK   | 79C DASP | $e^+e^-$ |

NODE=M070W70  
NODE=M070W70

 $J/\psi(1S) \Gamma(i) \Gamma(e^+e^-) / \Gamma(\text{total})$ 

NODE=M070225

This combination of a partial width with the partial width into  $e^+e^-$  and with the total width is obtained from the integrated cross section into channel  $i$  in the  $e^+e^-$  annihilation.

NODE=M070225

 $\Gamma(\text{hadrons}) \times \Gamma(e^+e^-) / \Gamma_{\text{total}}$  $\Gamma_1 \Gamma_5 / \Gamma$ 

| VALUE (keV)                                                                   | DOCUMENT ID | TECN        | COMMENT           |
|-------------------------------------------------------------------------------|-------------|-------------|-------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |             |                   |
| 4.884 $\pm 0.048 \pm 0.078$                                                   | 1,2         | ANASHIN     | 18A KEDR $e^+e^-$ |
| 4 $\pm 0.8$                                                                   | 3           | BALDINI-... | 75 FRAG $e^+e^-$  |
| 3.9 $\pm 0.8$                                                                 | 3           | ESPOSITO    | 75B FRAM $e^+e^-$ |

<sup>1</sup> From the cross sections of  $e^+e^- \rightarrow e^+e^-$  and  $e^+e^- \rightarrow$  hadrons near the  $J/\psi(1S)$  peak.

<sup>2</sup> Based on the same dataset as ANASHIN 20 and correlated to the values reported there.

<sup>3</sup> Data redundant with branching ratios or partial widths above.

NODE=M070G3;LINKAGE=A

NODE=M070G3;LINKAGE=B  
NODE=M070G3;LINKAGE=S

 $\Gamma(e^+e^-) \times \Gamma(e^+e^-) / \Gamma_{\text{total}}$  $\Gamma_5 \Gamma_5 / \Gamma$ 

| VALUE (eV)                                                                    | DOCUMENT ID | TECN        | COMMENT                                   |
|-------------------------------------------------------------------------------|-------------|-------------|-------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |             |                                           |
| 333.1 $\pm 6.6 \pm 4.0$                                                       | 1,2         | ANASHIN     | 18A KEDR $e^+e^-$                         |
| 332.3 $\pm 6.4 \pm 4.8$                                                       |             | ANASHIN     | 10 KEDR $3.097 e^+e^- \rightarrow e^+e^-$ |
| 350 $\pm 20$                                                                  |             | BRANDELIK   | 79C DASP $e^+e^-$                         |
| 320 $\pm 70$                                                                  | 3           | BALDINI-... | 75 FRAG $e^+e^-$                          |
| 340 $\pm 90$                                                                  | 3           | ESPOSITO    | 75B FRAM $e^+e^-$                         |
| 360 $\pm 100$                                                                 | 3           | FORD        | 75 SPEC $e^+e^-$                          |

<sup>1</sup> From the cross sections of  $e^+e^- \rightarrow e^+e^-$  and  $e^+e^- \rightarrow$  hadrons near the  $J/\psi(1S)$  peak.

<sup>2</sup> Based on the same dataset as ANASHIN 20 and correlated to the values reported there.

<sup>3</sup> Data redundant with branching ratios or partial widths above.

NODE=M070G1  
NODE=M070G1

OCCUR=2

NODE=M070G1;LINKAGE=A

NODE=M070G1;LINKAGE=B  
NODE=M070G1;LINKAGE=S

$$\Gamma(\mu^+\mu^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_7\Gamma_5/\Gamma$$

| VALUE (eV)                                                                    | EVTS | DOCUMENT ID           | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------|------|-----------------------|----------|---------------------------------------------|
| <b>333 ± 4 OUR AVERAGE</b>                                                    |      |                       |          |                                             |
| 333.4 ± 2.5 ± 4.4                                                             |      | ABLIKIM               | 16Q BES3 | 3.773 $e^+e^- \rightarrow \mu^+\mu^-\gamma$ |
| 331.8 ± 5.2 ± 6.3                                                             |      | ANASHIN               | 10 KEDR  | 3.097 $e^+e^- \rightarrow \mu^+\mu^-$       |
| 338.4 ± 5.8 ± 7.1 13k                                                         |      | ADAMS                 | 06A CLEO | $e^+e^- \rightarrow \mu^+\mu^-\gamma$       |
| 330.1 ± 7.7 ± 7.3 7.8k                                                        |      | AUBERT                | 04 BABR  | $e^+e^- \rightarrow \mu^+\mu^-\gamma$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |          |                                             |
| 510 ± 90                                                                      |      | DASP                  | 75 DASP  | $e^+e^-$                                    |
| 380 ± 50                                                                      |      | <sup>1</sup> ESPOSITO | 75B FRAM | $e^+e^-$                                    |

<sup>1</sup> Data redundant with branching ratios or partial widths above.

NODE=M070G2  
NODE=M070G2

NODE=M070G2;LINKAGE=S

$$\Gamma(\rho(770)^\mp K^\pm K_S^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{10}\Gamma_5/\Gamma$$

| VALUE (eV)              | EVTS | DOCUMENT ID | TECN     | COMMENT                                               |
|-------------------------|------|-------------|----------|-------------------------------------------------------|
| <b>10.4 ± 1.0 ± 1.9</b> | 130  | LEES        | 17D BABR | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp \pi^0 \gamma$ |

NODE=M070G31  
NODE=M070G31

$$\Gamma(\omega\pi^+\pi^-\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{23}\Gamma_5/\Gamma$$

| VALUE (10 <sup>-2</sup> keV) | EVTS | DOCUMENT ID | TECN     | COMMENT                                               |
|------------------------------|------|-------------|----------|-------------------------------------------------------|
| <b>2.2 ± 0.3 ± 0.2</b>       | 170  | AUBERT      | 06D BABR | 10.6 $e^+e^- \rightarrow \omega\pi^+\pi^-\pi^0\gamma$ |

NODE=M070G8  
NODE=M070G8

$$\Gamma(\omega\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{24}\Gamma_5/\Gamma$$

| VALUE (eV)              | EVTS | DOCUMENT ID         | TECN      | COMMENT                                          |
|-------------------------|------|---------------------|-----------|--------------------------------------------------|
| <b>53.6 ± 5.0 ± 0.4</b> | 788  | <sup>1</sup> AUBERT | 07AU BABR | 10.6 $e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$ |

NODE=M070G24  
NODE=M070G24

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(J/\psi(1S) \rightarrow \omega\pi^+\pi^-) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow \pi^+\pi^-\pi^0)] = 47.8 \pm 3.1 \pm 3.2$  eV which we divide by our best value  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G24;LINKAGE=AU

$$\Gamma(\omega\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{62}\Gamma_5/\Gamma$$

| VALUE (eV)              | EVTS | DOCUMENT ID       | TECN     | COMMENT                                         |
|-------------------------|------|-------------------|----------|-------------------------------------------------|
| <b>27.8 ± 3.5 ± 0.2</b> | 398  | <sup>1</sup> LEES | 18E BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$ |

NODE=M070P54  
NODE=M070P54

<sup>1</sup> LEES 18E reports  $[\Gamma(J/\psi(1S) \rightarrow \omega\pi^0\pi^0) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow \pi^+\pi^-\pi^0)] = 24.8 \pm 1.8 \pm 2.5$  eV which we divide by our best value  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070P54;LINKAGE=A

$$\Gamma(K^*(892)^0 \bar{K}^*(892)^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{26}\Gamma_5/\Gamma$$

| VALUE (eV)                | EVTS    | DOCUMENT ID       | TECN     | COMMENT                                             |
|---------------------------|---------|-------------------|----------|-----------------------------------------------------|
| <b>1.28 ± 0.34 ± 0.07</b> | 47 ± 12 | <sup>1</sup> LEES | 12F BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^- K^+ K^- \gamma$ |

NODE=M070G01  
NODE=M070G01

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.28 ± 0.40 ± 0.11 25 ± 8 <sup>1,2</sup> AUBERT 07AK BABR 10.6  $e^+e^- \rightarrow \pi^+\pi^- K^+ K^- \gamma$

<sup>1</sup> Dividing by  $(2/3)^2$  to take twice into account that  $B(K^{*0} \rightarrow K^+\pi^-) = 2/3 B(K^{*0} \rightarrow K\pi)$ .

NODE=M070G01;LINKAGE=AE

<sup>2</sup> Superseded by LEES 12F.

NODE=M070G01;LINKAGE=A

$$\Gamma(K^*(892)^\pm K^*(892)^\mp) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{27}\Gamma_5/\Gamma$$

| VALUE (eV)                | EVTS  | DOCUMENT ID       | TECN     | COMMENT                                            |
|---------------------------|-------|-------------------|----------|----------------------------------------------------|
| <b>0.80 ± 0.48 ± 0.32</b> | 1 ± 5 | <sup>1</sup> LEES | 14H BABR | $e^+e^- \rightarrow \pi^+\pi^- K_S^0 K_S^0 \gamma$ |

NODE=M070GY8  
NODE=M070GY8

<sup>1</sup> Dividing by  $(1/4)^2$  to take twice into account  $B(K^*(892) \rightarrow K_S^0 \pi) = 1/4$ .

NODE=M070GY8;LINKAGE=A

$$\Gamma(K_S^0 \pi^- K^*(892)^+ + \text{c.c.}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{29}\Gamma_5/\Gamma$$

| VALUE (eV)                    | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------------------------|------|-------------|------|---------|
| <b>11.0 ± 2.8 OUR AVERAGE</b> |      |             |      |         |

NODE=M070GY4  
NODE=M070GY4

|                  |    |                   |          |                                                       |
|------------------|----|-------------------|----------|-------------------------------------------------------|
| 9.2 ± 1.2 ± 3.2  | 64 | <sup>1</sup> LEES | 17D BABR | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp \pi^0 \gamma$ |
| 14.8 ± 4.8 ± 1.2 | 53 | <sup>2</sup> LEES | 14H BABR | $e^+e^- \rightarrow \pi^+\pi^- K_S^0 K_S^0 \gamma$    |

<sup>1</sup> Dividing by 1/2 to take into account  $B(K^*(892)^\pm \rightarrow K^\pm \pi^\mp) = 1/2$ .

NODE=M070GY4;LINKAGE=B

<sup>2</sup> Dividing by 1/4 to take into account  $B(K^*(892) \rightarrow K_S^0 \pi) = 1/4$ .

NODE=M070GY4;LINKAGE=A

$$\Gamma(K_S^0 \pi^- K^*(892)^+ + \text{c.c.} \rightarrow K_S^0 K_S^0 \pi^+ \pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$$

$$\Gamma_{30}\Gamma_5/\Gamma$$

| VALUE (eV)             | EVTS | DOCUMENT ID | TECN     | COMMENT                                            |
|------------------------|------|-------------|----------|----------------------------------------------------|
| <b>3.7 ± 1.2 ± 0.3</b> | 53   | LEES        | 14H BABR | $e^+e^- \rightarrow \pi^+\pi^- K_S^0 K_S^0 \gamma$ |

NODE=M070GY5  
NODE=M070GY5

$$\Gamma(K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{46} \Gamma_5 / \Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                  |     |            |          |                                                                                                    |
|------------------|-----|------------|----------|----------------------------------------------------------------------------------------------------|
| 25.8 ± 1.4 ± 0.6 | 710 | 1,2,3 LEES | 12F BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> K <sup>+</sup> K <sup>-</sup> γ |
|------------------|-----|------------|----------|----------------------------------------------------------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|            |     |            |           |                                                                                                    |
|------------|-----|------------|-----------|----------------------------------------------------------------------------------------------------|
| 33 ± 4 ± 1 | 317 | 2,4 AUBERT | 07AK BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> K <sup>+</sup> K <sup>-</sup> γ |
|------------|-----|------------|-----------|----------------------------------------------------------------------------------------------------|

<sup>1</sup> LEES 12F reports  $[\Gamma(J/\psi(1S) \rightarrow K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(K_2^*(1430) \rightarrow K\pi)] = 12.89 \pm 0.54 \pm 0.41 \text{ eV}$  which we divide by our best value  $B(K_2^*(1430) \rightarrow K\pi) = (49.9 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Dividing by 2/3 to take into account that  $B(K^*0 \rightarrow K^+ \pi^-) = 2/3 B(K^*0 \rightarrow K\pi)$ .

<sup>3</sup> The  $K_2^*(1430)$  cannot be distinguished from the  $K_0^*(1430)$ .

<sup>4</sup> Superseded by LEES 12F. AUBERT 07AK reports  $[\Gamma(J/\psi(1S) \rightarrow K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(K_2^*(1430) \rightarrow K\pi)] = 16.4 \pm 1.1 \pm 1.4 \text{ eV}$  which we divide by our best value  $B(K_2^*(1430) \rightarrow K\pi) = (49.9 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G02  
NODE=M070G02

NODE=M070G02;LINKAGE=A

NODE=M070G02;LINKAGE=AE

NODE=M070G02;LINKAGE=B

NODE=M070G02;LINKAGE=UB

$$\Gamma(K^*(892)^+ K_2^*(1430)^- + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{47} \Gamma_5 / \Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                   |       |          |          |                                                                                                                         |
|-------------------|-------|----------|----------|-------------------------------------------------------------------------------------------------------------------------|
| 18.6 ± 16.1 ± 0.4 | 8 ± 8 | 1,2 LEES | 14H BABR | e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> K <sub>S</sub> <sup>0</sup> K <sub>S</sub> <sup>0</sup> γ |
|-------------------|-------|----------|----------|-------------------------------------------------------------------------------------------------------------------------|

<sup>1</sup> Dividing by (1/4)<sup>2</sup> to take into account  $B(K^*(892) \rightarrow K_S^0 \pi) = 1/4$  and  $B(K^*(1430) \rightarrow K_S^0 \pi) = 1/4 B(K^*(1430) \rightarrow K\pi)$ .

<sup>2</sup> LEES 14H reports  $[\Gamma(J/\psi(1S) \rightarrow K^*(892)^+ K_2^*(1430)^- + \text{c.c.}) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(K_2^*(1430) \rightarrow K\pi)] = 9.28 \pm 8.0 \pm 0.32 \text{ eV}$  which we divide by our best value  $B(K_2^*(1430) \rightarrow K\pi) = (49.9 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070GY9  
NODE=M070GY9

NODE=M070GY9;LINKAGE=A

NODE=M070GY9;LINKAGE=B

$$\Gamma(K^*(892)^+ K_2^*(1430)^- + \text{c.c.} \rightarrow K^*(892)^+ K_S^0 \pi^- + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{48} \Gamma_5 / \Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                    |       |                   |          |                                                                                                                         |
|--------------------|-------|-------------------|----------|-------------------------------------------------------------------------------------------------------------------------|
| 2.32 ± 2.00 ± 0.08 | 8 ± 8 | <sup>1</sup> LEES | 14H BABR | e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> K <sub>S</sub> <sup>0</sup> K <sub>S</sub> <sup>0</sup> γ |
|--------------------|-------|-------------------|----------|-------------------------------------------------------------------------------------------------------------------------|

<sup>1</sup> Dividing by 1/4 to take into account  $B(K^*(892) \rightarrow K_S^0 \pi) = 1/4$ .

NODE=M070GZ0  
NODE=M070GZ0

NODE=M070GZ0;LINKAGE=A

$$\Gamma(K^*(892)^0 \bar{K}_2^*(1770)^0 + \text{c.c.} \rightarrow K^*(892)^0 K^- \pi^+ + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{49} \Gamma_5 / \Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                 |          |                     |           |                                                                                                    |
|-----------------|----------|---------------------|-----------|----------------------------------------------------------------------------------------------------|
| 3.8 ± 0.4 ± 0.3 | 110 ± 14 | <sup>1</sup> AUBERT | 07AK BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> K <sup>+</sup> K <sup>-</sup> γ |
|-----------------|----------|---------------------|-----------|----------------------------------------------------------------------------------------------------|

<sup>1</sup> Dividing by 2/3 to take into account that  $B(K^*0 \rightarrow K^+ \pi^-) = 2/3$ .

NODE=M070G03  
NODE=M070G03

NODE=M070G03;LINKAGE=AE

$$\Gamma(K^+ K^*(892)^- + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{53} \Gamma_5 / \Gamma$$

| VALUE (eV) | DOCUMENT ID | TECN | COMMENT |
|------------|-------------|------|---------|
|------------|-------------|------|---------|

|                  |        |          |                                                                                         |
|------------------|--------|----------|-----------------------------------------------------------------------------------------|
| 29.0 ± 1.7 ± 1.3 | AUBERT | 08S BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>*</sup> (892) <sup>-</sup> γ |
|------------------|--------|----------|-----------------------------------------------------------------------------------------|

NODE=M070G18  
NODE=M070G18

$$\Gamma(K^+ K^*(892)^- + \text{c.c.} \rightarrow K^+ K^- \pi^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{54} \Gamma_5 / \Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                     |     |        |          |                                                                                     |
|---------------------|-----|--------|----------|-------------------------------------------------------------------------------------|
| 10.96 ± 0.85 ± 0.70 | 155 | AUBERT | 08S BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → K <sup>+</sup> K <sup>-</sup> π <sup>0</sup> γ |
|---------------------|-----|--------|----------|-------------------------------------------------------------------------------------|

NODE=M070G20  
NODE=M070G20

$$\Gamma(K^+ K^*(892)^- + \text{c.c.} \rightarrow K^+ K^- \pi^0) / \Gamma_{\text{total}} \quad \Gamma_{54} / \Gamma$$

| VALUE (units 10 <sup>-3</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
|---------------------------------|------|-------------|------|---------|

|                                               |      |         |          |                                                    |
|-----------------------------------------------|------|---------|----------|----------------------------------------------------|
| 2.69 ± 0.01 <sup>+0.13</sup> <sub>-0.20</sub> | 183k | ABLIKIM | 19AQ BES | J/ψ → K <sup>+</sup> K <sup>-</sup> π <sup>0</sup> |
|-----------------------------------------------|------|---------|----------|----------------------------------------------------|

NODE=M070P79  
NODE=M070P79

$$\Gamma(K^+ K^*(892)^- + \text{c.c.} \rightarrow K^0 K^\pm \pi^\mp + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{55} \Gamma_5 / \Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                     |    |        |          |                                                                                                  |
|---------------------|----|--------|----------|--------------------------------------------------------------------------------------------------|
| 16.76 ± 1.70 ± 1.00 | 89 | AUBERT | 08S BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → K <sub>S</sub> <sup>0</sup> K <sup>±</sup> π <sup>∓</sup> γ |
|---------------------|----|--------|----------|--------------------------------------------------------------------------------------------------|

NODE=M070G21  
NODE=M070G21

$$\Gamma(K^0 \bar{K}^*(892)^0 + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{56} \Gamma_5 / \Gamma$$

| VALUE (eV) | DOCUMENT ID | TECN | COMMENT |
|------------|-------------|------|---------|
|------------|-------------|------|---------|

|                  |        |          |                                                                                         |
|------------------|--------|----------|-----------------------------------------------------------------------------------------|
| 26.6 ± 2.5 ± 1.5 | AUBERT | 08S BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → K <sup>0</sup> K <sup>*</sup> (892) <sup>0</sup> γ |
|------------------|--------|----------|-----------------------------------------------------------------------------------------|

NODE=M070G19  
NODE=M070G19



$$\Gamma(K^0 \bar{K}^*(892)^0 + \text{c.c.} \rightarrow K^0 K^\pm \pi^\mp + \text{c.c.}) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{57} \Gamma_5/\Gamma$$

| VALUE (eV)                | EVTS | DOCUMENT ID | TECN | COMMENT                                                                   |
|---------------------------|------|-------------|------|---------------------------------------------------------------------------|
| $17.70 \pm 1.70 \pm 1.00$ | 94   | AUBERT      | 08S  | BABR $10.6 \text{ e}^+ \text{e}^- \rightarrow K_S^0 K^\pm \pi^\mp \gamma$ |

NODE=M070G22  
NODE=M070G22

$$\Gamma(K_S^0 K^*(892)^0 \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}} \quad \Gamma_{31}/\Gamma$$

| VALUE (units $10^{-6}$ )         | DOCUMENT ID | TECN | COMMENT                                      |
|----------------------------------|-------------|------|----------------------------------------------|
| $6.28^{+0.16+0.59}_{-0.17-0.52}$ | ABLIKIM     | 18AA | BES3 $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

NODE=M070P71  
NODE=M070P71

$$\Gamma(\bar{K}^*(892)^0 K^+ \pi^- + \text{c.c.}) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{59} \Gamma_5/\Gamma$$

| VALUE (eV)             | EVTS | DOCUMENT ID       | TECN | COMMENT                                                     |
|------------------------|------|-------------------|------|-------------------------------------------------------------|
| $42.6 \pm 4.8 \pm 7.2$ | 99   | <sup>1</sup> LEES | 17D  | BABR $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp \pi^0 \gamma$ |

NODE=M070G39  
NODE=M070G39

<sup>1</sup> Dividing by 1/6 to account for  $B(K^*(892)^0 \rightarrow K_S^0 \pi^0) = 1/6$ .

NODE=M070G39;LINKAGE=A

$$\Gamma(K^*(892)^\pm K^\mp \pi^0) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{60} \Gamma_5/\Gamma$$

| VALUE (eV)             | EVTS | DOCUMENT ID       | TECN | COMMENT                                                     |
|------------------------|------|-------------------|------|-------------------------------------------------------------|
| $22.8 \pm 2.8 \pm 6.8$ | 80   | <sup>1</sup> LEES | 17D  | BABR $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp \pi^0 \gamma$ |

NODE=M070G32  
NODE=M070G32

<sup>1</sup> Dividing by 1/4 to account for  $B(K^*(892)^\pm \rightarrow K_S^0 \pi^\pm) = 1/4$ .

NODE=M070G32;LINKAGE=A

$$\Gamma(K_2^*(1430)^+ K^- + \text{c.c.} \rightarrow K^+ K^- \pi^0)/\Gamma_{\text{total}} \quad \Gamma_{32}/\Gamma$$

| VALUE (units $10^{-4}$ )        | EVTS | DOCUMENT ID | TECN | COMMENT                                |
|---------------------------------|------|-------------|------|----------------------------------------|
| $2.69 \pm 0.04^{+0.25}_{-0.19}$ | 183k | ABLIKIM     | 19AQ | BES $J/\psi \rightarrow K^+ K^- \pi^0$ |

NODE=M070P76  
NODE=M070P76

$$\Gamma(K_2^*(1980)^+ K^- + \text{c.c.} \rightarrow K^+ K^- \pi^0)/\Gamma_{\text{total}} \quad \Gamma_{33}/\Gamma$$

| VALUE (units $10^{-5}$ )    | EVTS | DOCUMENT ID | TECN | COMMENT                                |
|-----------------------------|------|-------------|------|----------------------------------------|
| $1.1 \pm 0.1^{+0.6}_{-0.1}$ | 183k | ABLIKIM     | 19AQ | BES $J/\psi \rightarrow K^+ K^- \pi^0$ |

NODE=M070P77  
NODE=M070P77

$$\Gamma(K_4^*(2045)^+ K^- + \text{c.c.} \rightarrow K^+ K^- \pi^0)/\Gamma_{\text{total}} \quad \Gamma_{34}/\Gamma$$

| VALUE (units $10^{-6}$ )    | EVTS | DOCUMENT ID | TECN | COMMENT                                |
|-----------------------------|------|-------------|------|----------------------------------------|
| $6.2 \pm 0.7^{+2.8}_{-1.4}$ | 183k | ABLIKIM     | 19AQ | BES $J/\psi \rightarrow K^+ K^- \pi^0$ |

NODE=M070P78  
NODE=M070P78

$$\Gamma(K^*(892)^0 K_S^0 \pi^0) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{61} \Gamma_5/\Gamma$$

| VALUE (eV)               | EVTS | DOCUMENT ID       | TECN | COMMENT                                                     |
|--------------------------|------|-------------------|------|-------------------------------------------------------------|
| $3.60 \pm 0.75 \pm 2.25$ | 34   | <sup>1</sup> LEES | 17D  | BABR $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp \pi^0 \gamma$ |

NODE=M070G33  
NODE=M070G33

<sup>1</sup> Dividing by 2/3 to account for  $B(K^*(892)^0 \rightarrow K^+ \pi^-) = 2/3$ .

NODE=M070G33;LINKAGE=A

$$\Gamma(\eta K^\pm K_S^0 \pi^\mp) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{67} \Gamma_5/\Gamma$$

| VALUE (eV)            | EVTS | DOCUMENT ID | TECN | COMMENT                                                     |
|-----------------------|------|-------------|------|-------------------------------------------------------------|
| $7.3 \pm 1.4 \pm 0.4$ | 44   | LEES        | 17D  | BABR $e^+ e^- \rightarrow K_S^0 K^\pm \pi^\mp \pi^0 \gamma$ |

NODE=M070G38  
NODE=M070G38

$$\Gamma(\omega K \bar{K}) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{69} \Gamma_5/\Gamma$$

| VALUE (eV)               | EVTS | DOCUMENT ID         | TECN | COMMENT                                                              |
|--------------------------|------|---------------------|------|----------------------------------------------------------------------|
| $3.70 \pm 1.98 \pm 0.03$ | 24   | <sup>1</sup> AUBERT | 07AU | BABR $10.6 \text{ e}^+ \text{e}^- \rightarrow \omega K^+ K^- \gamma$ |

NODE=M070G29  
NODE=M070G29

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(J/\psi(1S) \rightarrow \omega K \bar{K}) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow \pi^+ \pi^- \pi^0)] = 3.3 \pm 1.3 \pm 1.2 \text{ eV}$  which we divide by our best value  $B(\omega(782) \rightarrow \pi^+ \pi^- \pi^0) = (89.2 \pm 0.7) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G29;LINKAGE=AU

$$\Gamma(\phi 2(\pi^+ \pi^-)) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{71} \Gamma_5/\Gamma$$

| VALUE ( $10^{-2} \text{ keV}$ ) | EVTS | DOCUMENT ID         | TECN | COMMENT                                                                   |
|---------------------------------|------|---------------------|------|---------------------------------------------------------------------------|
| $0.95 \pm 0.19 \pm 0.01$        | 35   | <sup>1</sup> AUBERT | 06D  | BABR $10.6 \text{ e}^+ \text{e}^- \rightarrow \phi 2(\pi^+ \pi^-) \gamma$ |

NODE=M070G10  
NODE=M070G10

<sup>1</sup> AUBERT 06D reports  $[\Gamma(J/\psi(1S) \rightarrow \phi 2(\pi^+ \pi^-)) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+ K^-)] = (0.47 \pm 0.09 \pm 0.03) \times 10^{-2} \text{ keV}$  which we divide by our best value  $B(\phi(1020) \rightarrow K^+ K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G10;LINKAGE=AU

$$\Gamma(\phi K_S^0 K_S^0) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{76} \Gamma_5 / \Gamma$$

| VALUE (eV)            | EVTS | DOCUMENT ID       | TECN     | COMMENT                                          |
|-----------------------|------|-------------------|----------|--------------------------------------------------|
| <b>3.25±0.84±0.03</b> | 29   | <sup>1</sup> LEES | 14H BABR | $e^+ e^- \rightarrow K_S^0 K_S^0 K^+ K^- \gamma$ |

<sup>1</sup> LEES 14H reports  $[\Gamma(J/\psi(1S) \rightarrow \phi K_S^0 K_S^0) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+ K^-)] = 1.6 \pm 0.4 \pm 0.1$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+ K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070GZ1  
NODE=M070GZ1

NODE=M070GZ1;LINKAGE=A

$$\Gamma(\phi K^+ K^-) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{78} \Gamma_5 / \Gamma$$

| VALUE (eV)            | EVTS | DOCUMENT ID       | TECN     | COMMENT                                           |
|-----------------------|------|-------------------|----------|---------------------------------------------------|
| <b>4.59±0.62±0.05</b> | 163  | <sup>1</sup> LEES | 12F BABR | $10.6 e^+ e^- \rightarrow K^+ K^- K^+ K^- \gamma$ |

<sup>1</sup> LEES 12F reports  $[\Gamma(J/\psi(1S) \rightarrow \phi K^+ K^-) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+ K^-)] = 2.26 \pm 0.26 \pm 0.16$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+ K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G09  
NODE=M070G09

NODE=M070G09;LINKAGE=A

$$\Gamma(\phi f_2(1270)) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{79} \Gamma_5 / \Gamma$$

| VALUE (eV)                                       | EVTS | DOCUMENT ID           | TECN     | COMMENT                                               |
|--------------------------------------------------|------|-----------------------|----------|-------------------------------------------------------|
| <b>1.79±0.32<sup>+0.02</sup><sub>-0.06</sub></b> | 61   | <sup>1,2,3</sup> LEES | 12F BABR | $10.6 e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                  |    |                       |           |                                                       |
|--------------------------------------------------|----|-----------------------|-----------|-------------------------------------------------------|
| <b>4.08±0.73<sup>+0.04</sup><sub>-0.14</sub></b> | 44 | <sup>2,4</sup> AUBERT | 07AK BABR | $10.6 e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$ |
|--------------------------------------------------|----|-----------------------|-----------|-------------------------------------------------------|

<sup>1</sup> LEES 12F reports  $[\Gamma(J/\psi(1S) \rightarrow \phi f_2(1270)) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-)/\Gamma_{\text{total}}] \times [B(f_2(1270) \rightarrow \pi\pi)] = 1.51 \pm 0.25 \pm 0.10$  eV which we divide by our best value  $B(f_2(1270) \rightarrow \pi\pi) = (84.2^{+2.9}_{-0.9}) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Using  $B(\phi \rightarrow K^+ K^-) = (48.9 \pm 0.5)\%$ .

<sup>3</sup> Using  $\pi^+ \pi^-$  invariant mass between 1.1 and 1.5 GeV. May include other sources such as  $f_0(1370)$ .

<sup>4</sup> Superseded by LEES 12F. AUBERT 07AK reports  $[\Gamma(J/\psi(1S) \rightarrow \phi f_2(1270)) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-)/\Gamma_{\text{total}}] \times [B(f_2(1270) \rightarrow \pi\pi)] = 3.44 \pm 0.55 \pm 0.28$  eV which we divide by our best value  $B(f_2(1270) \rightarrow \pi\pi) = (84.2^{+2.9}_{-0.9}) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G07  
NODE=M070G07

NODE=M070G07;LINKAGE=A

NODE=M070G07;LINKAGE=AE  
NODE=M070G07;LINKAGE=B

NODE=M070G07;LINKAGE=UB

$$\Gamma(K^+ K^- f_2'(1525)) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{83} \Gamma_5 / \Gamma$$

| VALUE (eV)         | EVTS | DOCUMENT ID         | TECN     | COMMENT                                          |
|--------------------|------|---------------------|----------|--------------------------------------------------|
| <b>5.8±1.9±0.1</b> | 16   | <sup>1,2</sup> LEES | 14H BABR | $e^+ e^- \rightarrow K_S^0 K_S^0 K^+ K^- \gamma$ |

<sup>1</sup> Dividing by 1/4 to take into account  $B(f_2'(1525) \rightarrow K_S^0 K_S^0) = 1/4 B(f_2'(1525) \rightarrow K \bar{K})$ .

<sup>2</sup> LEES 14H reports  $[\Gamma(J/\psi(1S) \rightarrow K^+ K^- f_2'(1525)) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-)/\Gamma_{\text{total}}] \times [B(f_2'(1525) \rightarrow K \bar{K})] = 5.12 \pm 1.68 \pm 0.20$  eV which we divide by our best value  $B(f_2'(1525) \rightarrow K \bar{K}) = (87.6 \pm 2.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070GZ4  
NODE=M070GZ4

NODE=M070GZ4;LINKAGE=A

NODE=M070GZ4;LINKAGE=B

$$\Gamma(\phi f_2'(1525)) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{84} \Gamma_5 / \Gamma$$

| VALUE (eV)         | EVTS | DOCUMENT ID         | TECN     | COMMENT                                          |
|--------------------|------|---------------------|----------|--------------------------------------------------|
| <b>8.2±3.2±0.2</b> | 11   | <sup>1,2</sup> LEES | 14H BABR | $e^+ e^- \rightarrow K_S^0 K_S^0 K^+ K^- \gamma$ |

<sup>1</sup> Dividing by 1/4 to take into account  $B(f_2'(1525) \rightarrow K_S^0 K_S^0) = 1/4 B(f_2'(1525) \rightarrow K \bar{K})$  and using  $B(\phi \rightarrow K^+ K^-) = (48.9 \pm 0.5)\%$ .

<sup>2</sup> LEES 14H reports  $[\Gamma(J/\psi(1S) \rightarrow \phi f_2'(1525)) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-)/\Gamma_{\text{total}}] \times [B(f_2'(1525) \rightarrow K \bar{K})] = 7.2 \pm 2.8 \pm 0.3$  eV which we divide by our best value  $B(f_2'(1525) \rightarrow K \bar{K}) = (87.6 \pm 2.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070GZ2  
NODE=M070GZ2

NODE=M070GZ2;LINKAGE=A

NODE=M070GZ2;LINKAGE=B

$$\Gamma(\phi \pi^+ \pi^-) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{85} \Gamma_5 / \Gamma$$

| VALUE (eV)                   | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------------------------|------|-------------|------|---------|
| <b>4.47±0.35 OUR AVERAGE</b> |      |             |      |         |

|                |          |                   |          |                                                       |
|----------------|----------|-------------------|----------|-------------------------------------------------------|
| 4.45±0.49±0.05 | 181      | <sup>1</sup> LEES | 12F BABR | $10.6 e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$ |
| 4.50±0.48±0.05 | 254 ± 23 | <sup>2</sup> SHEN | 09 BELL  | $10.6 e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

NODE=M070G14  
NODE=M070G14

5.3  $\pm 0.7 \pm 0.1$ 

103

<sup>3</sup> AUBERT,BE 06D BABR 10.6  $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ 

<sup>1</sup> LEES 12F reports  $[\Gamma(J/\psi(1S) \rightarrow \phi\pi^+\pi^-) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] = 2.19 \pm 0.23 \pm 0.07$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G14;LINKAGE=B

<sup>2</sup> SHEN 09 reports  $4.50 \pm 0.41 \pm 0.26$  eV from a measurement of  $[\Gamma(J/\psi(1S) \rightarrow \phi\pi^+\pi^-) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)]$  assuming  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.6) \times 10^{-2}$ , which we rescale to our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G14;LINKAGE=SH

<sup>3</sup> Superseded by LEES 12F. AUBERT,BE 06D reports  $[\Gamma(J/\psi(1S) \rightarrow \phi\pi^+\pi^-) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] = 2.61 \pm 0.30 \pm 0.18$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G14;LINKAGE=AU

 $\Gamma(\phi\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{86}\Gamma_5/\Gamma$ 

| VALUE (eV)                                | EVTS | DOCUMENT ID                | TECN                                             | COMMENT |
|-------------------------------------------|------|----------------------------|--------------------------------------------------|---------|
| <b>2.76<math>\pm 0.57 \pm 0.03</math></b> | 45   | <sup>1</sup> LEES 12F BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^0\pi^0\gamma$ |         |

NODE=M070G15  
NODE=M070G15

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |    |                                 |                                                  |  |
|--------------------------|----|---------------------------------|--------------------------------------------------|--|
| 3.13 $\pm 0.88 \pm 0.03$ | 23 | <sup>2</sup> AUBERT,BE 06D BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^0\pi^0\gamma$ |  |
|--------------------------|----|---------------------------------|--------------------------------------------------|--|

<sup>1</sup> LEES 12F reports  $[\Gamma(J/\psi(1S) \rightarrow \phi\pi^0\pi^0) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] = 1.36 \pm 0.27 \pm 0.07$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G15;LINKAGE=A

<sup>2</sup> Superseded by LEES 12F. AUBERT,BE 06D reports  $[\Gamma(J/\psi(1S) \rightarrow \phi\pi^0\pi^0) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] = 1.54 \pm 0.40 \pm 0.16$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G15;LINKAGE=AU

 $\Gamma(\phi\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{89}\Gamma_5/\Gamma$ 

| VALUE (eV)                             | EVTS | DOCUMENT ID                   | TECN                                     | COMMENT |
|----------------------------------------|------|-------------------------------|------------------------------------------|---------|
| <b>6.1<math>\pm 2.7 \pm 0.4</math></b> | 6    | <sup>1</sup> AUBERT 07AU BABR | 10.6 $e^+e^- \rightarrow \phi\eta\gamma$ |         |

NODE=M070G28  
NODE=M070G28

<sup>1</sup> AUBERT 07AU quotes  $\Gamma_{ee}^{J/\psi} \cdot B(J/\psi \rightarrow \phi\eta) \cdot B(\phi \rightarrow K^+K^-) \cdot B(\eta \rightarrow 3\pi) = 0.84 \pm 0.37 \pm 0.05$  eV.

NODE=M070G28;LINKAGE=AU

 $\Gamma(\phi f_0(980) \rightarrow \phi\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{97}\Gamma_5/\Gamma$ 

| VALUE (eV)                                   | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------------------------------------------|------|-------------|------|---------|
| <b>1.44<math>\pm 0.19</math> OUR AVERAGE</b> |      |             |      |         |

NODE=M070G05  
NODE=M070G05

|                          |            |                            |                                                  |  |
|--------------------------|------------|----------------------------|--------------------------------------------------|--|
| 1.40 $\pm 0.25 \pm 0.02$ | 57 $\pm 9$ | <sup>1</sup> LEES 12F BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-K^+K^-\gamma$ |  |
|--------------------------|------------|----------------------------|--------------------------------------------------|--|

|                          |             |                           |                                                  |  |
|--------------------------|-------------|---------------------------|--------------------------------------------------|--|
| 1.48 $\pm 0.27 \pm 0.09$ | 60 $\pm 11$ | <sup>2</sup> SHEN 09 BELL | 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |  |
|--------------------------|-------------|---------------------------|--------------------------------------------------|--|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |            |                               |                                                  |  |
|--------------------------|------------|-------------------------------|--------------------------------------------------|--|
| 1.02 $\pm 0.24 \pm 0.01$ | 20 $\pm 5$ | <sup>3</sup> AUBERT 07AK BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-K^+K^-\gamma$ |  |
|--------------------------|------------|-------------------------------|--------------------------------------------------|--|

<sup>1</sup> LEES 12F reports  $[\Gamma(J/\psi(1S) \rightarrow \phi f_0(980) \rightarrow \phi\pi^+\pi^-) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] = 0.69 \pm 0.11 \pm 0.05$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G05;LINKAGE=A

<sup>2</sup> Multiplied by 2/3 to take into account the  $\phi\pi^+\pi^-$  mode only. Using  $B(\phi \rightarrow K^+K^-) = (49.2 \pm 0.6)\%$ .

NODE=M070G05;LINKAGE=SH

<sup>3</sup> Superseded by LEES 12F. AUBERT 07AK reports  $[\Gamma(J/\psi(1S) \rightarrow \phi f_0(980) \rightarrow \phi\pi^+\pi^-) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] = 0.50 \pm 0.11 \pm 0.04$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G05;LINKAGE=UB

 $\Gamma(\phi f_0(980) \rightarrow \phi\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{98}\Gamma_5/\Gamma$ 

| VALUE (eV)                                | EVTS       | DOCUMENT ID                | TECN                                             | COMMENT |
|-------------------------------------------|------------|----------------------------|--------------------------------------------------|---------|
| <b>0.98<math>\pm 0.26 \pm 0.01</math></b> | 16 $\pm 4$ | <sup>1</sup> LEES 12F BABR | 10.6 $e^+e^- \rightarrow \pi^0\pi^0K^+K^-\gamma$ |         |

NODE=M070G06  
NODE=M070G06

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |               |                               |                                                  |  |
|--------------------------|---------------|-------------------------------|--------------------------------------------------|--|
| 0.95 $\pm 0.40 \pm 0.01$ | 7.0 $\pm 2.8$ | <sup>2</sup> AUBERT 07AK BABR | 10.6 $e^+e^- \rightarrow \pi^0\pi^0K^+K^-\gamma$ |  |
|--------------------------|---------------|-------------------------------|--------------------------------------------------|--|

<sup>1</sup> LEES 12F reports  $[\Gamma(J/\psi(1S) \rightarrow \phi f_0(980) \rightarrow \phi \pi^0 \pi^0) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+ K^-)] = 0.48 \pm 0.12 \pm 0.05 \text{ eV}$  which we divide by our best value  $B(\phi(1020) \rightarrow K^+ K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G06;LINKAGE=A

<sup>2</sup> Superseded by LEES 12F. AUBERT 07AK reports  $[\Gamma(J/\psi(1S) \rightarrow \phi f_0(980) \rightarrow \phi \pi^0 \pi^0) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+ K^-)] = 0.47 \pm 0.19 \pm 0.05 \text{ eV}$  which we divide by our best value  $B(\phi(1020) \rightarrow K^+ K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G06;LINKAGE=UB

### $\Gamma(\eta \pi^+ \pi^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{109} \Gamma_5 / \Gamma$

| VALUE (eV)                   | EVTS | DOCUMENT ID         | TECN      | COMMENT                                            |
|------------------------------|------|---------------------|-----------|----------------------------------------------------|
| <b>2.3 ± 0.4 OUR AVERAGE</b> |      |                     |           |                                                    |
| 2.34 ± 0.43 ± 0.16           | 49   | LEES                | 18 BABR   | $e^+ e^- \rightarrow \eta \pi^+ \pi^- \gamma$      |
| 2.23 ± 0.97 ± 0.03           | 9    | <sup>1</sup> AUBERT | 07AU BABR | 10.6 $e^+ e^- \rightarrow \eta \pi^+ \pi^- \gamma$ |

NODE=M070G25  
NODE=M070G25

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(J/\psi(1S) \rightarrow \eta \pi^+ \pi^-) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(\eta \rightarrow \pi^+ \pi^- \pi^0)] = 0.51 \pm 0.22 \pm 0.03 \text{ eV}$  which we divide by our best value  $B(\eta \rightarrow \pi^+ \pi^- \pi^0) = (22.92 \pm 0.28) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G25;LINKAGE=AU

### $\Gamma(K_S^0 \pi^- K_2^*(1430)^+ + \text{c.c.}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{118} \Gamma_5 / \Gamma$

| VALUE (eV)              | EVTS | DOCUMENT ID         | TECN     | COMMENT                                              |
|-------------------------|------|---------------------|----------|------------------------------------------------------|
| <b>20.1 ± 9.8 ± 0.5</b> | 35   | <sup>1,2</sup> LEES | 14H BABR | $e^+ e^- \rightarrow \pi^+ \pi^- K_S^0 K_2^0 \gamma$ |

NODE=M070GY6  
NODE=M070GY6

<sup>1</sup> Dividing by 1/4 to take into account  $B(K^*(1430) \rightarrow K_S^0 \pi) = 1/4 B(K^*(1430) \rightarrow K \pi)$ .

NODE=M070GY6;LINKAGE=A

<sup>2</sup> LEES 14H reports  $[\Gamma(J/\psi(1S) \rightarrow K_S^0 \pi^- K_2^*(1430)^+ + \text{c.c.}) \times \Gamma(J/\psi(1S) \rightarrow e^+ e^-) / \Gamma_{\text{total}}] \times [B(K_2^*(1430) \rightarrow K \pi)] = 10.0 \pm 4.8 \pm 0.8 \text{ eV}$  which we divide by our best value  $B(K_2^*(1430) \rightarrow K \pi) = (49.9 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070GY6;LINKAGE=B

### $\Gamma(2(\pi^+ \pi^-) \pi^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{139} \Gamma_5 / \Gamma$

| VALUE (eV)          | EVTS | DOCUMENT ID | TECN      | COMMENT                                                |
|---------------------|------|-------------|-----------|--------------------------------------------------------|
| <b>303 ± 5 ± 18</b> | 4990 | AUBERT      | 07AU BABR | 10.6 $e^+ e^- \rightarrow 2(\pi^+ \pi^-) \pi^0 \gamma$ |

NODE=M070G23  
NODE=M070G23

### $\Gamma(\pi^+ \pi^- \pi^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{141} \Gamma_5 / \Gamma$

| VALUE (keV)                  | DOCUMENT ID | TECN     | COMMENT                                             |
|------------------------------|-------------|----------|-----------------------------------------------------|
| <b>0.122 ± 0.005 ± 0.008</b> | AUBERT,B    | 04N BABR | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \gamma$ |

NODE=M070G5  
NODE=M070G5

### $\Gamma(\pi^+ \pi^- \pi^0 \pi^0 \pi^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{142} \Gamma_5 / \Gamma$

| VALUE (eV)                | EVTS | DOCUMENT ID | TECN     | COMMENT                                              |
|---------------------------|------|-------------|----------|------------------------------------------------------|
| <b>150.0 ± 4.0 ± 15.0</b> | 2.3k | LEES        | 18E BABR | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- 3\pi^0 \gamma$ |

NODE=M070P53  
NODE=M070P53

### $\Gamma(\rho^\pm \pi^\mp \pi^0 \pi^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{143} \Gamma_5 / \Gamma$

| VALUE (eV)              | EVTS | DOCUMENT ID | TECN     | COMMENT                                              |
|-------------------------|------|-------------|----------|------------------------------------------------------|
| <b>78.0 ± 9.0 ± 8.0</b> | 1.2k | LEES        | 18E BABR | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- 3\pi^0 \gamma$ |

NODE=M070P55  
NODE=M070P55

### $\Gamma(\rho^+ \rho^- \pi^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{144} \Gamma_5 / \Gamma$

| VALUE (eV)              | EVTS | DOCUMENT ID | TECN     | COMMENT                                              |
|-------------------------|------|-------------|----------|------------------------------------------------------|
| <b>33.0 ± 5.0 ± 3.3</b> | 529  | LEES        | 18E BABR | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- 3\pi^0 \gamma$ |

NODE=M070P56  
NODE=M070P56

### $\Gamma(\pi^+ \pi^- \pi^0 K^+ K^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{145} \Gamma_5 / \Gamma$

| VALUE (eV)               | EVTS | DOCUMENT ID | TECN      | COMMENT                                                     |
|--------------------------|------|-------------|-----------|-------------------------------------------------------------|
| <b>107.0 ± 4.3 ± 6.4</b> | 768  | AUBERT      | 07AU BABR | 10.6 $e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \pi^0 \gamma$ |

NODE=M070G27  
NODE=M070G27

### $\Gamma(\pi^+ \pi^- K^+ K^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{147} \Gamma_5 / \Gamma$

| VALUE (eV)                 | EVTS | DOCUMENT ID | TECN     | COMMENT                                               |
|----------------------------|------|-------------|----------|-------------------------------------------------------|
| <b>37.94 ± 0.81 ± 1.10</b> | 3.1k | LEES        | 12F BABR | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$ |

NODE=M070G12  
NODE=M070G12

• • • We do not use the following data for averages, fits, limits, etc. • • •

OCCUR=2

|                  |      |                     |           |                                                       |
|------------------|------|---------------------|-----------|-------------------------------------------------------|
| 36.3 ± 1.3 ± 2.1 | 1.5k | <sup>1</sup> AUBERT | 07AK BABR | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$ |
| 33.6 ± 2.7 ± 2.7 | 233  | <sup>2</sup> AUBERT | 05D BABR  | 10.6 $e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$ |

<sup>1</sup> Superseded by LEES 12F.

NODE=M070G12;LINKAGE=B

<sup>2</sup> Superseded by AUBERT 07AK.

NODE=M070G12;LINKAGE=AU

$$\Gamma(\pi^+\pi^-K_S^0K_L^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{148}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTs | DOCUMENT ID | TECN     | COMMENT                                         |
|---------------------|------|-------------|----------|-------------------------------------------------|
| <b>20.8±2.3±2.1</b> | 248  | LEES        | 14H BABR | $e^+e^- \rightarrow \pi^+\pi^-K_S^0K_L^0\gamma$ |

NODE=M070GY1  
NODE=M070GY1

$$\Gamma(\pi^+\pi^-K_S^0K_S^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{149}\Gamma_5/\Gamma$$

| VALUE (eV)         | EVTs | DOCUMENT ID | TECN     | COMMENT                                         |
|--------------------|------|-------------|----------|-------------------------------------------------|
| <b>9.3±0.9±0.5</b> | 133  | LEES        | 14H BABR | $e^+e^- \rightarrow \pi^+\pi^-K_S^0K_S^0\gamma$ |

NODE=M070GY2  
NODE=M070GY2

$$\Gamma(\pi^\pm\pi^0K^\mp K_S^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{150}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTs | DOCUMENT ID | TECN     | COMMENT                                           |
|---------------------|------|-------------|----------|---------------------------------------------------|
| <b>31.7±1.9±1.8</b> | 393  | LEES        | 17D BABR | $e^+e^- \rightarrow K_S^0K^\pm\pi^\mp\pi^0\gamma$ |

NODE=M070G34  
NODE=M070G34

$$\Gamma(K^+K^-K_S^0K_S^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{151}\Gamma_5/\Gamma$$

| VALUE (eV)         | EVTs | DOCUMENT ID | TECN     | COMMENT                                     |
|--------------------|------|-------------|----------|---------------------------------------------|
| <b>2.3±0.4±0.1</b> | 29   | LEES        | 14H BABR | $e^+e^- \rightarrow K_S^0K_S^0K^+K^-\gamma$ |

NODE=M070GY3  
NODE=M070GY3

$$\Gamma(\pi^+\pi^-K^+K^-\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{152}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTs | DOCUMENT ID                   | TECN | COMMENT                                         |
|---------------------|------|-------------------------------|------|-------------------------------------------------|
| <b>25.9±3.9±0.1</b> | 73   | <sup>1</sup> AUBERT 07AU BABR | 10.6 | $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\eta\gamma$ |

NODE=M070G30  
NODE=M070G30

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(J/\psi(1S) \rightarrow \pi^+\pi^-K^+K^-\eta) \times \Gamma(J/\psi(1S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\eta \rightarrow 2\gamma)] = 10.2 \pm 1.3 \pm 0.8$  eV which we divide by our best value  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G30;LINKAGE=AU

$$\Gamma(\pi^0\pi^0K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{153}\Gamma_5/\Gamma$$

| VALUE (eV)             | EVTs | DOCUMENT ID | TECN     | COMMENT                                          |
|------------------------|------|-------------|----------|--------------------------------------------------|
| <b>11.75±0.81±0.90</b> | 388  | LEES        | 12F BABR | $10.6 e^+e^- \rightarrow \pi^0\pi^0K^+K^-\gamma$ |

NODE=M070G04  
NODE=M070G04

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |     |                               |      |                                             |
|----------------|-----|-------------------------------|------|---------------------------------------------|
| 13.6 ±1.1 ±1.3 | 203 | <sup>1</sup> AUBERT 07AK BABR | 10.6 | $e^+e^- \rightarrow \pi^0\pi^0K^+K^-\gamma$ |
|----------------|-----|-------------------------------|------|---------------------------------------------|

<sup>1</sup> Superseded by LEES 12F.

NODE=M070G04;LINKAGE=A

$$\Gamma(\pi^0\pi^0K_S^0K_L^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{154}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTs | DOCUMENT ID | TECN     | COMMENT                                         |
|---------------------|------|-------------|----------|-------------------------------------------------|
| <b>10.3±2.3±0.5</b> | 47   | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0K_L^0\pi^0\pi^0\gamma$ |

NODE=M070G40  
NODE=M070G40

$$\Gamma(K_S^0K_L^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{158}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTs | DOCUMENT ID | TECN     | COMMENT                                    |
|---------------------|------|-------------|----------|--------------------------------------------|
| <b>11.4±1.3±0.6</b> | 182  | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0K_L^0\pi^0\gamma$ |

NODE=M070G41  
NODE=M070G41

$$\Gamma(K^*(892)^0\bar{K}^0 + \text{c.c.} \rightarrow K_S^0K_L^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{159}\Gamma_5/\Gamma$$

| VALUE (eV)         | EVTs | DOCUMENT ID | TECN     | COMMENT                                    |
|--------------------|------|-------------|----------|--------------------------------------------|
| <b>6.7±0.9±0.4</b> | 106  | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0K_L^0\pi^0\gamma$ |

NODE=M070G42  
NODE=M070G42

$$\Gamma(K_2^*(1430)^0\bar{K}^0 + \text{c.c.} \rightarrow K_S^0K_L^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{160}\Gamma_5/\Gamma$$

| VALUE (eV)         | EVTs | DOCUMENT ID | TECN     | COMMENT                                    |
|--------------------|------|-------------|----------|--------------------------------------------|
| <b>2.4±0.7±0.1</b> | 37   | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0K_L^0\pi^0\gamma$ |

NODE=M070G43  
NODE=M070G43

$$\Gamma(K_S^0K_L^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{161}\Gamma_5/\Gamma$$

| VALUE (eV)         | EVTs | DOCUMENT ID | TECN     | COMMENT                                   |
|--------------------|------|-------------|----------|-------------------------------------------|
| <b>8.0±1.8±0.4</b> | 45   | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0K_L^0\eta\gamma$ |

NODE=M070G35  
NODE=M070G35

$$\Gamma(2(\pi^+\pi^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{162}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTs | DOCUMENT ID | TECN     | COMMENT                                      |
|---------------------|------|-------------|----------|----------------------------------------------|
| <b>20.4±0.9±0.4</b> |      | LEES        | 12E BABR | $10.6 e^+e^- \rightarrow 2\pi^+2\pi^-\gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |     |                              |      |                                          |
|--------------|-----|------------------------------|------|------------------------------------------|
| 19.5±1.4±1.3 | 270 | <sup>1</sup> AUBERT 05D BABR | 10.6 | $e^+e^- \rightarrow 2(\pi^+\pi^-)\gamma$ |
|--------------|-----|------------------------------|------|------------------------------------------|

<sup>1</sup> Superseded by LEES 12E.

NODE=M070G11;LINKAGE=AU

$$\Gamma(3(\pi^+\pi^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{163}\Gamma_5/\Gamma$$

| VALUE (10 <sup>-2</sup> keV) | EVTs | DOCUMENT ID     | TECN | COMMENT                                  |
|------------------------------|------|-----------------|------|------------------------------------------|
| <b>2.37±0.16±0.14</b>        | 496  | AUBERT 06D BABR | 10.6 | $e^+e^- \rightarrow 3(\pi^+\pi^-)\gamma$ |

NODE=M070G6  
NODE=M070G6

$$\Gamma(2(\pi^+\pi^-\pi^0)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{164}\Gamma_5/\Gamma$$

| VALUE (10 <sup>-2</sup> keV) | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                                |
|------------------------------|------|-------------|----------|----------------------------------------------------------------------------------------|
| <b>8.9±0.5±1.0</b>           | 761  | AUBERT      | 06D BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → 2(π <sup>+</sup> π <sup>-</sup> π <sup>0</sup> )γ |

NODE=M070G7  
NODE=M070G7

$$\Gamma(2(\pi^+\pi^-\eta)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{165}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTS | DOCUMENT ID         | TECN      | COMMENT                                                                  |
|---------------------|------|---------------------|-----------|--------------------------------------------------------------------------|
| <b>13.1±2.4±0.1</b> | 85   | <sup>1</sup> AUBERT | 07AU BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → 2(π <sup>+</sup> π <sup>-</sup> )ηγ |

NODE=M070G26  
NODE=M070G26

<sup>1</sup> AUBERT 07AU reports [Γ(J/ψ(1S) → 2(π<sup>+</sup>π<sup>-</sup>)η) × Γ(J/ψ(1S) → e<sup>+</sup>e<sup>-</sup>)/Γ<sub>total</sub>] × [B(η → 2γ)] = 5.16 ± 0.85 ± 0.39 eV which we divide by our best value B(η → 2γ) = (39.41 ± 0.20) × 10<sup>-2</sup>. Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070G26;LINKAGE=AU

$$\Gamma(\pi^+\pi^-\pi^0\pi^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{167}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                                             |
|---------------------|------|-------------|----------|-----------------------------------------------------------------------------------------------------|
| <b>12.8±1.8±2.0</b> | 203  | LEES        | 18E BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> π <sup>0</sup> π <sup>0</sup> ηγ |

NODE=M070P57  
NODE=M070P57

$$\Gamma(\omega\pi^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{63}\Gamma_5/\Gamma$$

| VALUE (eV)            | EVTS | DOCUMENT ID       | TECN     | COMMENT                                                                                             |
|-----------------------|------|-------------------|----------|-----------------------------------------------------------------------------------------------------|
| <b>1.90±0.96±0.01</b> | 27   | <sup>1</sup> LEES | 18E BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> π <sup>0</sup> π <sup>0</sup> ηγ |

NODE=M070P58  
NODE=M070P58

<sup>1</sup> LEES 18E reports [Γ(J/ψ(1S) → ωπ<sup>0</sup>η) × Γ(J/ψ(1S) → e<sup>+</sup>e<sup>-</sup>)/Γ<sub>total</sub>] × [B(ω(782) → π<sup>+</sup>π<sup>-</sup>π<sup>0</sup>)] = 1.7 ± 0.8 ± 0.3 eV which we divide by our best value B(ω(782) → π<sup>+</sup>π<sup>-</sup>π<sup>0</sup>) = (89.2 ± 0.7) × 10<sup>-2</sup>. Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070P58;LINKAGE=A

$$\Gamma(\rho^\pm\pi^\mp\pi^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{168}\Gamma_5/\Gamma$$

| VALUE (eV)          | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                                             |
|---------------------|------|-------------|----------|-----------------------------------------------------------------------------------------------------|
| <b>10.5±4.1±1.6</b> | 168  | LEES        | 18E BABR | 10.6 e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> π <sup>0</sup> π <sup>0</sup> ηγ |

NODE=M070P59  
NODE=M070P59

$$\Gamma(p\bar{p}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{169}\Gamma_5/\Gamma$$

| VALUE (eV)                  | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                       |
|-----------------------------|------|-------------------------------------------------------------|----------|-----------------------------------------------|
| <b>11.9±0.6 OUR AVERAGE</b> |      | Error includes scale factor of 1.8. See the ideogram below. |          |                                               |
| 11.3±0.4±0.3                | 821  | <sup>1</sup> LEES                                           | 130 BABR | e <sup>+</sup> e <sup>-</sup> → p $\bar{p}$ γ |
| 12.9±0.4±0.4                | 918  | <sup>2</sup> LEES                                           | 13Y BABR | e <sup>+</sup> e <sup>-</sup> → p $\bar{p}$ γ |
| 9.7±1.7                     |      | <sup>3</sup> ARMSTRONG                                      | 93B E760 | p $\bar{p}$ → e <sup>+</sup> e <sup>-</sup>   |
| 12.0±0.6±0.5                | 438  | <sup>4</sup> AUBERT                                         | 06B BABR | e <sup>+</sup> e <sup>-</sup> → p $\bar{p}$ γ |

NODE=M070G4  
NODE=M070G4

• • • We do not use the following data for averages, fits, limits, etc. • • •

<sup>1</sup> ISR photon reconstructed in the detector

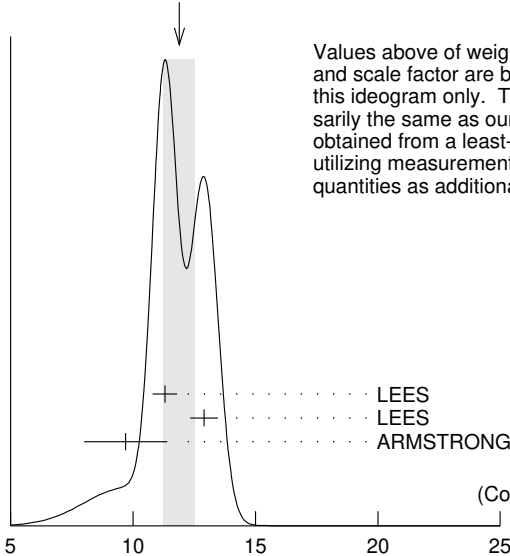
<sup>2</sup> ISR photon undetected

<sup>3</sup> Using Γ<sub>total</sub> = 85.5<sup>+6.1</sup><sub>-5.8</sub> MeV.

<sup>4</sup> Superseded by LEES 130

NODE=M070G4;LINKAGE=B  
NODE=M070G4;LINKAGE=C  
NODE=M070G;LINKAGE=A  
NODE=M070G4;LINKAGE=A

WEIGHTED AVERAGE  
11.9±0.6 (Error scaled by 1.8)



Values above of weighted average, error, and scale factor are based upon the data in this ideogram only. They are not necessarily the same as our 'best' values, obtained from a least-squares constrained fit utilizing measurements of other (related) quantities as additional information.

|           |     |      | $\chi^2$                   |
|-----------|-----|------|----------------------------|
| LEES      | 130 | BABR | 1.4                        |
| LEES      | 13Y | BABR | 3.2                        |
| ARMSTRONG | 93B | E760 | 1.7                        |
|           |     |      | 6.2                        |
|           |     |      | (Confidence Level = 0.044) |

Γ(p $\bar{p}$ ) × Γ(e<sup>+</sup>e<sup>-</sup>)/Γ<sub>total</sub> (eV)

$$\Gamma(\Sigma^0 \bar{\Sigma}^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{182} \Gamma_5 / \Gamma$$

| VALUE (eV)             | DOCUMENT ID | TECN      | COMMENT                                                   |
|------------------------|-------------|-----------|-----------------------------------------------------------|
| <b>6.4 ± 1.2 ± 0.6</b> | AUBERT      | 07BD BABR | 10.6 $e^+ e^- \rightarrow \Sigma^0 \bar{\Sigma}^0 \gamma$ |

NODE=M070G17  
NODE=M070G17

$$\Gamma(2(\pi^+ \pi^-) K^+ K^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{183} \Gamma_5 / \Gamma$$

| VALUE (10 <sup>-2</sup> keV) | EVTS | DOCUMENT ID | TECN     | COMMENT                                                  |
|------------------------------|------|-------------|----------|----------------------------------------------------------|
| <b>2.75 ± 0.23 ± 0.17</b>    | 205  | AUBERT      | 06D BABR | 10.6 $e^+ e^- \rightarrow K^+ K^- 2(\pi^+ \pi^-) \gamma$ |

NODE=M070G9  
NODE=M070G9

$$\Gamma(\Lambda \bar{\Lambda}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{189} \Gamma_5 / \Gamma$$

| VALUE (eV)              | DOCUMENT ID | TECN      | COMMENT                                                 |
|-------------------------|-------------|-----------|---------------------------------------------------------|
| <b>10.7 ± 0.9 ± 0.7</b> | AUBERT      | 07BD BABR | 10.6 $e^+ e^- \rightarrow \Lambda \bar{\Lambda} \gamma$ |

NODE=M070G16  
NODE=M070G16

$$\Gamma(2(K^+ K^-)) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{192} \Gamma_5 / \Gamma$$

| VALUE (eV)                | EVTS     | DOCUMENT ID | TECN     | COMMENT                                      |
|---------------------------|----------|-------------|----------|----------------------------------------------|
| <b>4.00 ± 0.33 ± 0.29</b> | 287 ± 24 | LEES        | 12F BABR | 10.6 $e^+ e^- \rightarrow 2(K^+ K^-) \gamma$ |

NODE=M070G13  
NODE=M070G13

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                    |          |                     |           |                                              |
|--------------------|----------|---------------------|-----------|----------------------------------------------|
| 4.11 ± 0.39 ± 0.30 | 156 ± 15 | <sup>1</sup> AUBERT | 07AK BABR | 10.6 $e^+ e^- \rightarrow 2(K^+ K^-) \gamma$ |
| 4.0 ± 0.7 ± 0.6    | 38       | <sup>2</sup> AUBERT | 05D BABR  | 10.6 $e^+ e^- \rightarrow 2(K^+ K^-) \gamma$ |

<sup>1</sup> Superseded by LEES 12F.

<sup>2</sup> Superseded by AUBERT 07AK.

NODE=M070G13;LINKAGE=A  
NODE=M070G13;LINKAGE=A

$$\Gamma(K^+ K^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_{194} \Gamma_5 / \Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                    |     |                   |          |                                      |
|--------------------|-----|-------------------|----------|--------------------------------------|
| 1.78 ± 0.11 ± 0.05 | 462 | <sup>1</sup> LEES | 15J BABR | $e^+ e^- \rightarrow K^+ K^- \gamma$ |
| 1.94 ± 0.11 ± 0.05 | 462 | <sup>2</sup> LEES | 15J BABR | $e^+ e^- \rightarrow K^+ K^- \gamma$ |
| 1.42 ± 0.23 ± 0.08 | 51  | <sup>3</sup> LEES | 13Q BABR | $e^+ e^- \rightarrow K^+ K^- \gamma$ |

<sup>1</sup>  $\sin \phi > 0$ .

<sup>2</sup>  $\sin \phi < 0$ .

<sup>3</sup> Interference with non-resonant  $K^+ K^-$  production not taken into account.

NODE=M070G08  
NODE=M070G08

OCCUR=2

NODE=M070G08;LINKAGE=A  
NODE=M070G08;LINKAGE=B  
NODE=M070G08;LINKAGE=B

## J/ψ(1S) BRANCHING RATIOS

NODE=M070230

For the first four branching ratios, see also the partial widths, and (partial widths) ×  $\Gamma(e^+ e^-) / \Gamma_{\text{total}}$  above.

NODE=M070300

$$\Gamma(\text{hadrons}) / \Gamma_{\text{total}} \quad \Gamma_1 / \Gamma$$

| VALUE                            | DOCUMENT ID | TECN    | COMMENT   |
|----------------------------------|-------------|---------|-----------|
| <b>0.877 ± 0.005 OUR AVERAGE</b> |             |         |           |
| 0.878 ± 0.005                    | BAI         | 95B BES | $e^+ e^-$ |
| 0.86 ± 0.02                      | BOYARSKI    | 75 MRK1 | $e^+ e^-$ |

NODE=M070R3  
NODE=M070R3

$$\Gamma(\text{virtual } \gamma \rightarrow \text{hadrons}) / \Gamma_{\text{total}} \quad \Gamma_2 / \Gamma$$

| VALUE                | DOCUMENT ID         | TECN    | COMMENT   |
|----------------------|---------------------|---------|-----------|
| <b>0.135 ± 0.003</b> | <sup>1,2</sup> SETH | 04 RVUE | $e^+ e^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |                       |         |           |
|-------------|-----------------------|---------|-----------|
| 0.17 ± 0.02 | <sup>1</sup> BOYARSKI | 75 MRK1 | $e^+ e^-$ |
|-------------|-----------------------|---------|-----------|

<sup>1</sup> Included in  $\Gamma(\text{hadrons}) / \Gamma_{\text{total}}$ .

<sup>2</sup> Using  $B(J/\psi \rightarrow \ell^+ \ell^-) = (5.90 \pm 0.09)\%$  from RPP-2002 and  $R = 2.28 \pm 0.04$  determined by a fit to data from BAI 00 and BAI 02c.

NODE=M070R4  
NODE=M070R4

NODE=M070R4;LINKAGE=C  
NODE=M070R4;LINKAGE=SE

$$\Gamma(g g g) / \Gamma_{\text{total}} \quad \Gamma_3 / \Gamma$$

| VALUE (units 10 <sup>-2</sup> ) | EVTS | DOCUMENT ID         | TECN    | COMMENT                                             |
|---------------------------------|------|---------------------|---------|-----------------------------------------------------|
| <b>64.1 ± 1.0</b>               | 6 M  | <sup>1</sup> BESSON | 08 CLEO | $\psi(2S) \rightarrow \pi^+ \pi^- + \text{hadrons}$ |

<sup>1</sup> Calculated using the value  $\Gamma(\gamma g g) / \Gamma(g g g) = 0.137 \pm 0.001 \pm 0.016 \pm 0.004$  from BESSON 08 and the PDG 08 values of  $B(\ell^+ \ell^-)$ ,  $B(\text{virtual } \gamma \rightarrow \text{hadrons})$ , and  $B(\gamma \eta_c)$ . The statistical error is negligible and the systematic error is partially correlated with that of  $\Gamma(\gamma g g) / \Gamma_{\text{total}}$  measurement of BESSON 08.

NODE=M070S65  
NODE=M070S65

NODE=M070S65;LINKAGE=BE

$\Gamma(\gamma g g)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTs  | DOCUMENT ID         | TECN    | COMMENT                                                    |
|--------------------------|-------|---------------------|---------|------------------------------------------------------------|
| <b>8.79±1.05</b>         | 200 k | <sup>1</sup> BESSON | 08 CLEO | $\psi(2S) \rightarrow \pi^+ \pi^- \gamma + \text{hadrons}$ |

NODE=M070S66  
 NODE=M070S66

<sup>1</sup> Calculated using the value  $\Gamma(\gamma g g)/\Gamma(g g g) = 0.137 \pm 0.001 \pm 0.016 \pm 0.004$  from BESSON 08 and the value of  $\Gamma(g g g)/\Gamma_{\text{total}}$ . The statistical error is negligible and the systematic error is partially correlated with that of  $\Gamma(g g g)/\Gamma_{\text{total}}$  measurement of BESSON 08.

NODE=M070S66;LINKAGE=BE

 $\Gamma(\gamma g g)/\Gamma(g g g)$  $\Gamma_4/\Gamma_3$ 

| VALUE (units $10^{-2}$ ) | EVTs | DOCUMENT ID | TECN    | COMMENT                                   |
|--------------------------|------|-------------|---------|-------------------------------------------|
| <b>13.7±0.1±0.7</b>      | 6 M  | BESSON      | 08 CLEO | $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |

NODE=M070S67  
 NODE=M070S67

 $\Gamma(e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-2}$ )       | EVTs | DOCUMENT ID | TECN     | COMMENT                                   |
|--------------------------------|------|-------------|----------|-------------------------------------------|
| <b>5.971±0.032 OUR AVERAGE</b> |      |             |          |                                           |
| 5.983±0.007±0.037              | 720k | ABLIKIM     | 13R BES3 | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ |
| 5.945±0.067±0.042              | 15k  | LI          | 05C CLEO | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ |
| 5.90 ±0.05 ±0.10               |      | BAI         | 98D BES  | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ |
| 6.09 ±0.33                     |      | BAI         | 95B BES  | $e^+ e^-$                                 |
| 5.92 ±0.15 ±0.20               |      | COFFMAN     | 92 MRK3  | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ |
| 6.9 ±0.9                       |      | BOYARSKI    | 75 MRK1  | $e^+ e^-$                                 |

NODE=M070R1  
 NODE=M070R1

 $\Gamma(e^+ e^- \gamma)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID            | TECN    | COMMENT                                |
|--------------------------|------------------------|---------|----------------------------------------|
| <b>8.8±1.3±0.4</b>       | <sup>1</sup> ARMSTRONG | 96 E760 | $\bar{p} p \rightarrow e^+ e^- \gamma$ |

<sup>1</sup> For  $E_\gamma > 100$  MeV.

NODE=M070S33  
 NODE=M070S33

NODE=M070S33;LINKAGE=A

 $\Gamma(\mu^+ \mu^-)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| VALUE (units $10^{-2}$ )       | EVTs | DOCUMENT ID | TECN     | COMMENT                                   |
|--------------------------------|------|-------------|----------|-------------------------------------------|
| <b>5.961±0.033 OUR AVERAGE</b> |      |             |          |                                           |
| 5.973±0.007±0.038              | 770k | ABLIKIM     | 13R BES3 | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ |
| 5.960±0.065±0.050              | 17k  | LI          | 05C CLEO | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ |
| 5.84 ±0.06 ±0.10               |      | BAI         | 98D BES  | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ |
| 6.08 ±0.33                     |      | BAI         | 95B BES  | $e^+ e^-$                                 |
| 5.90 ±0.15 ±0.19               |      | COFFMAN     | 92 MRK3  | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ |
| 6.9 ±0.9                       |      | BOYARSKI    | 75 MRK1  | $e^+ e^-$                                 |

NODE=M070R2  
 NODE=M070R2

 $\Gamma(e^+ e^-)/\Gamma(\mu^+ \mu^-)$  $\Gamma_5/\Gamma_7$ 

| VALUE                                                                         | DOCUMENT ID            | TECN     | COMMENT                                          |
|-------------------------------------------------------------------------------|------------------------|----------|--------------------------------------------------|
| <b>1.0016±0.0031 OUR AVERAGE</b>                                              |                        |          |                                                  |
| 1.0022±0.0044±0.0048                                                          | <sup>1</sup> AULCHENKO | 14 KEDR  | $3.097 e^+ e^- \rightarrow e^+ e^-, \mu^+ \mu^-$ |
| 1.0017±0.0017±0.0033                                                          | <sup>2</sup> ABLIKIM   | 13R BES3 | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$        |
| 1.002 ±0.021 ±0.013                                                           | <sup>3</sup> ANASHIN   | 10 KEDR  | $3.097 e^+ e^- \rightarrow e^+ e^-, \mu^+ \mu^-$ |
| 0.997 ±0.012 ±0.006                                                           | LI                     | 05C CLEO | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$        |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                        |          |                                                  |
| 1.011 ±0.013 ±0.016                                                           | BAI                    | 98D BES  | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$        |
| 1.00 ±0.07                                                                    | BAI                    | 95B BES  | $e^+ e^-$                                        |
| 1.00 ±0.05                                                                    | BOYARSKI               | 75 MRK1  | $e^+ e^-$                                        |
| 0.91 ±0.15                                                                    | ESPOSITO               | 75B FRAM | $e^+ e^-$                                        |
| 0.93 ±0.10                                                                    | FORD                   | 75 SPEC  | $e^+ e^-$                                        |

NODE=M070R5  
 NODE=M070R5

<sup>1</sup> From 235.3k  $J/\psi \rightarrow e^+ e^-$  and 156.6k  $J/\psi \rightarrow \mu^+ \mu^-$  observed events.

<sup>2</sup> Not independent of the corresponding measurements of  $\Gamma(e^+ e^-)/\Gamma_{\text{total}}$  and  $\Gamma(\mu^+ \mu^-)/\Gamma_{\text{total}}$ .

<sup>3</sup> Not independent of the corresponding measurements of  $\Gamma(e^+ e^-) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$  and  $\Gamma(\mu^+ \mu^-) \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ .

NODE=M070R5;LINKAGE=A  
 NODE=M070R5;LINKAGE=AB

NODE=M070R5;LINKAGE=AN

## HADRONSIC DECAYS

NODE=M070305

 $\Gamma(\rho\pi)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-2}$ )      | EVTs | DOCUMENT ID             | TECN     | COMMENT                                                     |
|-------------------------------|------|-------------------------|----------|-------------------------------------------------------------|
| <b>1.69 ±0.15 OUR AVERAGE</b> |      |                         |          | Error includes scale factor of 2.4. See the ideogram below. |
| 2.18 ±0.19                    |      | <sup>1,2</sup> AUBERT,B | 04N BABR | $10.6 e^+ e^- \rightarrow \pi^+ \pi^- \pi^0 \gamma$         |
| 2.184±0.005±0.201             | 220k | <sup>2,3</sup> BAI      | 04H BES  | $e^+ e^- \rightarrow J/\psi \rightarrow \pi^+ \pi^- \pi^0$  |

NODE=M070R20  
 NODE=M070R20



|                       |     |            |     |      |                                           |
|-----------------------|-----|------------|-----|------|-------------------------------------------|
| 2.091 ± 0.021 ± 0.116 | 2,4 | BAI        | 04H | BES  | $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |
| 1.21 ± 0.20           |     | BAI        | 96D | BES  | $e^+ e^- \rightarrow \rho \pi$            |
| 1.42 ± 0.01 ± 0.19    |     | COFFMAN    | 88  | MRK3 | $e^+ e^-$                                 |
| 1.3 ± 0.3             | 150 | FRANKLIN   | 83  | MRK2 | $e^+ e^-$                                 |
| 1.6 ± 0.4             | 183 | ALEXANDER  | 78  | PLUT | $e^+ e^-$                                 |
| 1.33 ± 0.21           |     | BRANDELIK  | 78B | DASP | $e^+ e^-$                                 |
| 1.0 ± 0.2             | 543 | BARTEL     | 76  | CNTR | $e^+ e^-$                                 |
| 1.3 ± 0.3             | 153 | JEAN-MARIE | 76  | MRK1 | $e^+ e^-$                                 |

<sup>1</sup> From the ratio of  $\Gamma(e^+ e^-) B(\pi^+ \pi^- \pi^0)$  and  $\Gamma(e^+ e^-) B(\mu^+ \mu^-)$  (AUBERT 04).

<sup>2</sup> Not independent of their  $B(\pi^+ \pi^- \pi^0)$ .

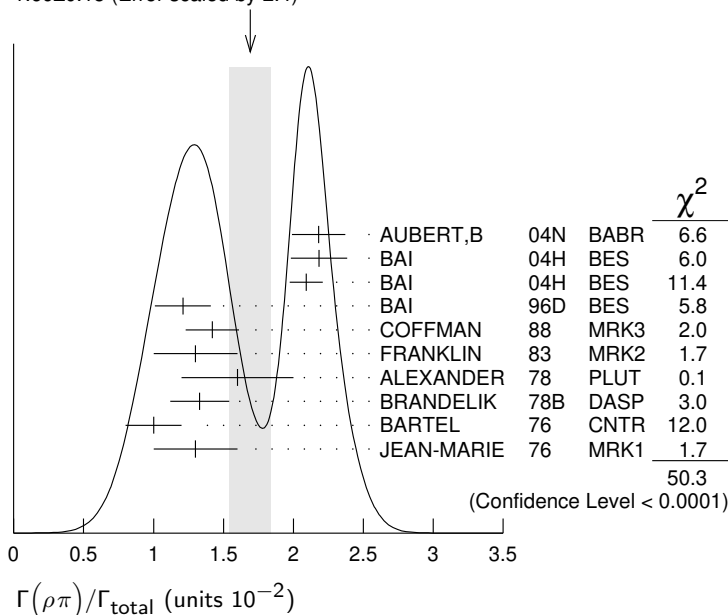
<sup>3</sup> From  $J/\psi \rightarrow \pi^+ \pi^- \pi^0$  events directly.

<sup>4</sup> Obtained comparing the rates for  $\pi^+ \pi^- \pi^0$  and  $\mu^+ \mu^-$ , using  $J/\psi$  events produced via  $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$  and with  $B(J/\psi \rightarrow \mu^+ \mu^-) = 5.88 \pm 0.10\%$ .

OCCUR=2

NODE=M070R20;LINKAGE=AU  
 NODE=M070R20;LINKAGE=BU  
 NODE=M070R20;LINKAGE=BA  
 NODE=M070R20;LINKAGE=BI

WEIGHTED AVERAGE  
 1.69 ± 0.15 (Error scaled by 2.4)



$\Gamma(\rho\pi)/\Gamma(\pi^+ \pi^- \pi^0)$

$\Gamma_8/\Gamma_{141}$

| VALUE                                                                         | EVTS | DOCUMENT ID       | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|------|-------------------|------|---------------------------------------------|
| <b>1.142 ± 0.011 ± 0.026</b>                                                  | 20k  | <sup>1</sup> LEES | 17C  | BABR $J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                   |      |                                             |
| 1.331 ± 0.033                                                                 | 20k  | <sup>2</sup> LEES | 17C  | BABR $J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

<sup>2</sup> From a Dalitz plot analysis in a Veneziano model.

NODE=M070P18  
 NODE=M070P18

OCCUR=2

NODE=M070P18;LINKAGE=A  
 NODE=M070P18;LINKAGE=B

$\Gamma(\rho^0 \pi^0)/\Gamma(\rho\pi)$

$\Gamma_9/\Gamma_8$

| VALUE                                                                         | DOCUMENT ID   | TECN | COMMENT   |
|-------------------------------------------------------------------------------|---------------|------|-----------|
| <b>0.328 ± 0.005 ± 0.027</b>                                                  | COFFMAN 88    | MRK3 | $e^+ e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |               |      |           |
| 0.35 ± 0.08                                                                   | ALEXANDER 78  | PLUT | $e^+ e^-$ |
| 0.32 ± 0.08                                                                   | BRANDELIK 78B | DASP | $e^+ e^-$ |
| 0.39 ± 0.11                                                                   | BARTEL 76     | CNTR | $e^+ e^-$ |
| 0.37 ± 0.09                                                                   | JEAN-MARIE 76 | MRK1 | $e^+ e^-$ |

NODE=M070R21  
 NODE=M070R21

$\Gamma(\rho(1450)\pi \rightarrow \pi^+ \pi^- \pi^0)/\Gamma(\pi^+ \pi^- \pi^0)$

$\Gamma_{12}/\Gamma_{141}$

| VALUE (%)                                                                     | EVTS | DOCUMENT ID       | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|------|-------------------|------|---------------------------------------------|
| <b>10.9 ± 1.7 ± 2.7</b>                                                       | 20k  | <sup>1</sup> LEES | 17C  | BABR $J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                   |      |                                             |
| 0.80 ± 0.27                                                                   | 20k  | <sup>2</sup> LEES | 17C  | BABR $J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

<sup>2</sup> From a Dalitz plot analysis in a Veneziano model.

NODE=M070P25  
 NODE=M070P25

OCCUR=2

NODE=M070P25;LINKAGE=A  
 NODE=M070P25;LINKAGE=B

$$\Gamma(\rho(1450)^\pm \pi^\mp \rightarrow K_S^0 K^\pm \pi^\mp) / \Gamma(K_S^0 K^\pm \pi^\mp) \quad \Gamma_{13}/\Gamma_{157}$$

| VALUE (%)          | EVTS | DOCUMENT ID       | TECN     | COMMENT                                  |
|--------------------|------|-------------------|----------|------------------------------------------|
| <b>6.3±0.8±0.6</b> | 4k   | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$ |

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

NODE=M070P31  
NODE=M070P31

NODE=M070P31;LINKAGE=A

$$\Gamma(\rho(1450)^0 \pi^0 \rightarrow K^+ K^- \pi^0) / \Gamma(K^+ K^- \pi^0) \quad \Gamma_{14}/\Gamma_{156}$$

| VALUE (%)          | EVTS | DOCUMENT ID       | TECN     | COMMENT                            |
|--------------------|------|-------------------|----------|------------------------------------|
| <b>9.3±2.0±0.6</b> | 2k   | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow K^+ K^- \pi^0$ |

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

NODE=M070P27  
NODE=M070P27

NODE=M070P27;LINKAGE=A

$$\Gamma(\rho(1450)\eta'(958) \rightarrow \pi^+ \pi^- \eta'(958)) / \Gamma_{\text{total}} \quad \Gamma_{15}/\Gamma$$

| VALUE (units 10 <sup>-6</sup> ) | EVTS | DOCUMENT ID          | TECN      | COMMENT                                |
|---------------------------------|------|----------------------|-----------|----------------------------------------|
| <b>3.28±0.55±0.44</b>           | 119  | <sup>1</sup> ABLIKIM | 17AK BES3 | $J/\psi \rightarrow \pi^+ \pi^- \eta'$ |

<sup>1</sup> From a partial wave analysis of the decay  $J/\psi \rightarrow \pi^+ \pi^- \eta'$ .

NODE=M070P36  
NODE=M070P36

NODE=M070P36;LINKAGE=A

$$\Gamma(\rho(1700)\pi \rightarrow \pi^+ \pi^- \pi^0) / \Gamma(\pi^+ \pi^- \pi^0) \quad \Gamma_{17}/\Gamma_{141}$$

| VALUE (units 10 <sup>-3</sup> ) | EVTS | DOCUMENT ID       | TECN     | COMMENT                                |
|---------------------------------|------|-------------------|----------|----------------------------------------|
| <b>8±2±5</b>                    | 20k  | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |     |                   |          |                                        |
|------|-----|-------------------|----------|----------------------------------------|
| 22±6 | 20k | <sup>2</sup> LEES | 17C BABR | $J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |
|------|-----|-------------------|----------|----------------------------------------|

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

<sup>2</sup> From a Dalitz plot analysis in a Veneziano model.

NODE=M070P21  
NODE=M070P21

OCCUR=2

NODE=M070P21;LINKAGE=A  
NODE=M070P21;LINKAGE=B

$$\Gamma(\rho(2150)\pi \rightarrow \pi^+ \pi^- \pi^0) / \Gamma(\pi^+ \pi^- \pi^0) \quad \Gamma_{19}/\Gamma_{141}$$

| VALUE (units 10 <sup>-4</sup> ) | EVTS | DOCUMENT ID       | TECN     | COMMENT                                |
|---------------------------------|------|-------------------|----------|----------------------------------------|
| <b>4± 1±20</b>                  | 20k  | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |     |                   |          |                                        |
|---------|-----|-------------------|----------|----------------------------------------|
| 600±250 | 20k | <sup>2</sup> LEES | 17C BABR | $J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |
|---------|-----|-------------------|----------|----------------------------------------|

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

<sup>2</sup> From a Dalitz plot analysis in a Veneziano model.

NODE=M070P22  
NODE=M070P22

OCCUR=2

NODE=M070P22;LINKAGE=A  
NODE=M070P22;LINKAGE=B

$$\Gamma(\rho_3(1690)\pi \rightarrow \pi^+ \pi^- \pi^0) / \Gamma(\pi^+ \pi^- \pi^0) \quad \Gamma_{20}/\Gamma_{141}$$

| VALUE (units 10 <sup>-3</sup> ) | EVTS | DOCUMENT ID       | TECN     | COMMENT                                |
|---------------------------------|------|-------------------|----------|----------------------------------------|
| <b>4.0±0.8</b>                  | 20k  | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<sup>1</sup> From a Dalitz plot analysis in a Veneziano model.

NODE=M070P24  
NODE=M070P24

NODE=M070P24;LINKAGE=A

$$\Gamma(a_2(1320)\rho) / \Gamma_{\text{total}} \quad \Gamma_{21}/\Gamma$$

| VALUE (units 10 <sup>-3</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
| <b>10.9±2.2 OUR AVERAGE</b>     |      |             |      |         |

|              |      |          |         |                                              |
|--------------|------|----------|---------|----------------------------------------------|
| 11.7±0.7±2.5 | 7584 | AUGUSTIN | 89 DM2  | $J/\psi \rightarrow \rho^0 \rho^\pm \pi^\mp$ |
| 8.4±4.5      | 36   | VANNUCCI | 77 MRK1 | $e^+ e^- \rightarrow 2(\pi^+ \pi^-) \pi^0$   |

NODE=M070R43  
NODE=M070R43

$$\Gamma(\omega \pi^+ \pi^+ \pi^- \pi^-) / \Gamma_{\text{total}} \quad \Gamma_{22}/\Gamma$$

| VALUE (units 10 <sup>-4</sup> ) | EVTS | DOCUMENT ID | TECN    | COMMENT                                    |
|---------------------------------|------|-------------|---------|--------------------------------------------|
| <b>85±34</b>                    | 140  | VANNUCCI    | 77 MRK1 | $e^+ e^- \rightarrow 3(\pi^+ \pi^-) \pi^0$ |

NODE=M070R26  
NODE=M070R26

$$\Gamma(\omega \pi^+ \pi^-) / \Gamma_{\text{total}} \quad \Gamma_{24}/\Gamma$$

| VALUE (units 10 <sup>-3</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|------|-------------|------|---------|
| <b>7.2±1.0 OUR AVERAGE</b>      |      |             |      |         |

|         |       |           |          |                                            |
|---------|-------|-----------|----------|--------------------------------------------|
| 7.0±1.6 | 18058 | AUGUSTIN  | 89 DM2   | $J/\psi \rightarrow 2(\pi^+ \pi^-) \pi^0$  |
| 7.8±1.6 | 215   | BURMESTER | 77D PLUT | $e^+ e^-$                                  |
| 6.8±1.9 | 348   | VANNUCCI  | 77 MRK1  | $e^+ e^- \rightarrow 2(\pi^+ \pi^-) \pi^0$ |

NODE=M070R24  
NODE=M070R24

$$\Gamma(\omega \eta' \pi^+ \pi^-) / \Gamma_{\text{total}} \quad \Gamma_{74}/\Gamma$$

| VALUE (units 10 <sup>-3</sup> ) | EVTS | DOCUMENT ID          | TECN      | COMMENT                                       |
|---------------------------------|------|----------------------|-----------|-----------------------------------------------|
| <b>1.12±0.02±0.13</b>           | 14k  | <sup>1</sup> ABLIKIM | 19AC BES3 | $J/\psi \rightarrow \omega \eta' \pi^+ \pi^-$ |

<sup>1</sup> Using the decays  $\omega \rightarrow \pi^+ \pi^- \pi^0$  and  $\eta' \rightarrow \eta \pi^+ \pi^-$ .

NODE=M070P83  
NODE=M070P83

NODE=M070P83;LINKAGE=A

$\Gamma(\omega f_2(1270))/\Gamma_{\text{total}}$   $\Gamma_{25}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                      | EVTs | DOCUMENT ID | TECN     | COMMENT                                 |
|-------------------------------------------------------------------------------|------|-------------|----------|-----------------------------------------|
| <b>4.3±0.6 OUR AVERAGE</b>                                                    |      |             |          |                                         |
| 4.3±0.2±0.6                                                                   | 5860 | AUGUSTIN    | 89 DM2   | $e^+e^-$                                |
| 4.0±1.6                                                                       | 70   | BURMESTER   | 77D PLUT | $e^+e^-$                                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |                                         |
| 1.9±0.8                                                                       | 81   | VANNUCCI    | 77 MRK1  | $e^+e^- \rightarrow 2(\pi^+\pi^-)\pi^0$ |

NODE=M070R28  
NODE=M070R28

 $\Gamma(K^*(892)^0\bar{K}^*(892)^0)/\Gamma_{\text{total}}$   $\Gamma_{26}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | DOCUMENT ID | TECN    | COMMENT                               |
|-------------------------------------------------------------------------------|-----|-------------|---------|---------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |         |                                       |
| <5                                                                            | 90  | VANNUCCI    | 77 MRK1 | $e^+e^- \rightarrow \pi^+\pi^-K^+K^-$ |

NODE=M070R46  
NODE=M070R46

 $\Gamma(K^*(892)^\pm K^*(892)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{27}/\Gamma$ 

| VALUE (units $10^{-3}$ )                         | EVTs | DOCUMENT ID | TECN     | COMMENT                                        |
|--------------------------------------------------|------|-------------|----------|------------------------------------------------|
| <b>1.00±0.19<sup>+0.11</sup><sub>-0.32</sub></b> | 323  | ABLIKIM     | 10E BES2 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp \pi^0$ |

NODE=M070S73  
NODE=M070S73

 $\Gamma(K^*(892)^\pm K^*(700)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{28}/\Gamma$ 

| VALUE (units $10^{-3}$ )                         | EVTs | DOCUMENT ID | TECN     | COMMENT                                        |
|--------------------------------------------------|------|-------------|----------|------------------------------------------------|
| <b>1.09±0.18<sup>+0.94</sup><sub>-0.54</sub></b> | 655  | ABLIKIM     | 10E BES2 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp \pi^0$ |

NODE=M070S74  
NODE=M070S74

 $\Gamma(\eta K^*(892)^0\bar{K}^*(892)^0)/\Gamma_{\text{total}}$   $\Gamma_{35}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN     | COMMENT                                    |
|--------------------------|------|-------------|----------|--------------------------------------------|
| <b>1.15±0.13±0.22</b>    | 209  | ABLIKIM     | 10C BES2 | $J/\psi \rightarrow \eta K^+\pi^-K^-\pi^+$ |

NODE=M070S69  
NODE=M070S69

 $\Gamma(K^*(1410)\bar{K}+c.c. \rightarrow K^\pm K^\mp \pi^0)/\Gamma(K^+K^-\pi^0)$   $\Gamma_{41}/\Gamma_{156}$ 

| VALUE (%)          | EVTs | DOCUMENT ID       | TECN     | COMMENT                          |
|--------------------|------|-------------------|----------|----------------------------------|
| <b>2.3±1.1±0.7</b> | 2k   | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow K^+K^-\pi^0$ |

NODE=M070P28  
NODE=M070P28

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

NODE=M070P28;LINKAGE=A

 $\Gamma(K^*(1410)\bar{K}+c.c. \rightarrow K_S^0 K^\pm \pi^\mp)/\Gamma(K_S^0 K^\pm \pi^\mp)$   $\Gamma_{42}/\Gamma_{157}$ 

| VALUE (%)          | EVTs | DOCUMENT ID       | TECN     | COMMENT                                  |
|--------------------|------|-------------------|----------|------------------------------------------|
| <b>1.5±0.5±0.9</b> | 4k   | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$ |

NODE=M070P32  
NODE=M070P32

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

NODE=M070P32;LINKAGE=A

 $\Gamma(K_2^*(1430)\bar{K}+c.c. \rightarrow K^\pm K^\mp \pi^0)/\Gamma(K^+K^-\pi^0)$   $\Gamma_{44}/\Gamma_{156}$ 

| VALUE (%)          | EVTs | DOCUMENT ID       | TECN     | COMMENT                          |
|--------------------|------|-------------------|----------|----------------------------------|
| <b>3.5±1.3±0.9</b> | 2k   | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow K^+K^-\pi^0$ |

NODE=M070P29  
NODE=M070P29

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

NODE=M070P29;LINKAGE=A

 $\Gamma(K_2^*(1430)\bar{K}+c.c. \rightarrow K_S^0 K^\pm \pi^\mp)/\Gamma(K_S^0 K^\pm \pi^\mp)$   $\Gamma_{45}/\Gamma_{157}$ 

| VALUE (%)          | EVTs | DOCUMENT ID       | TECN     | COMMENT                                  |
|--------------------|------|-------------------|----------|------------------------------------------|
| <b>7.1±1.3±1.2</b> | 4k   | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$ |

NODE=M070P33  
NODE=M070P33

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

NODE=M070P33;LINKAGE=A

 $\Gamma(K^*(892)^0\bar{K}_2^*(1430)^0+c.c.)/\Gamma_{\text{total}}$   $\Gamma_{46}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                      | EVTs | DOCUMENT ID | TECN    | COMMENT                               |
|-------------------------------------------------------------------------------|------|-------------|---------|---------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |         |                                       |
| 6.7±2.6                                                                       | 40   | VANNUCCI    | 77 MRK1 | $e^+e^- \rightarrow \pi^+\pi^-K^+K^-$ |

NODE=M070R48  
NODE=M070R48

 $\Gamma(\omega K^*(892)\bar{K}+c.c.)/\Gamma_{\text{total}}$   $\Gamma_{50}/\Gamma$ 

| VALUE (units $10^{-4}$ )  | EVTs      | DOCUMENT ID | TECN     | COMMENT                                         |
|---------------------------|-----------|-------------|----------|-------------------------------------------------|
| <b>61 ± 9 OUR AVERAGE</b> |           |             |          |                                                 |
| 62.0± 6.8±10.6            | 899 ± 98  | ABLIKIM     | 08E BES2 | $J/\psi \rightarrow \omega K_S^0 K^\pm \pi^\mp$ |
| 65.3±10.2±13.5            | 176 ± 28  | ABLIKIM     | 08E BES2 | $J/\psi \rightarrow \omega K^+K^-\pi^0$         |
| 53 ±14 ±14                | 530 ± 140 | BECKER      | 87 MRK3  | $e^+e^- \rightarrow \text{hadrons}$             |

NODE=M070S2  
NODE=M070S2

OCCUR=2

 $\Gamma(\bar{K}K^*(892)+c.c. \rightarrow K_S^0 K^\pm \pi^\mp)/\Gamma(K_S^0 K^\pm \pi^\mp)$   $\Gamma_{52}/\Gamma_{157}$ 

| VALUE (%)           | EVTs | DOCUMENT ID       | TECN     | COMMENT                                  |
|---------------------|------|-------------------|----------|------------------------------------------|
| <b>90.5±0.9±3.8</b> | 4k   | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow K_S^0 K^\pm \pi^\mp$ |

NODE=M070P30  
NODE=M070P30

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

NODE=M070P30;LINKAGE=A

$\Gamma(K^+ K^*(892)^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{53}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

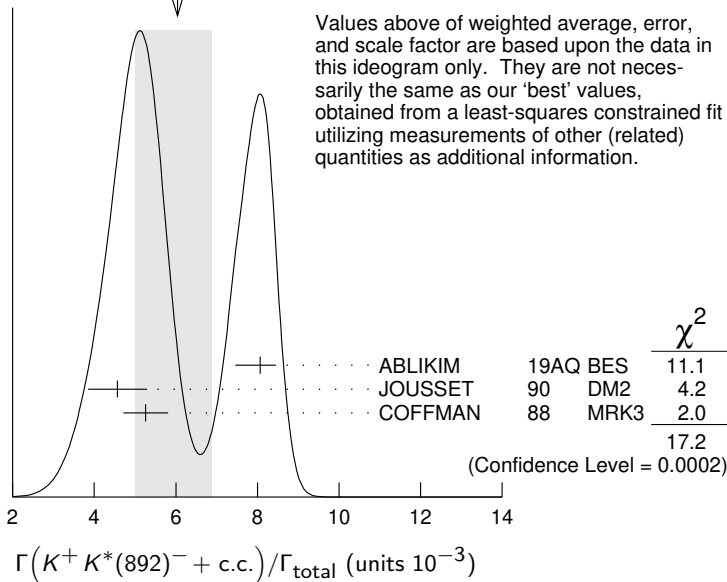
**6.0  $^{+0.8}_{-1.0}$  OUR AVERAGE** Error includes scale factor of 2.9. See the ideogram below.

|                                 |      |         |          |                                                         |
|---------------------------------|------|---------|----------|---------------------------------------------------------|
| $8.07 \pm 0.04^{+0.38}_{-0.61}$ | 183k | ABLIKIM | 19AQ BES | $J/\psi \rightarrow K^+ K^- \pi^0$                      |
| $4.57 \pm 0.17 \pm 0.70$        | 2285 | JOUSSET | 90 DM2   | $J/\psi \rightarrow \text{hadrons}$                     |
| $5.26 \pm 0.13 \pm 0.53$        |      | COFFMAN | 88 MRK3  | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp, K^+ K^- \pi^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |    |             |         |                                          |
|---------------|----|-------------|---------|------------------------------------------|
| $2.6 \pm 0.6$ | 24 | FRANKLIN    | 83 MRK2 | $J/\psi \rightarrow K^+ K^- \pi^0$       |
| $3.2 \pm 0.6$ | 48 | VANNUCCI    | 77 MRK1 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp$ |
| $4.1 \pm 1.2$ | 39 | BRAUNSCH... | 76 DASP | $J/\psi \rightarrow K^\pm X$             |

WEIGHTED AVERAGE  
6.0 $\pm$ 0.8-1.0 (Error scaled by 2.9)

 $\Gamma(K^+ K^*(892)^- + \text{c.c.} \rightarrow K^+ K^- \pi^0)/\Gamma(K^+ K^- \pi^0)$  $\Gamma_{54}/\Gamma_{156}$ 

| VALUE (%) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-----------|------|-------------|------|---------|
|-----------|------|-------------|------|---------|

**92.4 $\pm$ 1.5 $\pm$ 3.4** 2k <sup>1</sup> LEES 17C BABR  $J/\psi \rightarrow K^+ K^- \pi^0$

<sup>1</sup> From a Dalitz plot analysis in an isobar model.

 $\Gamma(K^0 \bar{K}^*(892)^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{56}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**4.2  $\pm 0.4$  OUR AVERAGE**

|                          |      |         |         |                                          |
|--------------------------|------|---------|---------|------------------------------------------|
| $3.96 \pm 0.15 \pm 0.60$ | 1192 | JOUSSET | 90 DM2  | $J/\psi \rightarrow \text{hadrons}$      |
| $4.33 \pm 0.12 \pm 0.45$ |      | COFFMAN | 88 MRK3 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |    |          |         |                                          |
|---------------|----|----------|---------|------------------------------------------|
| $2.7 \pm 0.6$ | 45 | VANNUCCI | 77 MRK1 | $J/\psi \rightarrow K^\pm K_S^0 \pi^\mp$ |
|---------------|----|----------|---------|------------------------------------------|

 $\Gamma(K_1(1400)^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**3.8 $\pm$ 0.8 $\pm$ 1.2** <sup>1</sup> BAI 99C BES  $e^+ e^-$

<sup>1</sup> Assuming  $B(K_1(1400) \rightarrow K^* \pi) = 0.94 \pm 0.06$

 $\Gamma(\bar{K}^*(892)^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{59}/\Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

seen <sup>1</sup> ABLIKIM 06C BES2  $J/\psi \rightarrow \bar{K}^*(892)^0 K^+ \pi^-$

<sup>1</sup> A  $K_0^*(700)$  is observed by ABLIKIM 06C in the  $K^+ \pi^-$  mass spectrum of the  $\bar{K}^*(892)^0 K^+ \pi^-$  final state against the  $\bar{K}^*(892)$ . A corresponding branching fraction of the  $J/\psi(1S)$  is not presented.

NODE=M070S15  
NODE=M070S15

NODE=M070P26  
NODE=M070P26

NODE=M070P26;LINKAGE=A

NODE=M070S16  
NODE=M070S16

NODE=M070S35  
NODE=M070S35

NODE=M070S35;LINKAGE=M3

NODE=M070S52  
NODE=M070S52

NODE=M070S52;LINKAGE=AB

$\Gamma(\omega\pi^0\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | EPTS |
|--------------------------|------|
| <b>3.4±0.3±0.7</b>       | 509  |

DOCUMENT ID

TECN

COMMENT

AUGUSTIN

89

DM2

 $J/\psi \rightarrow \pi^+\pi^-\pi^0$  $\Gamma_{62}/\Gamma$ 

NODE=M070S26  
NODE=M070S26

 $\Gamma(b_1(1235)^\pm\pi^\mp)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | EPTS |
|--------------------------|------|
| <b>30±5 OUR AVERAGE</b>  |      |
| 31±6                     | 4600 |
| 29±7                     | 87   |

DOCUMENT ID

TECN

COMMENT

AUGUSTIN

89

DM2

 $J/\psi \rightarrow 2(\pi^+\pi^-\pi^0)$ 

BURMESTER

77D

PLUT

 $e^+e^-$  $\Gamma_{64}/\Gamma$ 

NODE=M070R49  
NODE=M070R49

 $\Gamma(\omega K^\pm K_S^0\pi^\mp)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | EPTS      |
|--------------------------|-----------|
| <b>34 ±5 OUR AVERAGE</b> |           |
| 37.7±0.8±5.8             | 1972 ± 41 |
| 29.5±1.4±7.0             | 879 ± 41  |

DOCUMENT ID

TECN

COMMENT

ABLIKIM

08E

BES2

 $e^+e^- \rightarrow J/\psi$ 

BECKER

87

MRK3

 $e^+e^- \rightarrow \text{hadrons}$  $\Gamma_{65}/\Gamma$ 

NODE=M070S1  
NODE=M070S1

 $\Gamma(b_1(1235)^0\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | EPTS |
|--------------------------|------|
| <b>23±3±5</b>            | 229  |

DOCUMENT ID

TECN

COMMENT

AUGUSTIN

89

DM2

 $e^+e^-$  $\Gamma_{66}/\Gamma$ 

NODE=M070S28  
NODE=M070S28

 $\Gamma(\eta K^\pm K_S^0\pi^\mp)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | EPTS     |
|--------------------------|----------|
| <b>21.8±2.2±3.4</b>      | 232 ± 23 |

DOCUMENT ID

TECN

COMMENT

ABLIKIM

08E

BES2

 $e^+e^- \rightarrow J/\psi$  $\Gamma_{67}/\Gamma$ 

NODE=M070S57  
NODE=M070S57

 $\Gamma(\eta' K^{*0}\bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | EPTS |
|--------------------------|------|
| <b>1.66±0.03±0.21</b>    |      |

DOCUMENT ID

TECN

COMMENT

<sup>1</sup> ABLIKIM

18AB

BES3

 $J/\psi \rightarrow \eta' K^{*}\bar{K}$  $\Gamma_{37}/\Gamma$ 

NODE=M070P49  
NODE=M070P49

 $\Gamma(\eta' K^{*\pm} K^\mp)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ )     | EPTS |
|------------------------------|------|
| <b>1.48±0.13 OUR AVERAGE</b> |      |
| 1.50±0.02±0.19               |      |
| 1.47±0.03±0.17               |      |

DOCUMENT ID

TECN

COMMENT

<sup>1</sup> ABLIKIM

18AB

BES3

 $J/\psi \rightarrow \eta' K^{*}\bar{K}$ <sup>2</sup> ABLIKIM

18AB

BES3

 $J/\psi \rightarrow \eta' K^{*}\bar{K}$  $\Gamma_{36}/\Gamma$ 

NODE=M070P48  
NODE=M070P48

 $\Gamma(\eta' h_1(1415) \rightarrow \eta' K^{*\pm} K^\mp)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | EPTS |
|--------------------------|------|
| <b>1.51±0.09±0.21</b>    | 1.0k |

DOCUMENT ID

TECN

COMMENT

<sup>1</sup> ABLIKIM

18AB

BES3

 $J/\psi \rightarrow \eta' h_1 \rightarrow \eta' K^{*}\bar{K}$  $\Gamma_{39}/\Gamma$ 

NODE=M070P44  
NODE=M070P44

 $\Gamma(\eta' h_1(1415) \rightarrow \eta' K^{*}\bar{K} + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | EPTS |
|--------------------------|------|
| <b>2.16±0.12±0.29</b>    | 1.1k |

DOCUMENT ID

TECN

COMMENT

<sup>1</sup> ABLIKIM

18AB

BES3

 $J/\psi \rightarrow \eta' h_1 \rightarrow \eta' K^{*}\bar{K}$  $\Gamma_{38}/\Gamma$ 

NODE=M070P52  
NODE=M070P52

 $\Gamma(\phi K^{*}(892)\bar{K} + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )    | EPTS     |
|-----------------------------|----------|
| <b>21.8±2.3 OUR AVERAGE</b> |          |
| 20.8±2.7±3.9                | 195 ± 25 |
| 29.6±3.7±4.7                | 238 ± 30 |
| 20.7±2.4±3.0                |          |
| 20 ±3 ±3                    | 155 ± 20 |

DOCUMENT ID

TECN

COMMENT

ABLIKIM

08E

BES2

 $J/\psi \rightarrow \phi K_S^0 K^\pm \pi^\mp$ 

ABLIKIM

08E

BES2

 $J/\psi \rightarrow \phi K^+ K^- \pi^0$ 

FALVARD

88

DM2

 $J/\psi \rightarrow \text{hadrons}$ 

BECKER

87

MRK3

 $e^+e^- \rightarrow \text{hadrons}$  $\Gamma_{68}/\Gamma$ 

NODE=M070S4  
NODE=M070S4

 $\Gamma(\omega K\bar{K})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )  | EPTS |
|---------------------------|------|
| <b>19 ± 4 OUR AVERAGE</b> |      |
| 19.8± 2.1±3.9             |      |
| 16 ±10                    | 22   |

DOCUMENT ID

TECN

COMMENT

<sup>1</sup> FALVARD

88

DM2

 $J/\psi \rightarrow \text{hadrons}$ 

FELDMAN

77

MRK1

 $e^+e^-$  $\Gamma_{69}/\Gamma$ 

NODE=M070R27  
NODE=M070R27

<sup>1</sup> Addition of  $\omega K^+ K^-$  and  $\omega K^0 \bar{K}^0$  branching ratios.

NODE=M070R27;LINKAGE=B

$\Gamma(\omega f_0(1710) \rightarrow \omega K \bar{K})/\Gamma_{\text{total}}$  $\Gamma_{70}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**4.8 ± 1.1 ± 0.3**

1,2 FALVARD

88

DM2

 $J/\psi \rightarrow \text{hadrons}$ <sup>1</sup> Includes unknown branching fraction  $f_0(1710) \rightarrow K \bar{K}$ .<sup>2</sup> Addition of  $f_0(1710) \rightarrow K^+ K^-$  and  $f_0(1710) \rightarrow K^0 \bar{K}^0$  branching ratios.NODE=M070S25  
NODE=M070S25NODE=M070S25;LINKAGE=F  
NODE=M070S25;LINKAGE=G $\Gamma(\phi 2(\pi^+ \pi^-))/\Gamma_{\text{total}}$  $\Gamma_{71}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**16.0 ± 1.0 ± 3.0**

FALVARD

88

DM2

 $J/\psi \rightarrow \text{hadrons}$ NODE=M070R35  
NODE=M070R35 $\Gamma(\Delta(1232)^{++} \bar{p} \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{72}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.58 ± 0.23 ± 0.40**

332

EATON

84

MRK2

 $e^+ e^-$ NODE=M070R70  
NODE=M070R70 $\Gamma(\omega \eta)/\Gamma_{\text{total}}$  $\Gamma_{73}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.74 ± 0.20 OUR AVERAGE**

Error includes scale factor of 1.6. See the ideogram below.

2.352 ± 0.273

5k

<sup>1</sup>

ABLIKIM

06F

BES2

 $J/\psi \rightarrow \omega \eta$ 

1.44 ± 0.40 ± 0.14

13

<sup>2</sup>

AUBERT

06D

BABR

 $10.6 e^+ e^- \rightarrow \omega \eta \gamma$ 

1.43 ± 0.10 ± 0.21

378

JOUSSET

90

DM2

 $J/\psi \rightarrow \text{hadrons}$ 

1.71 ± 0.08 ± 0.20

COFFMAN

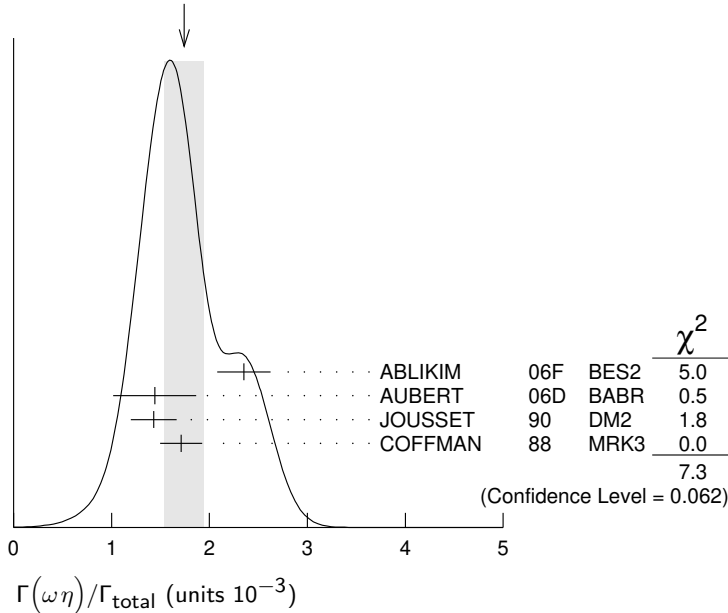
88

MRK3

 $e^+ e^- \rightarrow 3\pi \eta$ <sup>1</sup> Using  $B(\eta \rightarrow 2\gamma) = (39.43 \pm 0.26)\%$ ,  $B(\eta \rightarrow \pi^+ \pi^- \pi^0) = 22.6 \pm 0.4\%$ ,  $B(\eta \rightarrow \pi^+ \pi^- \gamma) = 4.68 \pm 0.11\%$ , and  $B(\omega \rightarrow \pi^+ \pi^- \pi^0) = (89.1 \pm 0.7)\%$ .<sup>2</sup> Using  $\Gamma(J/\psi \rightarrow e^+ e^-) = 5.52 \pm 0.14 \pm 0.04 \text{ keV}$ .NODE=M070R30  
NODE=M070R30

NODE=M070R30;LINKAGE=BL

NODE=M070R30;LINKAGE=EE

WEIGHTED AVERAGE  
1.74 ± 0.20 (Error scaled by 1.6) $\Gamma(\phi K \bar{K})/\Gamma_{\text{total}}$  $\Gamma_{75}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**17.7 ± 1.6 OUR AVERAGE**

Error includes scale factor of 1.3. See the ideogram below.

16.6 ± 1.9 ± 1.2

163 ± 19

LEES

12F

BABR

 $10.6 e^+ e^- \rightarrow 2(K^+ K^-) \gamma$ 

21.4 ± 0.4 ± 2.2

ABLIKIM

05

BES2

 $J/\psi \rightarrow \phi \pi^+ \pi^-$ 48  $^{+20}_{-16}$  ± 69.0  $^{+3.7}_{-3.0}$ 

1,2

HUANG

03

BELL

 $B^+ \rightarrow (\phi K^+ K^-) K^+$ 

14.6 ± 0.8 ± 2.1

<sup>3</sup>

FALVARD

88

DM2

 $J/\psi \rightarrow \text{hadrons}$ 

18 ± 8

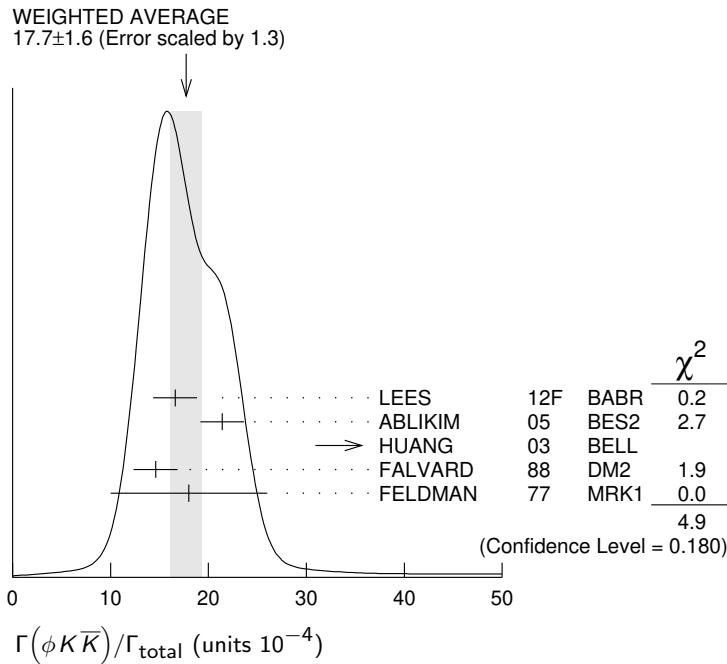
14

FELDMAN

77

MRK1

 $e^+ e^-$ <sup>1</sup> We have multiplied  $K^+ K^-$  measurement by 2 to obtain  $K \bar{K}$ .<sup>2</sup> Using  $B(B^+ \rightarrow J/\psi K^+) = (1.01 \pm 0.05) \times 10^{-3}$ .<sup>3</sup> Addition of  $\phi K^+ K^-$  and  $\phi K^0 \bar{K}^0$  branching ratios.NODE=M070R36  
NODE=M070R36NODE=M070R36;LINKAGE=AA  
NODE=M070R36;LINKAGE=CC  
NODE=M070R36;LINKAGE=A



### Γ(φf<sub>0</sub>(1710) → φK̄K̄)/Γ<sub>total</sub>

Γ<sub>77</sub>/Γ

| VALUE (units 10 <sup>-4</sup> ) | DOCUMENT ID | TECN   | COMMENT       |
|---------------------------------|-------------|--------|---------------|
| <b>3.6±0.2±0.6</b>              | 1,2 FALVARD | 88 DM2 | J/ψ → hadrons |

<sup>1</sup> Including interference with f'<sub>2</sub>(1525).

<sup>2</sup> Includes unknown branching fraction f<sub>0</sub>(1710) → K̄K̄.

NODE=M070S24  
NODE=M070S24

NODE=M070S24;LINKAGE=D  
NODE=M070S24;LINKAGE=E

### Γ(φf<sub>2</sub>(1270))/Γ<sub>total</sub>

Γ<sub>79</sub>/Γ

| VALUE (units 10 <sup>-3</sup> )                                               | CL% | DOCUMENT ID | TECN    | COMMENT                                                                                     |
|-------------------------------------------------------------------------------|-----|-------------|---------|---------------------------------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |         |                                                                                             |
| < 0.45                                                                        | 90  | FALVARD     | 88 DM2  | J/ψ → hadrons                                                                               |
| < 0.37                                                                        | 90  | VANNUCCI    | 77 MRK1 | e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> K <sup>+</sup> K <sup>-</sup> |

NODE=M070R39  
NODE=M070R39

### Γ(Δ(1232)<sup>++</sup>Δ̄(1232)<sup>--</sup>)/Γ<sub>total</sub>

Γ<sub>80</sub>/Γ

| VALUE (units 10 <sup>-3</sup> ) | EVTS | DOCUMENT ID | TECN    | COMMENT                       |
|---------------------------------|------|-------------|---------|-------------------------------|
| <b>1.10±0.09±0.28</b>           | 233  | EATON       | 84 MRK2 | e <sup>+</sup> e <sup>-</sup> |

NODE=M070R66  
NODE=M070R66

### Γ(Σ(1385)<sup>-</sup>Σ̄(1385)<sup>+</sup> (or c.c.))/Γ<sub>total</sub>

Γ<sub>81</sub>/Γ

| VALUE (units 10 <sup>-3</sup> ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                          |
|---------------------------------|------|-------------|----------|--------------------------------------------------|
| <b>1.16 ±0.05 OUR AVERAGE</b>   |      |             |          |                                                  |
| 1.096±0.012±0.071               | 43k  | ABLIKIM     | 16L BES3 | J/ψ → Σ(1385) <sup>-</sup> Σ̄(1385) <sup>+</sup> |
| 1.258±0.014±0.078               | 53k  | ABLIKIM     | 16L BES3 | J/ψ → Σ(1385) <sup>+</sup> Σ̄(1385) <sup>-</sup> |
| 1.23 ±0.07 ±0.30                | 0.8k | ABLIKIM     | 12P BES2 | J/ψ → Σ(1385) <sup>-</sup> Σ̄(1385) <sup>+</sup> |
| 1.50 ±0.08 ±0.38                | 1k   | ABLIKIM     | 12P BES2 | J/ψ → Σ(1385) <sup>+</sup> Σ̄(1385) <sup>-</sup> |
| 1.00 ±0.04 ±0.21                | 0.6k | HENRARD     | 87 DM2   | e <sup>+</sup> e <sup>-</sup> → Σ* <sup>-</sup>  |
| 1.19 ±0.04 ±0.25                | 0.7k | HENRARD     | 87 DM2   | e <sup>+</sup> e <sup>-</sup> → Σ* <sup>+</sup>  |
| 0.86 ±0.18 ±0.22                | 56   | EATON       | 84 MRK2  | e <sup>+</sup> e <sup>-</sup> → Σ* <sup>-</sup>  |
| 1.03 ±0.24 ±0.25                | 68   | EATON       | 84 MRK2  | e <sup>+</sup> e <sup>-</sup> → Σ* <sup>+</sup>  |

NODE=M070R67  
NODE=M070R67

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=2

### Γ(Σ(1385)<sup>0</sup>Σ̄(1385)<sup>0</sup>)/Γ<sub>total</sub>

Γ<sub>82</sub>/Γ

| VALUE (units 10 <sup>-3</sup> ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                       |
|---------------------------------|------|-------------|----------|-----------------------------------------------|
| <b>1.071±0.009±0.082</b>        | 103k | ABLIKIM     | 17E BES3 | e <sup>+</sup> e <sup>-</sup> → J/ψ → hadrons |

NODE=M070P17  
NODE=M070P17

OCCUR=2

### Γ(φf'<sub>2</sub>(1525))/Γ<sub>total</sub>

Γ<sub>84</sub>/Γ

| VALUE (units 10 <sup>-4</sup> ) | EVTS | DOCUMENT ID | TECN    | COMMENT                                                           |
|---------------------------------|------|-------------|---------|-------------------------------------------------------------------|
| <b>8 ±4 OUR AVERAGE</b>         |      |             |         | Error includes scale factor of 2.7.                               |
| 12.3±0.6±2.0                    |      | 1,2 FALVARD | 88 DM2  | J/ψ → hadrons                                                     |
| 4.8±1.8                         | 46   | 1 GIDAL     | 81 MRK2 | J/ψ → K <sup>+</sup> K <sup>-</sup> K <sup>+</sup> K <sup>-</sup> |

<sup>1</sup> Re-evaluated using B(f'<sub>2</sub>(1525) → K̄K̄) = 0.713.

<sup>2</sup> Including interference with f<sub>0</sub>(1710).

NODE=M070R40  
NODE=M070R40

NODE=M070R40;LINKAGE=B  
NODE=M070R40;LINKAGE=C

$\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{85}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.94±0.15 OUR AVERAGE** Error includes scale factor of 1.7.

|                |    |         |    |      |                                     |
|----------------|----|---------|----|------|-------------------------------------|
| 1.09±0.02±0.13 |    | ABLIKIM | 05 | BES2 | $J/\psi \rightarrow \phi\pi^+\pi^-$ |
| 0.78±0.03±0.12 |    | FALVARD | 88 | DM2  | $J/\psi \rightarrow \text{hadrons}$ |
| 2.1 ±0.9       | 23 | FELDMAN | 77 | MRK1 | $e^+e^-$                            |

NODE=M070R34  
NODE=M070R34

 $\Gamma(\phi K^\pm K_S^0 \pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{87}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**7.2±0.8 OUR AVERAGE**

|             |          |         |     |      |                                     |
|-------------|----------|---------|-----|------|-------------------------------------|
| 7.4±0.6±1.4 | 227 ± 19 | ABLIKIM | 08E | BES2 | $e^+e^- \rightarrow J/\psi$         |
| 7.4±0.9±1.1 |          | FALVARD | 88  | DM2  | $J/\psi \rightarrow \text{hadrons}$ |
| 7 ±0.6±1.0  | 163 ± 15 | BECKER  | 87  | MRK3 | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M070S3  
NODE=M070S3

 $\Gamma(\omega f_1(1420))/\Gamma_{\text{total}}$  $\Gamma_{88}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

|                        |           |        |    |      |                                     |
|------------------------|-----------|--------|----|------|-------------------------------------|
| <b>6.8+1.9-1.6±1.7</b> | 111+31-26 | BECKER | 87 | MRK3 | $e^+e^- \rightarrow \text{hadrons}$ |
|------------------------|-----------|--------|----|------|-------------------------------------|

NODE=M070S5  
NODE=M070S5

 $\Gamma(\phi\eta)/\Gamma_{\text{total}}$  $\Gamma_{89}/\Gamma$ 

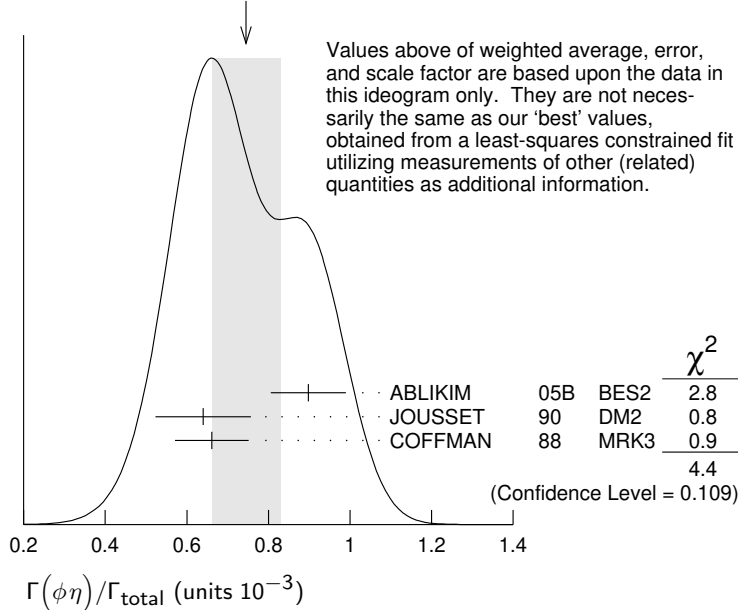
| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.74 ±0.08 OUR AVERAGE** Error includes scale factor of 1.5. See the ideogram below.

|                   |     |         |     |      |                                                     |
|-------------------|-----|---------|-----|------|-----------------------------------------------------|
| 0.898±0.024±0.089 |     | ABLIKIM | 05B | BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \text{hadr}$ |
| 0.64 ±0.04 ±0.11  | 346 | JOUSSET | 90  | DM2  | $J/\psi \rightarrow \text{hadrons}$                 |
| 0.661±0.045±0.078 |     | COFFMAN | 88  | MRK3 | $e^+e^- \rightarrow K^+K^-\eta$                     |

NODE=M070R37  
NODE=M070R37

WEIGHTED AVERAGE  
0.74±0.08 (Error scaled by 1.5)

 $\Gamma(\phi\eta\eta')/\Gamma_{\text{total}}$  $\Gamma_{99}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.32±0.06±0.16** 2.2k <sup>1</sup> ABLIKIM 19AN BES3  $e^+e^- \rightarrow J/\psi \rightarrow \text{hadrons}$ 

<sup>1</sup> Including contributions from intermediate resonances. Evidence for an intermediate resonance at  $M \approx 2 \text{ GeV}$  and  $\Gamma \approx 150 \text{ MeV}$  decaying to  $\phi\eta'$  with  $J^P = 1^+$  or  $J^P = 1^-$ , and  $B(J/\psi \rightarrow \eta X) \times B(X \rightarrow \phi\eta') \approx 10^{-4}$ .

NODE=M070P85  
NODE=M070P85

NODE=M070P85;LINKAGE=A

 $\Gamma(\Xi^0\Xi^0)/\Gamma_{\text{total}}$  $\Gamma_{90}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**1.17 ±0.04 OUR AVERAGE**

|                   |      |         |     |      |                                                        |
|-------------------|------|---------|-----|------|--------------------------------------------------------|
| 1.165±0.004±0.043 | 135k | ABLIKIM | 17E | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \text{hadrons}$ |
| 1.20 ±0.12 ±0.21  | 206  | ABLIKIM | 080 | BES2 | $e^+e^- \rightarrow J/\psi$                            |

NODE=M070S64  
NODE=M070S64



$\Gamma(\Xi(1530)^- \Xi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ )                        | EVTS | DOCUMENT ID | TECN    | COMMENT                      |
|-------------------------------------------------|------|-------------|---------|------------------------------|
| <b><math>0.318 \pm 0.008</math> OUR AVERAGE</b> |      |             |         |                              |
| $0.317 \pm 0.002 \pm 0.008$                     | 70k  | ABLIKIM     | 20 BES3 | $e^+ e^- \rightarrow J/\psi$ |
| $0.59 \pm 0.09 \pm 0.12$                        | 75   | HENRARD     | 87 DM2  | $e^+ e^-$                    |

 $\Gamma_{91}/\Gamma$ 

NODE=M070S9  
 NODE=M070S9

 $\Gamma(pK^- \bar{\Sigma}(1385)^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID | TECN    | COMMENT   |
|--------------------------------------------|------|-------------|---------|-----------|
| <b><math>0.51 \pm 0.26 \pm 0.18</math></b> | 89   | EATON       | 84 MRK2 | $e^+ e^-$ |

 $\Gamma_{92}/\Gamma$ 

NODE=M070R74  
 NODE=M070R74

 $\Gamma(\omega\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ )                      | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                     |
|-----------------------------------------------|------|----------------------|----------|-------------------------------------------------------------|
| <b><math>0.45 \pm 0.05</math> OUR AVERAGE</b> |      |                      |          | Error includes scale factor of 1.4. See the ideogram below. |
| $0.538 \pm 0.012 \pm 0.065$                   | 2090 | <sup>1</sup> ABLIKIM | 06F BES2 | $J/\psi \rightarrow \omega\pi^0$                            |
| $0.360 \pm 0.028 \pm 0.054$                   | 222  | JOUSSET              | 90 DM2   | $J/\psi \rightarrow \text{hadrons}$                         |
| $0.482 \pm 0.019 \pm 0.064$                   |      | COFFMAN              | 88 MRK3  | $e^+ e^- \rightarrow \pi^0 \pi^+ \pi^- \pi^0$               |

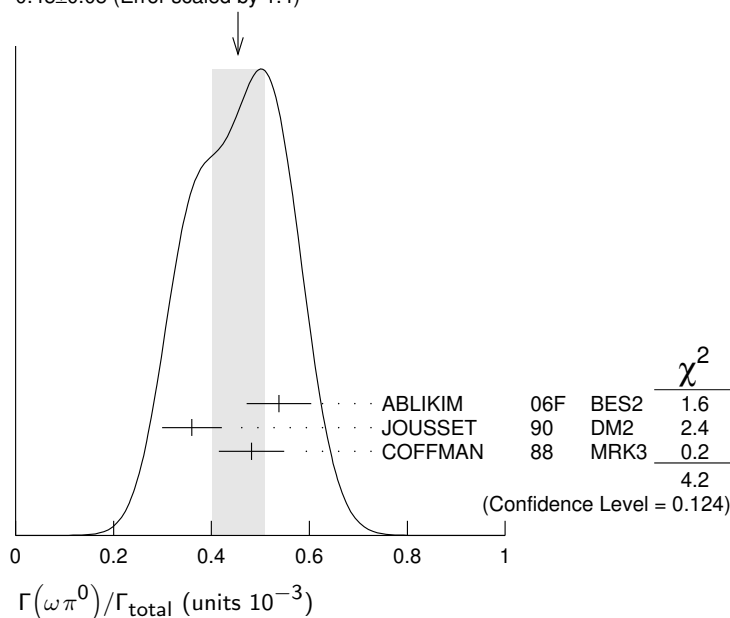
 $\Gamma_{93}/\Gamma$ 

NODE=M070R32  
 NODE=M070R32

<sup>1</sup> Using  $B(\omega \rightarrow \pi^+ \pi^- \pi^0) = (89.1 \pm 0.7)\%$ .

NODE=M070R32;LINKAGE=BL

WEIGHTED AVERAGE  
 $0.45 \pm 0.05$  (Error scaled by 1.4)

 $\Gamma(\omega\pi^0 \rightarrow \pi^+ \pi^- \pi^0)/\Gamma(\pi^+ \pi^- \pi^0)$ 

| VALUE (units $10^{-4}$ )          | EVTS | DOCUMENT ID       | TECN     | COMMENT                                |
|-----------------------------------|------|-------------------|----------|----------------------------------------|
| <b><math>8 \pm 3 \pm 2</math></b> | 20k  | <sup>1</sup> LEES | 17C BABR | $J/\psi \rightarrow \pi^+ \pi^- \pi^0$ |

 $\Gamma_{94}/\Gamma_{141}$ 

NODE=M070P23  
 NODE=M070P23

<sup>1</sup> From a Dalitz plot analysis in an isobar model and significance  $4.9 \sigma$ .

NODE=M070P23;LINKAGE=A

 $\Gamma(\phi\eta'(958))/\Gamma_{\text{total}}$ 

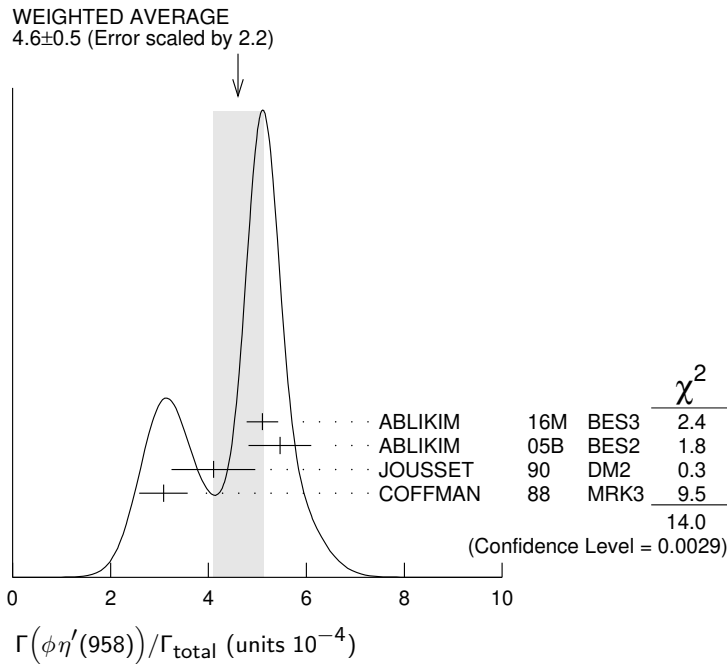
| VALUE (units $10^{-4}$ )                    | CL% | EVTS | DOCUMENT ID | TECN     | COMMENT                                                     |
|---------------------------------------------|-----|------|-------------|----------|-------------------------------------------------------------|
| <b><math>4.6 \pm 0.5</math> OUR AVERAGE</b> |     |      |             |          | Error includes scale factor of 2.2. See the ideogram below. |
| $5.10 \pm 0.03 \pm 0.32$                    |     | 31k  | ABLIKIM     | 16M BES3 | $e^+ e^- \rightarrow J/\psi \rightarrow \text{hadrons}$     |
| $5.46 \pm 0.31 \pm 0.56$                    |     |      | ABLIKIM     | 05B BES2 | $e^+ e^- \rightarrow J/\psi \rightarrow \text{hadrons}$     |
| $4.1 \pm 0.3 \pm 0.8$                       |     | 167  | JOUSSET     | 90 DM2   | $J/\psi \rightarrow \text{hadrons}$                         |
| $3.08 \pm 0.34 \pm 0.36$                    |     |      | COFFMAN     | 88 MRK3  | $e^+ e^- \rightarrow K^+ K^- \eta'$                         |

 $\Gamma_{95}/\Gamma$ 

NODE=M070R38  
 NODE=M070R38

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 13                      90                      VANNUCCI    77    MRK1     $e^+ e^-$



### $\Gamma(\phi f_0(980))/\Gamma_{\text{total}}$

| VALUE (units $10^{-4}$ )   | EVTS                                | DOCUMENT ID          | TECN    | COMMENT                              |
|----------------------------|-------------------------------------|----------------------|---------|--------------------------------------|
| <b>3.2±0.9 OUR AVERAGE</b> | Error includes scale factor of 1.9. |                      |         |                                      |
| 4.6±0.4±0.8                |                                     | <sup>1</sup> FALVARD | 88 DM2  | $J/\psi \rightarrow \text{hadrons}$  |
| 2.6±0.6                    | 50                                  | <sup>1</sup> GIDAL   | 81 MRK2 | $J/\psi \rightarrow K^+ K^- K^+ K^-$ |

<sup>1</sup> Assuming  $B(f_0(980) \rightarrow \pi\pi) = 0.78$ .

NODE=M070R41  
NODE=M070R41

NODE=M070R41;LINKAGE=A

### $\Gamma(\phi\pi^0 f_0(980) \rightarrow \phi\pi^0\pi^+\pi^-)/\Gamma_{\text{total}}$

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                           |
|--------------------------|------|-------------|----------|-----------------------------------|
| <b>4.50±0.80±0.61</b>    | 355  | ABLIKIM     | 15P BES3 | $J/\psi \rightarrow K^+ K^- 3\pi$ |

NODE=M070S97  
NODE=M070S97

### $\Gamma(\phi\pi^0 f_0(980) \rightarrow \phi\pi^0\rho^0\pi^0)/\Gamma_{\text{total}}$

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                           |
|--------------------------|------|-------------|----------|-----------------------------------|
| <b>1.67±0.50±0.24</b>    | 70   | ABLIKIM     | 15P BES3 | $J/\psi \rightarrow K^+ K^- 3\pi$ |

NODE=M070S98  
NODE=M070S98

### $\Gamma(\eta\phi f_0(980) \rightarrow \eta\phi\pi^+\pi^-)/\Gamma_{\text{total}}$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN    | COMMENT                                |
|--------------------------|------|-------------|---------|----------------------------------------|
| <b>3.23±0.75±0.73</b>    | 52   | ABLIKIM     | 08F BES | $J/\psi \rightarrow \eta\phi f_0(980)$ |

NODE=M070R08  
NODE=M070R08

### $\Gamma(\phi a_0(980)^0 \rightarrow \phi\eta\pi^0)/\Gamma_{\text{total}}$

| VALUE (units $10^{-6}$ )                                                      | DOCUMENT ID          | TECN     | COMMENT                            |
|-------------------------------------------------------------------------------|----------------------|----------|------------------------------------|
| <b>4.37±1.35</b>                                                              | <sup>1</sup> ABLIKIM | 18D BES3 | $J/\psi \rightarrow \phi\eta\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |          |                                    |
| 5.0 ±2.7 ±2.5                                                                 | <sup>2</sup> ABLIKIM | 11D BES3 | $J/\psi \rightarrow \phi\eta\pi^0$ |

NODE=M070S75  
NODE=M070S75

<sup>1</sup> Assuming constructive interference between  $a_0(980) - f_0(980)$  mixing and electromagnetic decay. Destructive interference gives a value of  $(4.93 \pm 1.77) \times 10^{-6}$  for this branching fraction.

<sup>2</sup> Assuming  $a_0(980) - f_0(980)$  mixing and isospin breaking via  $\gamma^*$  and  $K^* K$  loops.

NODE=M070S75;LINKAGE=A

NODE=M070S75;LINKAGE=AB

### $\Gamma(\Xi(1530)^0 \Xi^0)/\Gamma_{\text{total}}$

| VALUE (units $10^{-3}$ ) | EVTS   | DOCUMENT ID | TECN   | COMMENT   |
|--------------------------|--------|-------------|--------|-----------|
| <b>0.32±0.12±0.07</b>    | 24 ± 9 | HENRARD     | 87 DM2 | $e^+ e^-$ |

NODE=M070S10  
NODE=M070S10

### $\Gamma(\Sigma(1385)^- \bar{\Sigma}^+ (\text{or c.c.}))/\Gamma_{\text{total}}$

| VALUE (units $10^{-3}$ )     | EVTS   | DOCUMENT ID | TECN    | COMMENT                           |
|------------------------------|--------|-------------|---------|-----------------------------------|
| <b>0.31±0.05 OUR AVERAGE</b> |        |             |         |                                   |
| 0.30±0.03±0.07               | 74 ± 8 | HENRARD     | 87 DM2  | $e^+ e^- \rightarrow \Sigma^{*-}$ |
| 0.34±0.04±0.07               | 77 ± 9 | HENRARD     | 87 DM2  | $e^+ e^- \rightarrow \Sigma^{*+}$ |
| 0.29±0.11±0.10               | 26     | EATON       | 84 MRK2 | $e^+ e^- \rightarrow \Sigma^{*-}$ |
| 0.31±0.11±0.11               | 28     | EATON       | 84 MRK2 | $e^+ e^- \rightarrow \Sigma^{*+}$ |

NODE=M070R68  
NODE=M070R68

OCCUR=2

OCCUR=2

$\Gamma(\phi f_1(1285))/\Gamma_{\text{total}}$  $\Gamma_{106}/\Gamma$ VALUE (units  $10^{-4}$ ) EVTS

DOCUMENT ID TECN COMMENT

**2.6±0.5 OUR AVERAGE**3.4±1.8±1.5 1.1k <sup>1</sup> ABLIKIM 15H BES3  $e^+e^- \rightarrow J/\psi \rightarrow \phi\eta\pi^+\pi^-$ 3.2±0.6±0.4 JOUSSET 90 DM2  $J/\psi \rightarrow \phi 2(\pi^+\pi^-)$ 2.1±0.5±0.4 25 <sup>2</sup> JOUSSET 90 DM2  $J/\psi \rightarrow \phi\eta\pi^+\pi^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.6±0.2±0.1 16 BECKER 87 MRK3  $J/\psi \rightarrow \phi K \bar{K} \pi$ 

<sup>1</sup> ABLIKIM 15H reports  $[\Gamma(J/\psi(1S) \rightarrow \phi f_1(1285))/\Gamma_{\text{total}}] \times [B(f_1(1285) \rightarrow \eta\pi^+\pi^-)] = (1.20 \pm 0.6 \pm 0.14) \times 10^{-4}$  which we divide by our best value  $B(f_1(1285) \rightarrow \eta\pi^+\pi^-) = (35 \pm 15) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> We attribute to the  $f_1(1285)$  the signal observed in the  $\pi^+\pi^-\eta$  invariant mass distribution at 1297 MeV.

NODE=M070S6  
NODE=M070S6

OCCUR=2

NODE=M070S6;LINKAGE=A

NODE=M070S6;LINKAGE=Q

 $\Gamma(\phi f_1(1285) \rightarrow \phi\pi^0 f_0(980) \rightarrow \phi\pi^0\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{107}/\Gamma$ VALUE (units  $10^{-7}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**9.36±2.31±1.54**

78

ABLIKIM

15P

BES3

 $J/\psi \rightarrow K^+ K^- 3\pi$ NODE=M070S99  
NODE=M070S99 $\Gamma(\phi f_1(1285) \rightarrow \phi\pi^0 f_0(980) \rightarrow \phi\pi^0\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{108}/\Gamma$ VALUE (units  $10^{-7}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**2.08±1.63±1.47**

9

ABLIKIM

15P

BES3

 $J/\psi \rightarrow K^+ K^- 3\pi$ NODE=M070S00  
NODE=M070S00 $\Gamma(\eta\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{109}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**3.78±0.68**

471

<sup>1</sup> ABLIKIM

19Q

BES3

 $e^+e^- \rightarrow J/\psi \rightarrow \eta\pi^+\pi^-$ 

<sup>1</sup> From an energy scan of  $e^+e^- \rightarrow J/\psi \rightarrow \eta\pi^+\pi^-$  assuming PDG 16 values for  $\Gamma(e^+e^-)$ ,  $\Gamma(\mu^+\mu^-)$ , and  $\Gamma(\text{total})$ .

NODE=M070P81  
NODE=M070P81

NODE=M070P81;LINKAGE=A

 $\Gamma(\eta\rho)/\Gamma_{\text{total}}$  $\Gamma_{110}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**0.193±0.023 OUR AVERAGE**

0.194±0.017±0.029 299

JOUSSET

90

DM2

 $J/\psi \rightarrow \text{hadrons}$ 

0.193±0.013±0.029

COFFMAN

88

MRK3

 $e^+e^- \rightarrow \pi^+\pi^-\eta$ NODE=M070R22  
NODE=M070R22 $\Gamma(\omega\eta'(958))/\Gamma_{\text{total}}$  $\Gamma_{111}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.89±0.18 OUR AVERAGE**

2.08±0.30±0.14 137

<sup>1</sup> ABLIKIM

17AK

BES3

 $J/\psi \rightarrow \pi^+\pi^-\eta'$ 

2.26±0.43 218

<sup>2</sup> ABLIKIM

06F

BES2

 $J/\psi \rightarrow \omega\eta'$ 1.8  $^{+1.0}_{-0.8}$  ±0.3 6

JOUSSET

90

DM2

 $J/\psi \rightarrow \text{hadrons}$ 

1.66±0.17±0.19

COFFMAN

88

MRK3

 $e^+e^- \rightarrow 3\pi\eta'$ 

<sup>1</sup> From a partial wave analysis of the decay  $J/\psi \rightarrow \pi^+\pi^-\eta'$ .

<sup>2</sup> Using  $B(\eta' \rightarrow \pi^+\pi^-\eta) = (44.3 \pm 1.5)\%$ ,  $B(\eta' \rightarrow \pi^+\pi^-\gamma) = 29.5 \pm 1.0\%$ ,  $B(\eta \rightarrow 2\gamma) = 39.43 \pm 0.26\%$ , and  $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.1 \pm 0.7)\%$ .

NODE=M070R31  
NODE=M070R31NODE=M070R31;LINKAGE=A  
NODE=M070R31;LINKAGE=BL $\Gamma(\omega f_0(980))/\Gamma_{\text{total}}$  $\Gamma_{112}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**1.41±0.27±0.47**<sup>1</sup> AUGUSTIN

89

DM2

 $J/\psi \rightarrow 2(\pi^+\pi^-)\pi^0$ 

<sup>1</sup> Assuming  $B(f_0(980) \rightarrow \pi\pi) = 0.78$ .

NODE=M070S27  
NODE=M070S27

NODE=M070S27;LINKAGE=K

 $\Gamma(\rho\eta'(958))/\Gamma_{\text{total}}$  $\Gamma_{113}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**8.1 ±0.8 OUR AVERAGE** Error includes scale factor of 1.6.

7.90±0.19±0.49 3476

<sup>1</sup> ABLIKIM

17AK

BES3

 $J/\psi \rightarrow \pi^+\pi^-\eta'$ 

8.3 ±3.0 ±1.2 19

JOUSSET

90

DM2

 $J/\psi \rightarrow \text{hadrons}$ 

11.4 ±1.4 ±1.6

COFFMAN

88

MRK3

 $J/\psi \rightarrow \pi^+\pi^-\eta'$ 

<sup>1</sup> From a partial wave analysis of the decay  $J/\psi \rightarrow \pi^+\pi^-\eta'$ .

NODE=M070R23  
NODE=M070R23

NODE=M070R23;LINKAGE=A

 $\Gamma(a_2(1320)^\pm\pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{114}/\Gamma$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<43 × 10<sup>-4</sup>**

90

BRAUNSCH...

76

DASP

 $e^+e^-$ NODE=M070R42  
NODE=M070R42

$\Gamma(K\bar{K}_2^*(1430) + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{115}/\Gamma$ 

| VALUE                | CL% | DOCUMENT ID | TECN | COMMENT                                |
|----------------------|-----|-------------|------|----------------------------------------|
| $<40 \times 10^{-4}$ | 90  | VANNUCCI 77 | MRK1 | $e^+e^- \rightarrow K^0\bar{K}_2^{*0}$ |

NODE=M070R45  
NODE=M070R45

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                      |    |                |      |                                            |
|----------------------|----|----------------|------|--------------------------------------------|
| $<66 \times 10^{-4}$ | 90 | BRAUNSCH... 76 | DASP | $e^+e^- \rightarrow K^\pm\bar{K}_2^{*\mp}$ |
|----------------------|----|----------------|------|--------------------------------------------|

 $\Gamma(K_1(1270)^\pm K^\mp)/\Gamma_{\text{total}}$   $\Gamma_{116}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID          | TECN | COMMENT  |
|-----------------------|-----|----------------------|------|----------|
| $<3.0 \times 10^{-3}$ | 90  | <sup>1</sup> BAI 99C | BES  | $e^+e^-$ |

NODE=M070S34  
NODE=M070S34

<sup>1</sup> Assuming  $B(K_1(1270) \rightarrow K\rho)=0.42 \pm 0.06$

NODE=M070S34;LINKAGE=M2

 $\Gamma(K_1(1270)K_S^0 \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{117}/\Gamma$ 

| VALUE (units $10^{-7}$ )         | DOCUMENT ID  | TECN | COMMENT                                 |
|----------------------------------|--------------|------|-----------------------------------------|
| $8.54^{+1.07+2.35}_{-1.20-2.13}$ | ABLIKIM 18AA | BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

NODE=M070P72  
NODE=M070P72

 $\Gamma(K_2^*(1430)^0\bar{K}_2^*(1430)^0)/\Gamma_{\text{total}}$   $\Gamma_{119}/\Gamma$ 

| VALUE                | CL% | DOCUMENT ID | TECN | COMMENT                                |
|----------------------|-----|-------------|------|----------------------------------------|
| $<29 \times 10^{-4}$ | 90  | VANNUCCI 77 | MRK1 | $e^+e^- \rightarrow \pi^+\pi^- K^+K^-$ |

NODE=M070R47  
NODE=M070R47

 $\Gamma(\phi\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{120}/\Gamma$ 

The two different fit values of ABLIKIM 15K below have the same statistical significance of  $6.4\sigma$  and cannot be distinguished at this moment.

| VALUE (units $10^{-6}$ )    | CL% | EVTS       | DOCUMENT ID              | TECN | COMMENT                                                    |
|-----------------------------|-----|------------|--------------------------|------|------------------------------------------------------------|
| $2.94 \pm 0.16 \pm 0.16$    |     | 0.8k       | <sup>1</sup> ABLIKIM 15K | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow K^+K^-\gamma\gamma$ |
| $0.124 \pm 0.033 \pm 0.030$ |     | $35 \pm 9$ | <sup>2</sup> ABLIKIM 15K | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow K^+K^-\gamma\gamma$ |

NODE=M070R33  
NODE=M070R33

NODE=M070R33

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |                          |      |                                                          |
|--------|----|--------------------------|------|----------------------------------------------------------|
| $<6.4$ | 90 | <sup>3</sup> ABLIKIM 05B | BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \phi\gamma\gamma$ |
| $<6.8$ | 90 | COFFMAN 88               | MRK3 | $e^+e^- \rightarrow K^+K^-\pi^0$                         |

<sup>1</sup> Corresponding to one of the two fit solutions with  $\delta = (-95.9 \pm 1.5)^\circ$  for the phase angle between the resonant  $J/\psi \rightarrow \phi\pi^0$  and non-phi  $J/\psi \rightarrow K^+K^-\pi^0$  contributions.

<sup>2</sup> Corresponding to one of the two fit solutions with  $\delta = (-152.1 \pm 7.7)^\circ$  for the phase angle between the resonant  $J/\psi \rightarrow \phi\pi^0$  and non-phi  $J/\psi \rightarrow K^+K^-\pi^0$  contributions.

<sup>3</sup> Superseded by ABLIKIM 15K.

NODE=M070R33;LINKAGE=A

NODE=M070R33;LINKAGE=C

NODE=M070R33;LINKAGE=B

 $\Gamma(\phi\eta(1405) \rightarrow \phi\eta\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{121}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | EVTS | DOCUMENT ID              | TECN | COMMENT                                                    |
|--------------------------|-----|------|--------------------------|------|------------------------------------------------------------|
| $2.01 \pm 0.58 \pm 0.82$ | 172 |      | <sup>1</sup> ABLIKIM 15H | BES3 | $e^+e^- \rightarrow J/\psi \rightarrow \phi\eta\pi^+\pi^-$ |

NODE=M070S23  
NODE=M070S23

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                         |     |                                     |
|-------|----|-------------------------|-----|-------------------------------------|
| $<17$ | 90 | <sup>2</sup> FALVARD 88 | DM2 | $J/\psi \rightarrow \text{hadrons}$ |
|-------|----|-------------------------|-----|-------------------------------------|

<sup>1</sup> With  $3.6\sigma$  significance.

<sup>2</sup> Includes unknown branching fraction  $\eta(1405) \rightarrow \eta\pi\pi$ .

NODE=M070S23;LINKAGE=B  
NODE=M070S23;LINKAGE=A

 $\Gamma(\omega f'_2(1525))/\Gamma_{\text{total}}$   $\Gamma_{122}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID              | TECN | COMMENT                                     |
|-----------------------|-----|--------------------------|------|---------------------------------------------|
| $<2.2 \times 10^{-4}$ | 90  | <sup>1</sup> VANNUCCI 77 | MRK1 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0 K^+K^-$ |

NODE=M070R29  
NODE=M070R29

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |    |                         |     |                                     |
|-----------------------|----|-------------------------|-----|-------------------------------------|
| $<2.8 \times 10^{-4}$ | 90 | <sup>1</sup> FALVARD 88 | DM2 | $J/\psi \rightarrow \text{hadrons}$ |
|-----------------------|----|-------------------------|-----|-------------------------------------|

<sup>1</sup> Re-evaluated assuming  $B(f'_2(1525) \rightarrow K\bar{K}) = 0.713$ .

NODE=M070R29;LINKAGE=C

 $\Gamma(\omega X(1835) \rightarrow \omega p\bar{p})/\Gamma_{\text{total}}$   $\Gamma_{123}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                                   |
|-----------------------|-----|-------------|------|-------------------------------------------|
| $<3.9 \times 10^{-6}$ | 95  | ABLIKIM 13P | BES3 | $J/\psi \rightarrow \gamma\pi^0 p\bar{p}$ |

NODE=M070S81  
NODE=M070S81

 $\Gamma(\omega X(1835), X \rightarrow \eta'\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{124}/\Gamma$ 

| VALUE                 | DOCUMENT ID               | TECN | COMMENT                                    |
|-----------------------|---------------------------|------|--------------------------------------------|
| $<6.2 \times 10^{-5}$ | <sup>1</sup> ABLIKIM 19AC | BES3 | $J/\psi \rightarrow \omega\eta'\pi^+\pi^-$ |

NODE=M070P84  
NODE=M070P84

<sup>1</sup> Using the decays  $\omega \rightarrow \pi^+\pi^-\pi^0$  and  $\eta' \rightarrow \eta\pi^+\pi^-$ .

NODE=M070P84;LINKAGE=A

$\Gamma(\phi X(1835) \rightarrow \phi p \bar{p})/\Gamma_{\text{total}}$   $\Gamma_{125}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID          | TECN     | COMMENT                                                            |
|-----------------------|-----|----------------------|----------|--------------------------------------------------------------------|
| $<2.1 \times 10^{-7}$ | 90  | <sup>1</sup> ABLIKIM | 16K BES3 | $J/\psi \rightarrow p \bar{p} K_S^0 K_L^0,$<br>$p \bar{p} K^+ K^-$ |

NODE=M070P00  
NODE=M070P00  
OCCUR=2

<sup>1</sup> Upper limit applies to any  $p \bar{p}$  mass enhancement near threshold.

NODE=M070P00;LINKAGE=A

 $\Gamma(\phi X(1835) \rightarrow \phi \eta \pi^+ \pi^-)/\Gamma_{\text{total}}$   $\Gamma_{126}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                                                        |
|-----------------------|-----|-------------|----------|----------------------------------------------------------------|
| $<2.8 \times 10^{-4}$ | 90  | ABLIKIM     | 15H BES3 | $e^+ e^- \rightarrow J/\psi \rightarrow \phi \eta \pi^+ \pi^-$ |

NODE=M070B10  
NODE=M070B10

 $\Gamma(\phi X(1870) \rightarrow \phi \eta \pi^+ \pi^-)/\Gamma_{\text{total}}$   $\Gamma_{127}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                                                        |
|------------------------|-----|-------------|----------|----------------------------------------------------------------|
| $<6.13 \times 10^{-5}$ | 90  | ABLIKIM     | 15H BES3 | $e^+ e^- \rightarrow J/\psi \rightarrow \phi \eta \pi^+ \pi^-$ |

NODE=M070B11  
NODE=M070B11

 $\Gamma(\eta \phi(2170) \rightarrow \eta \phi f_0(980) \rightarrow \eta \phi \pi^+ \pi^-)/\Gamma_{\text{total}}$   $\Gamma_{128}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                                        |
|--------------------------|------|-------------|----------|----------------------------------------------------------------|
| $1.20 \pm 0.14 \pm 0.37$ | 471  | ABLIKIM     | 15H BES3 | $e^+ e^- \rightarrow J/\psi \rightarrow \phi \eta \pi^+ \pi^-$ |

NODE=M070B12  
NODE=M070B12

 $\Gamma(\eta \phi(2170) \rightarrow \eta K^*(892)^0 \bar{K}^*(892)^0)/\Gamma_{\text{total}}$   $\Gamma_{129}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                                       |
|------------------------|-----|-------------|----------|-----------------------------------------------|
| $<2.52 \times 10^{-4}$ | 90  | ABLIKIM     | 10C BES2 | $J/\psi \rightarrow \eta K^+ \pi^- K^- \pi^+$ |

NODE=M070S70  
NODE=M070S70

 $\Gamma(\Sigma(1385)^0 \bar{\Lambda} + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{130}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN     | COMMENT                                                  |
|-------------------------------------------------------------------------------|-----|-------------|----------|----------------------------------------------------------|
| $<0.82 \times 10^{-5}$                                                        | 90  | ABLIKIM     | 13F BES3 | $J/\psi \rightarrow p \bar{p} \pi^+ \pi^- \gamma \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                                                          |
| $<0.2 \times 10^{-3}$                                                         | 90  | HENRARD     | 87 DM2   | $e^+ e^-$                                                |

NODE=M070S13  
NODE=M070S13

 $\Gamma(\Delta(1232)^+ \bar{p})/\Gamma_{\text{total}}$   $\Gamma_{131}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN   | COMMENT   |
|-----------------------|-----|-------------|--------|-----------|
| $<0.1 \times 10^{-3}$ | 90  | HENRARD     | 87 DM2 | $e^+ e^-$ |

NODE=M070S14  
NODE=M070S14

 $\Gamma(\Lambda(1520) \bar{\Lambda} + \text{c.c.} \rightarrow \gamma \Lambda \bar{\Lambda})/\Gamma_{\text{total}}$   $\Gamma_{132}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                                           |
|-----------------------|-----|-------------|----------|---------------------------------------------------|
| $<4.1 \times 10^{-6}$ | 90  | ABLIKIM     | 12B BES3 | $J/\psi \rightarrow \Lambda \bar{\Lambda} \gamma$ |

NODE=M070S77  
NODE=M070S77

 $\Gamma(\bar{\Lambda}(1520) \Lambda + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{133}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID | TECN    | COMMENT                                   |
|------------------------|-----|-------------|---------|-------------------------------------------|
| $<1.80 \times 10^{-3}$ | 90  | LU          | 19 BELL | $B^+ \rightarrow \bar{p} \Lambda K^+ K^+$ |

NODE=M070P60  
NODE=M070P60

 $\Gamma(\Theta(1540) \bar{\Theta}(1540) \rightarrow K_S^0 p K^- \bar{n} + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{134}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT   |
|-----------------------|-----|-------------|----------|-----------|
| $<1.1 \times 10^{-5}$ | 90  | BAI         | 04G BES2 | $e^+ e^-$ |

NODE=M070S47  
NODE=M070S47

 $\Gamma(\Theta(1540) K^- \bar{n} \rightarrow K_S^0 p K^- \bar{n})/\Gamma_{\text{total}}$   $\Gamma_{135}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT   |
|-----------------------|-----|-------------|----------|-----------|
| $<2.1 \times 10^{-5}$ | 90  | BAI         | 04G BES2 | $e^+ e^-$ |

NODE=M070S48  
NODE=M070S48

 $\Gamma(\Theta(1540) K_S^0 \bar{p} \rightarrow K_S^0 \bar{p} K^+ n)/\Gamma_{\text{total}}$   $\Gamma_{136}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT   |
|-----------------------|-----|-------------|----------|-----------|
| $<1.6 \times 10^{-5}$ | 90  | BAI         | 04G BES2 | $e^+ e^-$ |

NODE=M070S49  
NODE=M070S49

 $\Gamma(\bar{\Theta}(1540) K^+ n \rightarrow K_S^0 \bar{p} K^+ n)/\Gamma_{\text{total}}$   $\Gamma_{137}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT   |
|-----------------------|-----|-------------|----------|-----------|
| $<5.6 \times 10^{-5}$ | 90  | BAI         | 04G BES2 | $e^+ e^-$ |

NODE=M070S50  
NODE=M070S50

 $\Gamma(\bar{\Theta}(1540) K_S^0 p \rightarrow K_S^0 p K^- \bar{n})/\Gamma_{\text{total}}$   $\Gamma_{138}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT   |
|-----------------------|-----|-------------|----------|-----------|
| $<1.1 \times 10^{-5}$ | 90  | BAI         | 04G BES2 | $e^+ e^-$ |

NODE=M070S51  
NODE=M070S51

# STABLE HADRONS

$\Gamma(2(\pi^+\pi^-)\pi^0)/\Gamma_{\text{total}}$

$\Gamma_{139}/\Gamma$

| VALUE (units $10^{-2}$ )     | EVTS  | DOCUMENT ID                                                 | TECN     | COMMENT                                 |
|------------------------------|-------|-------------------------------------------------------------|----------|-----------------------------------------|
| <b>3.73±0.32 OUR AVERAGE</b> |       | Error includes scale factor of 1.4. See the ideogram below. |          |                                         |
| 4.73±0.44                    | 228k  | <sup>1</sup> ABLIKIM                                        | 19Q BES3 | $J/\psi \rightarrow 2(\pi^+\pi^-)\pi^0$ |
| 3.25±0.49                    | 46055 | AUGUSTIN                                                    | 89 DM2   | $J/\psi \rightarrow 2(\pi^+\pi^-)\pi^0$ |
| 3.17±0.42                    | 147   | FRANKLIN                                                    | 83 MRK2  | $e^+e^- \rightarrow \text{hadrons}$     |
| 3.64±0.52                    | 1500  | BURMESTER                                                   | 77D PLUT | $e^+e^-$                                |
| 4 ±1                         | 675   | JEAN-MARIE                                                  | 76 MRK1  | $e^+e^-$                                |

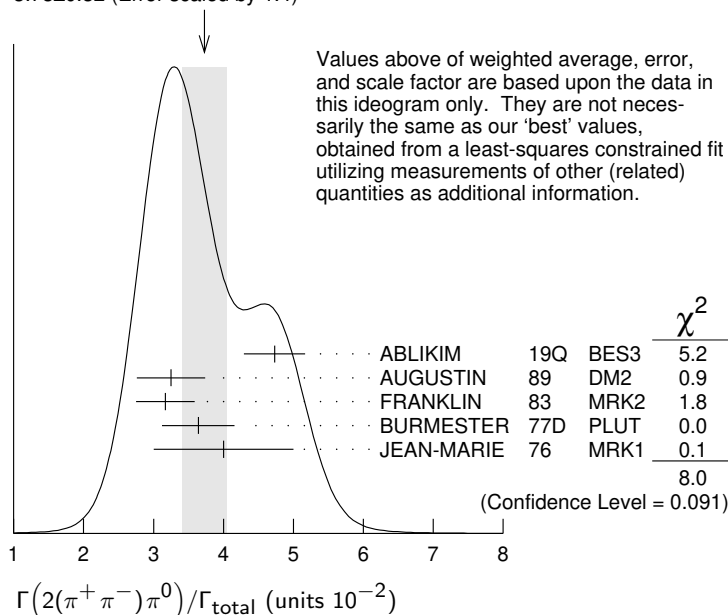
<sup>1</sup> From an energy scan of  $e^+e^- \rightarrow J/\psi \rightarrow 2(\pi^+\pi^-)\pi^0$ , assuming PDG 16 values for  $\Gamma(e^+e^-)$ ,  $\Gamma(\mu^+\mu^-)$ , and  $\Gamma(\text{total})$ , and for a phase difference between strong and electromagnetic amplitudes of  $(84.9 \pm 3.6)^\circ$ . An alternative solution is  $(4.85 \pm 0.45)\%$  with a phase of  $(-84.7 \pm 3.1)^\circ$ .

NODE=M070307

NODE=M070R9  
NODE=M070R9

NODE=M070R9;LINKAGE=A

WEIGHTED AVERAGE  
3.73±0.32 (Error scaled by 1.4)



$\Gamma(3(\pi^+\pi^-)\pi^0)/\Gamma_{\text{total}}$

$\Gamma_{140}/\Gamma$

| VALUE                          | EVTS | DOCUMENT ID | TECN    | COMMENT                             |
|--------------------------------|------|-------------|---------|-------------------------------------|
| <b>0.029±0.006 OUR AVERAGE</b> |      |             |         |                                     |
| 0.028±0.009                    | 11   | FRANKLIN    | 83 MRK2 | $e^+e^- \rightarrow \text{hadrons}$ |
| 0.029±0.007                    | 181  | JEAN-MARIE  | 76 MRK1 | $e^+e^-$                            |

NODE=M070R11  
NODE=M070R11

$\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$

$\Gamma_{141}/\Gamma$

| VALUE (units $10^{-3}$ )                     | EVTS | DOCUMENT ID                                                 | TECN      | COMMENT                                          |
|----------------------------------------------|------|-------------------------------------------------------------|-----------|--------------------------------------------------|
| <b>21.0 ±0.8 OUR AVERAGE</b>                 |      | Error includes scale factor of 1.6. See the ideogram below. |           |                                                  |
| 21.37±0.04 <sup>+0.64</sup> <sub>-0.62</sub> | 1.8M | <sup>1,2</sup> ABLIKIM                                      | 12H BES3  | $e^+e^- \rightarrow J/\psi$                      |
| 23.0 ±2.0 ±0.4                               | 256  | <sup>3</sup> AUBERT                                         | 07AU BABR | 10.6 $e^+e^- \rightarrow J/\psi\pi^+\pi^-\gamma$ |
| 21.84±0.05±2.01                              | 220k | <sup>1,4</sup> BAI                                          | 04H BES   | $e^+e^-$                                         |
| 20.91±0.21±1.16                              |      | <sup>4,5</sup> BAI                                          | 04H BES   | $e^+e^-$                                         |
| 15 ±2                                        | 168  | FRANKLIN                                                    | 83 MRK2   | $e^+e^-$                                         |

NODE=M070R7  
NODE=M070R7

OCCUR=2

<sup>1</sup> From  $J/\psi \rightarrow \pi^+\pi^-\pi^0$  events directly.

<sup>2</sup> The quoted systematic error includes a contribution of 1.23% (added in quadrature) from the uncertainty on the number of  $J/\psi$  events.

<sup>3</sup> AUBERT 07AU reports  $[\Gamma(J/\psi(1S) \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}] \times [\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] = (18.6 \pm 1.2 \pm 1.1) \times 10^{-3}$  keV which we divide by our best value  $\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}} = 0.808 \pm 0.013$  keV. Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>4</sup> Mostly  $\rho\pi$ , see also  $\rho\pi$  subsection.

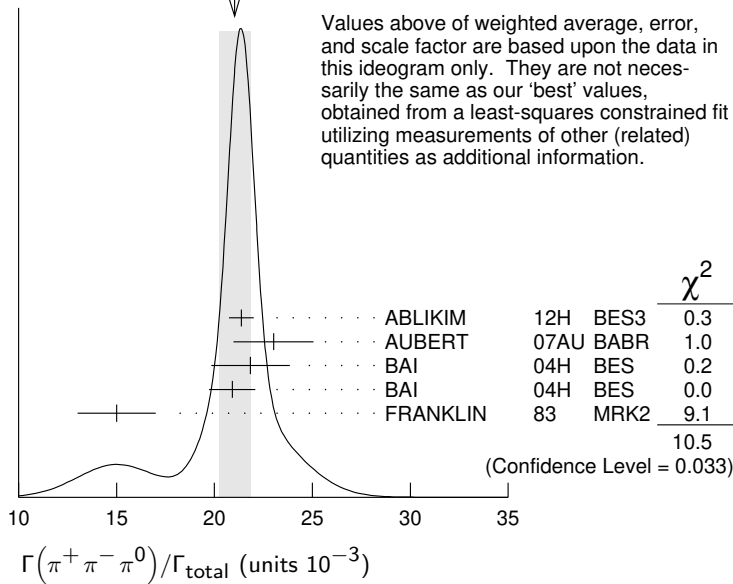
<sup>5</sup> Obtained comparing the rates for  $\pi^+\pi^-\pi^0$  and  $\mu^+\mu^-$ , using  $J/\psi$  events produced via  $\psi(2S) \rightarrow \pi^+\pi^-J/\psi$  and with  $B(J/\psi \rightarrow \mu^+\mu^-) = 5.88 \pm 0.10\%$ .

NODE=M070R;LINKAGE=BA  
NODE=M070R7;LINKAGE=AB

NODE=M070R7;LINKAGE=AU

NODE=M070R;LINKAGE=BU  
NODE=M070R;LINKAGE=BI

WEIGHTED AVERAGE  
21.0±0.8 (Error scaled by 1.6)



$\Gamma(\pi^+\pi^-\pi^0 K^+K^-)/\Gamma_{\text{total}}$

$\Gamma_{145}/\Gamma$

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN    | COMMENT  |
|--------------------------|------|-------------|---------|----------|
| 1.2±0.3                  | 309  | VANNUCCI    | 77 MRK1 | $e^+e^-$ |

NODE=M070R18  
NODE=M070R18

$\Gamma(4(\pi^+\pi^-\pi^0))/\Gamma_{\text{total}}$

$\Gamma_{146}/\Gamma$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN    | COMMENT  |
|--------------------------|------|-------------|---------|----------|
| 90±30                    | 13   | JEAN-MARIE  | 76 MRK1 | $e^+e^-$ |

NODE=M070R12  
NODE=M070R12

$\Gamma(\pi^+\pi^-K^+K^-)/\Gamma_{\text{total}}$

$\Gamma_{147}/\Gamma$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

NODE=M070R16  
NODE=M070R16

• • • We do not use the following data for averages, fits, limits, etc. • • •

7.2±2.3 205 VANNUCCI 77 MRK1  $e^+e^-$

$\Gamma(K\bar{K}\pi)/\Gamma_{\text{total}}$

$\Gamma_{155}/\Gamma$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN    | COMMENT                                  |
|--------------------------|------|-------------|---------|------------------------------------------|
| 61 ±10 OUR AVERAGE       |      |             |         |                                          |
| 55.2±12.0                | 25   | FRANKLIN    | 83 MRK2 | $e^+e^- \rightarrow K^+K^-\pi^0$         |
| 78.0±21.0                | 126  | VANNUCCI    | 77 MRK1 | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$ |

NODE=M070R15  
NODE=M070R15

$\Gamma(K^+K^-\pi^0)/\Gamma_{\text{total}}$

$\Gamma_{156}/\Gamma$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                          |
|--------------------------|------|-------------|----------|----------------------------------|
| 2.88±0.01±0.12           | 183k | ABLIKIM     | 19AQ BES | $J/\psi \rightarrow K^+K^-\pi^0$ |

NODE=M070P80  
NODE=M070P80

$\Gamma(K^+K^-\pi^0)/\Gamma(\pi^+\pi^-\pi^0)$

$\Gamma_{156}/\Gamma_{141}$

| VALUE (%)    | EVTS | DOCUMENT ID | TECN     | COMMENT                          |
|--------------|------|-------------|----------|----------------------------------|
| 12.0±0.3±0.9 | 23k  | LEES        | 17C BABR | $J/\psi \rightarrow h^+h^-\pi^0$ |

NODE=M070P34  
NODE=M070P34

$\Gamma(K_S^0 K^\pm \pi^\mp)/\Gamma(\pi^+\pi^-\pi^0)$

$\Gamma_{157}/\Gamma_{141}$

| VALUE (%)    | EVTS | DOCUMENT ID | TECN     | COMMENT                          |
|--------------|------|-------------|----------|----------------------------------|
| 26.5±0.5±2.1 | 24k  | LEES        | 17C BABR | $J/\psi \rightarrow h^0 h^+ h^-$ |

NODE=M070P35  
NODE=M070P35

$\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}}$

$\Gamma_{162}/\Gamma$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
| 3.57±0.30 OUR AVERAGE    |      |             |      |         |

NODE=M070R8  
NODE=M070R8

3.53±0.12±0.29 1107 <sup>1</sup> ABLIKIM 05H BES2  $e^+e^- \rightarrow \psi(2S) \rightarrow J/\psi \pi^+\pi^-, J/\psi \rightarrow 2(\pi^+\pi^-)$

4.0 ±1.0 76 JEAN-MARIE 76 MRK1  $e^+e^-$

<sup>1</sup> Computed using  $B(J/\psi \rightarrow \mu^+\mu^-) = 0.0588 \pm 0.0010$ .

NODE=M070R8;LINKAGE=AB

$\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{163}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |    |            |    |      |          |
|---------|----|------------|----|------|----------|
| 40 ± 20 | 32 | JEAN-MARIE | 76 | MRK1 | $e^+e^-$ |
|---------|----|------------|----|------|----------|

NODE=M070R10  
NODE=M070R10

 $\Gamma(2(\pi^+\pi^-)\eta)/\Gamma_{\text{total}}$  $\Gamma_{165}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

|                    |      |         |     |      |                                        |
|--------------------|------|---------|-----|------|----------------------------------------|
| 2.26 ± 0.08 ± 0.27 | 4.8k | ABLIKIM | 05C | BES2 | $e^+e^- \rightarrow 2(\pi^+\pi^-)\eta$ |
|--------------------|------|---------|-----|------|----------------------------------------|

NODE=M070S42  
NODE=M070S42

 $\Gamma(3(\pi^+\pi^-)\eta)/\Gamma_{\text{total}}$  $\Gamma_{166}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

|                    |     |         |     |      |                                        |
|--------------------|-----|---------|-----|------|----------------------------------------|
| 7.24 ± 0.96 ± 1.11 | 616 | ABLIKIM | 05C | BES2 | $e^+e^- \rightarrow 3(\pi^+\pi^-)\eta$ |
|--------------------|-----|---------|-----|------|----------------------------------------|

NODE=M070S43  
NODE=M070S43

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{169}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.120 ± 0.029 OUR AVERAGE**[(2.121 ± 0.029) × 10<sup>-3</sup> OUR 2020 AVERAGE]

|                       |       |                      |     |      |                               |
|-----------------------|-------|----------------------|-----|------|-------------------------------|
| 2.112 ± 0.004 ± 0.031 | 314k  | ABLIKIM              | 12C | BES3 | $e^+e^-$                      |
| 2.17 ± 0.16 ± 0.04    | 317   | <sup>1</sup> WU      | 06  | BELL | $B^+ \rightarrow p\bar{p}K^+$ |
| 2.26 ± 0.01 ± 0.14    | 63316 | BAI                  | 04E | BES2 | $e^+e^- \rightarrow J/\psi$   |
| 1.97 ± 0.22           | 99    | BALDINI              | 98  | FENI | $e^+e^-$                      |
| 1.91 ± 0.04 ± 0.30    |       | PALLIN               | 87  | DM2  | $e^+e^-$                      |
| 2.16 ± 0.07 ± 0.15    | 1420  | EATON                | 84  | MRK2 | $e^+e^-$                      |
| 2.5 ± 0.4             | 133   | BRANDELIK            | 79C | DASP | $e^+e^-$                      |
| 2.0 ± 0.5             |       | BESCH                | 78  | BONA | $e^+e^-$                      |
| 2.2 ± 0.2             | 331   | <sup>2</sup> PERUZZI | 78  | MRK1 | $e^+e^-$                      |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |    |           |    |      |          |
|-----------|----|-----------|----|------|----------|
| 2.0 ± 0.3 | 48 | ANTONELLI | 93 | SPEC | $e^+e^-$ |
|-----------|----|-----------|----|------|----------|

<sup>1</sup>WU 06 reports  $[\Gamma(J/\psi(1S) \rightarrow p\bar{p})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow J/\psi(1S)K^+)] = (2.21 \pm 0.13 \pm 0.10) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow J/\psi(1S)K^+) = (1.020 \pm 0.019) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup>Assuming angular distribution  $(1+\cos^2\theta)$ .

NODE=M070R50  
NODE=M070R50

NEW

NODE=M070R50;LINKAGE=WU

NODE=M070R50;LINKAGE=A

 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{170}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**1.19 ± 0.08 OUR AVERAGE** Error includes scale factor of 1.1.

|                    |     |           |     |      |          |
|--------------------|-----|-----------|-----|------|----------|
| 1.33 ± 0.02 ± 0.11 | 11k | ABLIKIM   | 09B | BES2 | $e^+e^-$ |
| 1.13 ± 0.09 ± 0.09 | 685 | EATON     | 84  | MRK2 | $e^+e^-$ |
| 1.4 ± 0.4          |     | BRANDELIK | 79C | DASP | $e^+e^-$ |
| 1.00 ± 0.15        | 109 | PERUZZI   | 78  | MRK1 | $e^+e^-$ |

NODE=M070R52  
NODE=M070R52

 $\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{171}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

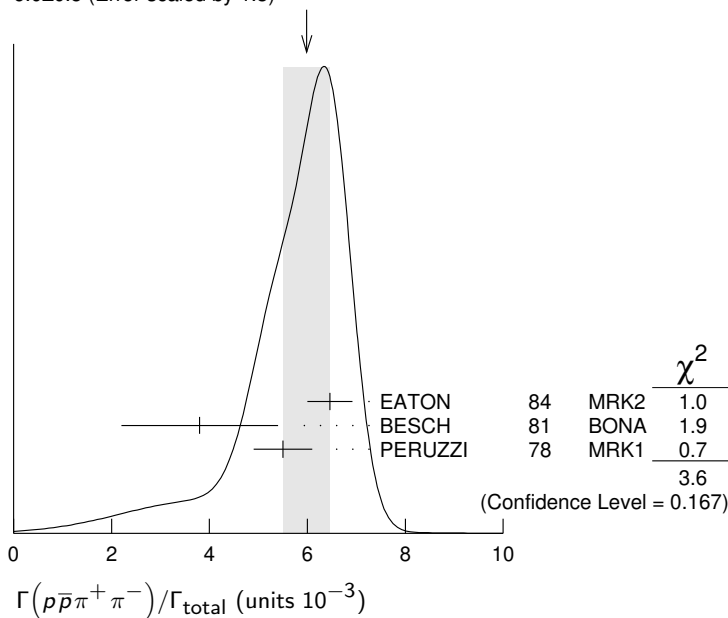
**6.0 ± 0.5 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

|                    |      |         |    |      |          |
|--------------------|------|---------|----|------|----------|
| 6.46 ± 0.17 ± 0.43 | 1435 | EATON   | 84 | MRK2 | $e^+e^-$ |
| 3.8 ± 1.6          | 48   | BESCH   | 81 | BONA | $e^+e^-$ |
| 5.5 ± 0.6          | 533  | PERUZZI | 78 | MRK1 | $e^+e^-$ |

NODE=M070R54  
NODE=M070R54



WEIGHTED AVERAGE  
 $6.0 \pm 0.5$  (Error scaled by 1.3)



### $\Gamma(p\bar{p}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$

$\Gamma_{172}/\Gamma$

Including  $p\bar{p}\pi^+\pi^-\gamma$  and excluding  $\omega, \eta, \eta'$

| VALUE (units $10^{-3}$ )                    | EVTs | DOCUMENT ID                         | TECN | COMMENT       |
|---------------------------------------------|------|-------------------------------------|------|---------------|
| <b><math>2.3 \pm 0.9</math> OUR AVERAGE</b> |      | Error includes scale factor of 1.9. |      |               |
| $3.36 \pm 0.65 \pm 0.28$                    | 364  | EATON                               | 84   | MRK2 $e^+e^-$ |
| $1.6 \pm 0.6$                               | 39   | PERUZZI                             | 78   | MRK1 $e^+e^-$ |

NODE=M070R55  
 NODE=M070R55  
 NODE=M070R55

### $\Gamma(p\bar{p}\eta)/\Gamma_{\text{total}}$

$\Gamma_{173}/\Gamma$

| VALUE (units $10^{-3}$ )                      | EVTs | DOCUMENT ID          | TECN | COMMENT       |
|-----------------------------------------------|------|----------------------|------|---------------|
| <b><math>2.00 \pm 0.12</math> OUR AVERAGE</b> |      |                      |      |               |
| $1.91 \pm 0.02 \pm 0.17$                      | 13k  | <sup>1</sup> ABLIKIM | 09   | BES2 $e^+e^-$ |
| $2.03 \pm 0.13 \pm 0.15$                      | 826  | EATON                | 84   | MRK2 $e^+e^-$ |
| $2.5 \pm 1.2$                                 |      | BRANDELIK            | 79C  | DASP $e^+e^-$ |
| $2.3 \pm 0.4$                                 | 197  | PERUZZI              | 78   | MRK1 $e^+e^-$ |

NODE=M070R56  
 NODE=M070R56

<sup>1</sup> From the combination of  $p\bar{p}\eta \rightarrow p\bar{p}\gamma\gamma$  and  $p\bar{p}\eta \rightarrow p\bar{p}\pi^+\pi^-\pi^0$  channels.

NODE=M070R56;LINKAGE=AB

### $\Gamma(p\bar{p}\rho)/\Gamma_{\text{total}}$

$\Gamma_{174}/\Gamma$

| VALUE                                        | CL% | DOCUMENT ID | TECN | COMMENT                                        |
|----------------------------------------------|-----|-------------|------|------------------------------------------------|
| <b><math>&lt; 0.31 \times 10^{-3}</math></b> | 90  | EATON       | 84   | MRK2 $e^+e^- \rightarrow \text{hadrons}\gamma$ |

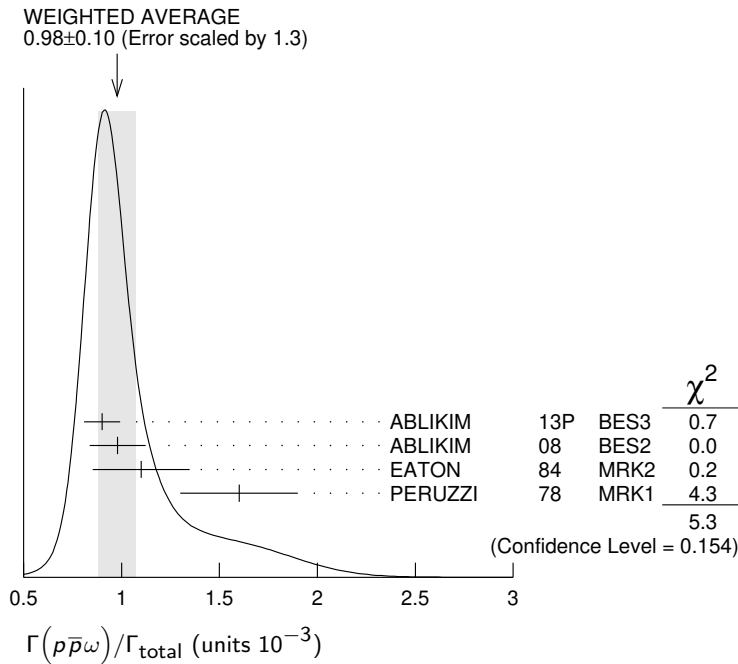
NODE=M070R57  
 NODE=M070R57

### $\Gamma(p\bar{p}\omega)/\Gamma_{\text{total}}$

$\Gamma_{175}/\Gamma$

| VALUE (units $10^{-3}$ )                      | EVTs | DOCUMENT ID                                                 | TECN | COMMENT       |
|-----------------------------------------------|------|-------------------------------------------------------------|------|---------------|
| <b><math>0.98 \pm 0.10</math> OUR AVERAGE</b> |      | Error includes scale factor of 1.3. See the ideogram below. |      |               |
| $0.90 \pm 0.02 \pm 0.09$                      | 2670 | ABLIKIM                                                     | 13P  | BES3 $e^+e^-$ |
| $0.98 \pm 0.03 \pm 0.14$                      | 2449 | ABLIKIM                                                     | 08   | BES2 $e^+e^-$ |
| $1.10 \pm 0.17 \pm 0.18$                      | 486  | EATON                                                       | 84   | MRK2 $e^+e^-$ |
| $1.6 \pm 0.3$                                 | 77   | PERUZZI                                                     | 78   | MRK1 $e^+e^-$ |

NODE=M070R58  
 NODE=M070R58



### $\Gamma(p\bar{p}\eta(958))/\Gamma_{\text{total}}$

$\Gamma_{176}/\Gamma$

| VALUE (units $10^{-3}$ )                        | EVTS         | DOCUMENT ID                         | TECN     | COMMENT  |
|-------------------------------------------------|--------------|-------------------------------------|----------|----------|
| <b><math>0.129 \pm 0.014</math> OUR AVERAGE</b> |              | Error includes scale factor of 2.0. |          |          |
| $0.126 \pm 0.002 \pm 0.007$                     | 16k          | <sup>1</sup> ABLIKIM                | 19N BES3 | $e^+e^-$ |
| $0.200 \pm 0.023 \pm 0.028$                     | $265 \pm 31$ | <sup>2</sup> ABLIKIM                | 09 BES2  | $e^+e^-$ |
| $0.68 \pm 0.23 \pm 0.17$                        | 19           | EATON                               | 84 MRK2  | $e^+e^-$ |
| $1.8 \pm 0.6$                                   | 19           | PERUZZI                             | 78 MRK1  | $e^+e^-$ |

<sup>1</sup> From the combination of  $p\bar{p}\eta' \rightarrow p\bar{p}\pi^+\pi^-\eta$  and  $p\bar{p}\eta' \rightarrow p\bar{p}\pi^+\pi^-\gamma$  channels.

<sup>2</sup> From the combination of  $p\bar{p}\eta' \rightarrow p\bar{p}\pi^+\pi^-\eta$  and  $p\bar{p}\eta' \rightarrow p\bar{p}\gamma\rho^0$  channels.

NODE=M070R59  
 NODE=M070R59

### $\Gamma(p\bar{p}a_0(980) \rightarrow p\bar{p}\pi^0\eta)/\Gamma_{\text{total}}$

$\Gamma_{177}/\Gamma$

| VALUE (units $10^{-5}$ )                | DOCUMENT ID | TECN     | COMMENT                     |
|-----------------------------------------|-------------|----------|-----------------------------|
| <b><math>6.8 \pm 1.2 \pm 1.3</math></b> | ABLIKIM     | 14N BES3 | $e^+e^- \rightarrow J/\psi$ |

NODE=M070S94  
 NODE=M070S94

### $\Gamma(p\bar{p}\phi)/\Gamma_{\text{total}}$

$\Gamma_{178}/\Gamma$

| VALUE (units $10^{-4}$ )                        | EVTS | DOCUMENT ID | TECN     | COMMENT                                                         |
|-------------------------------------------------|------|-------------|----------|-----------------------------------------------------------------|
| <b><math>0.519 \pm 0.033</math> OUR AVERAGE</b> |      |             |          |                                                                 |
| $0.523 \pm 0.006 \pm 0.033$                     | 14k  | ABLIKIM     | 16K BES3 | $J/\psi \rightarrow p\bar{p}K_S^0 K_L^0$ ,<br>$p\bar{p}K^+ K^-$ |
| $0.45 \pm 0.13 \pm 0.07$                        |      | FALVARD     | 88 DM2   | $J/\psi \rightarrow \text{hadrons}$                             |

NODE=M070S22  
 NODE=M070S22

### $\Gamma(n\bar{n})/\Gamma_{\text{total}}$

$\Gamma_{179}/\Gamma$

| VALUE (units $10^{-3}$ )                                                      | EVTS | DOCUMENT ID | TECN     | COMMENT  |
|-------------------------------------------------------------------------------|------|-------------|----------|----------|
| <b><math>2.09 \pm 0.16</math> OUR AVERAGE</b>                                 |      |             |          |          |
| $2.07 \pm 0.01 \pm 0.17$                                                      | 36k  | ABLIKIM     | 12C BES3 | $e^+e^-$ |
| $2.31 \pm 0.49$                                                               | 79   | BALDINI     | 98 FENI  | $e^+e^-$ |
| $1.8 \pm 0.9$                                                                 |      | BESCH       | 78 BONA  | $e^+e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |          |
| $1.90 \pm 0.55$                                                               | 40   | ANTONELLI   | 93 SPEC  | $e^+e^-$ |

NODE=M070R64  
 NODE=M070R64

### $\Gamma(n\bar{n}\pi^+\pi^-)/\Gamma_{\text{total}}$

$\Gamma_{180}/\Gamma$

| VALUE (units $10^{-3}$ )        | EVTS | DOCUMENT ID | TECN    | COMMENT  |
|---------------------------------|------|-------------|---------|----------|
| <b><math>3.8 \pm 3.6</math></b> | 5    | BESCH       | 81 BONA | $e^+e^-$ |

NODE=M070R65  
 NODE=M070R65

### $\Gamma(\Sigma^+\bar{\Sigma}^-)/\Gamma_{\text{total}}$

$\Gamma_{181}/\Gamma$

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID | TECN     | COMMENT                     |
|--------------------------------------------|------|-------------|----------|-----------------------------|
| <b><math>1.50 \pm 0.10 \pm 0.22</math></b> | 399  | ABLIKIM     | 080 BES2 | $e^+e^- \rightarrow J/\psi$ |

NODE=M070S09  
 NODE=M070S09

$\Gamma(\Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{182}/\Gamma$ NODE=M070R63  
NODE=M070R63

| VALUE (units $10^{-3}$ )                                                      | EVTS | DOCUMENT ID | TECN     | COMMENT                                       |
|-------------------------------------------------------------------------------|------|-------------|----------|-----------------------------------------------|
| <b>1.172±0.032 OUR AVERAGE</b> Error includes scale factor of 1.4.            |      |             |          |                                               |
| 1.164±0.004±0.023                                                             | 111k | ABLIKIM     | 17L BES3 | $J/\psi \rightarrow \Sigma^0 \bar{\Sigma}^0$  |
| 1.33 ±0.04 ±0.11                                                              | 1.7k | ABLIKIM     | 06 BES2  | $J/\psi \rightarrow \Sigma^0 \bar{\Sigma}^0$  |
| 1.06 ±0.04 ±0.23                                                              | 884  | PALLIN      | 87 DM2   | $e^+ e^- \rightarrow \Sigma^0 \bar{\Sigma}^0$ |
| 1.58 ±0.16 ±0.25                                                              | 90   | EATON       | 84 MRK2  | $e^+ e^- \rightarrow \Sigma^0 \bar{\Sigma}^0$ |
| 1.3 ±0.4                                                                      | 52   | PERUZZI     | 78 MRK1  | $e^+ e^- \rightarrow \Sigma^0 \bar{\Sigma}^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |                                               |
| 2.4 ±2.6                                                                      | 3    | BESCH       | 81 BONA  | $e^+ e^- \rightarrow \Sigma^+ \bar{\Sigma}^-$ |

 $\Gamma(2(\pi^+ \pi^-) K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{183}/\Gamma$ NODE=M070R17  
NODE=M070R17

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN    | COMMENT   |
|--------------------------|------|-------------|---------|-----------|
| <b>31±13</b>             | 30   | VANNUCCI    | 77 MRK1 | $e^+ e^-$ |

 $\Gamma(p \bar{n} \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{184}/\Gamma$ NODE=M070R53  
NODE=M070R53

| VALUE (units $10^{-3}$ )     | EVTS | DOCUMENT ID | TECN     | COMMENT                              |
|------------------------------|------|-------------|----------|--------------------------------------|
| <b>2.12±0.09 OUR AVERAGE</b> |      |             |          |                                      |
| 2.36±0.02±0.21               | 59k  | ABLIKIM     | 06K BES2 | $J/\psi \rightarrow p \pi^- \bar{n}$ |
| 2.47±0.02±0.24               | 55k  | ABLIKIM     | 06K BES2 | $J/\psi \rightarrow \bar{p} \pi^+ n$ |
| 2.02±0.07±0.16               | 1288 | EATON       | 84 MRK2  | $e^+ e^- \rightarrow p \pi^-$        |
| 1.93±0.07±0.16               | 1191 | EATON       | 84 MRK2  | $e^+ e^- \rightarrow \bar{p} \pi^+$  |
| 1.7 ±0.7                     | 32   | BESCH       | 81 BONA  | $e^+ e^- \rightarrow p \pi^-$        |
| 1.6 ±1.2                     | 5    | BESCH       | 81 BONA  | $e^+ e^- \rightarrow \bar{p} \pi^+$  |
| 2.16±0.29                    | 194  | PERUZZI     | 78 MRK1  | $e^+ e^- \rightarrow p \pi^-$        |
| 2.04±0.27                    | 204  | PERUZZI     | 78 MRK1  | $e^+ e^- \rightarrow \bar{p} \pi^+$  |

OCCUR=2

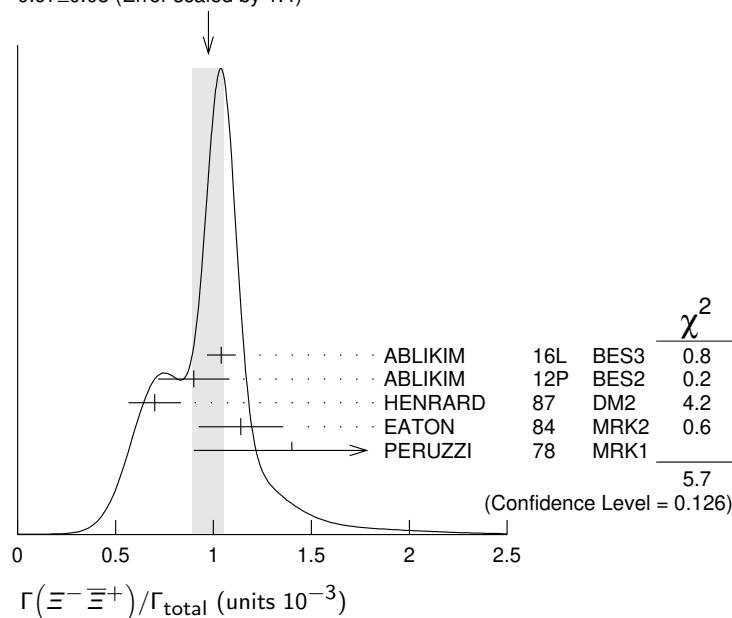
OCCUR=2

OCCUR=2

OCCUR=2

 $\Gamma(\Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}}$  $\Gamma_{188}/\Gamma$ NODE=M070R62  
NODE=M070R62

| VALUE (units $10^{-3}$ )                                                                  | EVTS | DOCUMENT ID | TECN     | COMMENT                                 |
|-------------------------------------------------------------------------------------------|------|-------------|----------|-----------------------------------------|
| <b>0.97 ±0.08 OUR AVERAGE</b> Error includes scale factor of 1.4. See the ideogram below. |      |             |          |                                         |
| 1.040±0.006±0.074                                                                         | 43k  | ABLIKIM     | 16L BES3 | $J/\psi \rightarrow \Xi^- \bar{\Xi}^+$  |
| 0.90 ±0.03 ±0.18                                                                          | 961  | ABLIKIM     | 12P BES2 | $J/\psi \rightarrow \Xi^- \bar{\Xi}^+$  |
| 0.70 ±0.06 ±0.12                                                                          | 132  | HENRARD     | 87 DM2   | $e^+ e^- \rightarrow \Xi^- \bar{\Xi}^+$ |
| 1.14 ±0.08 ±0.20                                                                          | 194  | EATON       | 84 MRK2  | $e^+ e^- \rightarrow \Xi^- \bar{\Xi}^+$ |
| 1.4 ±0.5                                                                                  | 51   | PERUZZI     | 78 MRK1  | $e^+ e^- \rightarrow \Xi^- \bar{\Xi}^+$ |

WEIGHTED AVERAGE  
0.97±0.08 (Error scaled by 1.4)

$\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$ 

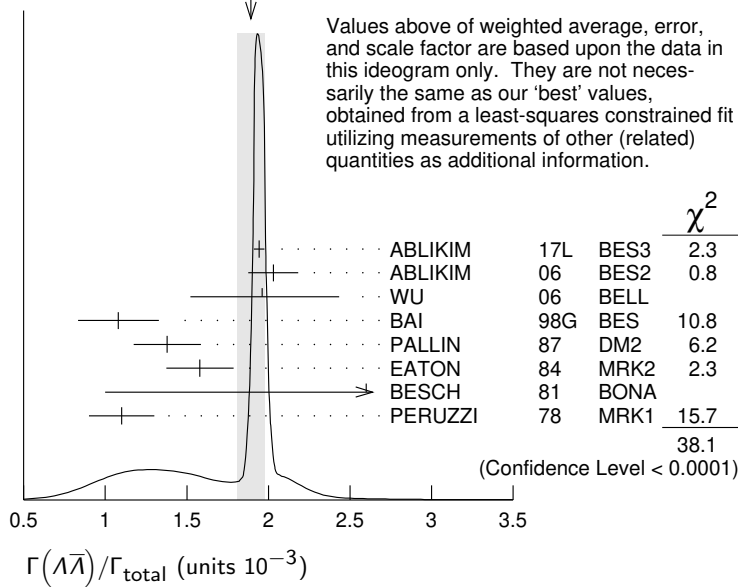
| VALUE (units $10^{-3}$ )                      | EVTS | DOCUMENT ID                         | TECN     | COMMENT                                   |
|-----------------------------------------------|------|-------------------------------------|----------|-------------------------------------------|
| <b>1.89 <math>\pm</math> 0.09 OUR AVERAGE</b> |      | Error includes scale factor of 2.8. |          | See the ideogram below.                   |
| 1.943 $\pm$ 0.003 $\pm$ 0.033                 | 441k | ABLIKIM                             | 17L BES3 | $e^+e^-$                                  |
| 2.03 $\pm$ 0.03 $\pm$ 0.15                    | 8887 | ABLIKIM                             | 06 BES2  | $J/\psi \rightarrow \Lambda\bar{\Lambda}$ |
| 1.96 $^{+0.47}_{-0.44} \pm 0.04$              | 46   | <sup>1</sup> WU                     | 06 BELL  | $B^+ \rightarrow \Lambda\bar{\Lambda}K^+$ |
| 1.08 $\pm$ 0.06 $\pm$ 0.24                    | 631  | BAI                                 | 98G BES  | $e^+e^-$                                  |
| 1.38 $\pm$ 0.05 $\pm$ 0.20                    | 1847 | PALLIN                              | 87 DM2   | $e^+e^-$                                  |
| 1.58 $\pm$ 0.08 $\pm$ 0.19                    | 365  | EATON                               | 84 MRK2  | $e^+e^-$                                  |
| 2.6 $\pm$ 1.6                                 | 5    | BESCH                               | 81 BONA  | $e^+e^-$                                  |
| 1.1 $\pm$ 0.2                                 | 196  | PERUZZI                             | 78 MRK1  | $e^+e^-$                                  |

<sup>1</sup>WU 06 reports  $[\Gamma(J/\psi(1S) \rightarrow \Lambda\bar{\Lambda})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow J/\psi(1S)K^+)] = (2.00^{+0.34}_{-0.29} \pm 0.34) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow J/\psi(1S)K^+) = (1.020 \pm 0.019) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070R60  
NODE=M070R60

NODE=M070R60;LINKAGE=WU

WEIGHTED AVERAGE  
1.89 $\pm$ 0.09 (Error scaled by 2.8)

 $\Gamma(\Lambda\bar{\Sigma}^-\pi^+(\text{or c.c.}))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ )                      | EVTS         | DOCUMENT ID                         | TECN     | COMMENT                                         |
|-----------------------------------------------|--------------|-------------------------------------|----------|-------------------------------------------------|
| <b>0.83 <math>\pm</math> 0.07 OUR AVERAGE</b> |              | Error includes scale factor of 1.2. |          |                                                 |
| 0.770 $\pm$ 0.051 $\pm$ 0.083                 | 335          | <sup>1</sup> ABLIKIM                | 07H BES2 | $e^+e^- \rightarrow \Lambda\bar{\Sigma}^+\pi^-$ |
| 0.747 $\pm$ 0.056 $\pm$ 0.076                 | 254          | <sup>1</sup> ABLIKIM                | 07H BES2 | $e^+e^- \rightarrow \Lambda\bar{\Sigma}^-\pi^+$ |
| 0.90 $\pm$ 0.06 $\pm$ 0.16                    | 225 $\pm$ 15 | HENRARD                             | 87 DM2   | $e^+e^- \rightarrow \Lambda\bar{\Sigma}^+\pi^-$ |
| 1.11 $\pm$ 0.06 $\pm$ 0.20                    | 342 $\pm$ 18 | HENRARD                             | 87 DM2   | $e^+e^- \rightarrow \Lambda\bar{\Sigma}^-\pi^+$ |
| 1.53 $\pm$ 0.17 $\pm$ 0.38                    | 135          | EATON                               | 84 MRK2  | $e^+e^- \rightarrow \Lambda\bar{\Sigma}^+\pi^-$ |
| 1.38 $\pm$ 0.21 $\pm$ 0.35                    | 118          | EATON                               | 84 MRK2  | $e^+e^- \rightarrow \Lambda\bar{\Sigma}^-\pi^+$ |

<sup>1</sup>Using  $B(\Lambda \rightarrow \pi^- p) = 63.9\%$  and  $B(\Sigma^+ \rightarrow \pi^0 p) = 51.6\%$ .

NODE=M070R71  
NODE=M070R71

OCCUR=2

OCCUR=2

OCCUR=2

NODE=M070R71;LINKAGE=AB

 $\Gamma(pK^-\bar{\Lambda}+\text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ )                          | EVTS | DOCUMENT ID     | TECN    | COMMENT                                  |
|---------------------------------------------------|------|-----------------|---------|------------------------------------------|
| <b>0.86 <math>\pm</math> 0.11 OUR AVERAGE</b>     |      |                 |         |                                          |
| $(0.87 \pm 0.11) \times 10^{-3}$ OUR 2020 AVERAGE |      |                 |         |                                          |
| 0.84 $^{+0.17}_{-0.15} \pm 0.02$                  | 45   | <sup>1</sup> LU | 19 BELL | $B^+ \rightarrow \bar{p}\Lambda K^+ K^+$ |
| 0.89 $\pm$ 0.07 $\pm$ 0.14                        | 307  | EATON           | 84 MRK2 | $e^+e^-$                                 |

<sup>1</sup>LU 19 reports  $(8.32^{+1.63}_{-1.45} \pm 0.49) \times 10^{-4}$  from a measurement of  $[\Gamma(J/\psi(1S) \rightarrow pK^-\bar{\Lambda}+\text{c.c.})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow J/\psi(1S)K^+)]$  assuming  $B(B^+ \rightarrow J/\psi(1S)K^+) = (1.026 \pm 0.031) \times 10^{-3}$ , which we rescale to our best value  $B(B^+ \rightarrow J/\psi(1S)K^+) = (1.020 \pm 0.019) \times 10^{-3}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070R72  
NODE=M070R72

NEW

NODE=M070R72;LINKAGE=A

$\Gamma(2(K^+ K^-))/\Gamma_{\text{total}}$  $\Gamma_{192}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                             |                      |                       |      |                                  |
|-----------------------------|----------------------|-----------------------|------|----------------------------------|
| $1.4^{+0.5}_{-0.4} \pm 0.2$ | $11.0^{+4.3}_{-3.5}$ | <sup>1</sup> HUANG 03 | BELL | $B^+ \rightarrow 2(K^+ K^-) K^+$ |
|-----------------------------|----------------------|-----------------------|------|----------------------------------|

|               |  |             |      |           |
|---------------|--|-------------|------|-----------|
| $0.7 \pm 0.3$ |  | VANNUCCI 77 | MRK1 | $e^+ e^-$ |
|---------------|--|-------------|------|-----------|

<sup>1</sup> Using  $B(B^+ \rightarrow J/\psi K^+) = (1.01 \pm 0.05) \times 10^{-3}$ .

NODE=M070R19  
NODE=M070R19

NODE=M070R19;LINKAGE=CC

 $\Gamma(p K^- \bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{193}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

|                          |    |       |    |                |
|--------------------------|----|-------|----|----------------|
| $0.29 \pm 0.06 \pm 0.05$ | 90 | EATON | 84 | MRK2 $e^+ e^-$ |
|--------------------------|----|-------|----|----------------|

NODE=M070R73  
NODE=M070R73

 $\Gamma(K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{194}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

|                          |    |                           |  |                                            |
|--------------------------|----|---------------------------|--|--------------------------------------------|
| $2.86 \pm 0.09 \pm 0.19$ | 1k | <sup>1</sup> METREVELI 12 |  | $\psi(2S) \rightarrow \pi^+ \pi^- K^+ K^-$ |
|--------------------------|----|---------------------------|--|--------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |     |                              |      |           |
|--------------------------|-----|------------------------------|------|-----------|
| $2.39 \pm 0.24 \pm 0.22$ | 107 | <sup>2</sup> BALTRUSAIT..85D | MRK3 | $e^+ e^-$ |
|--------------------------|-----|------------------------------|------|-----------|

|               |   |                            |      |           |
|---------------|---|----------------------------|------|-----------|
| $2.2 \pm 0.9$ | 6 | <sup>2</sup> BRANDELIK 79c | DASP | $e^+ e^-$ |
|---------------|---|----------------------------|------|-----------|

<sup>1</sup> Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

<sup>2</sup> Interference with non-resonant  $K^+ K^-$  production not taken into account.

NODE=M070R13  
NODE=M070R13

NODE=M070R13;LINKAGE=ME  
NODE=M070R13;LINKAGE=BA

 $\Gamma(K_S^0 K_L^0)/\Gamma_{\text{total}}$  $\Gamma_{195}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**1.95 ± 0.11 OUR AVERAGE** Error includes scale factor of 2.4. See the ideogram below.

|                          |      |              |      |                                                            |
|--------------------------|------|--------------|------|------------------------------------------------------------|
| $1.93 \pm 0.01 \pm 0.05$ | 110k | ABLIKIM 17AH | BES3 | $J/\psi \rightarrow K_S^0 K_L^0 \rightarrow \pi^+ \pi^- X$ |
|--------------------------|------|--------------|------|------------------------------------------------------------|

|                          |      |                           |  |                                                |
|--------------------------|------|---------------------------|--|------------------------------------------------|
| $2.62 \pm 0.15 \pm 0.14$ | 0.3k | <sup>1</sup> METREVELI 12 |  | $\psi(2S) \rightarrow \pi^+ \pi^- K_S^0 K_L^0$ |
|--------------------------|------|---------------------------|--|------------------------------------------------|

|                          |      |                      |      |                                                            |
|--------------------------|------|----------------------|------|------------------------------------------------------------|
| $1.82 \pm 0.04 \pm 0.13$ | 2.1k | <sup>2</sup> BAI 04A | BES2 | $J/\psi \rightarrow K_S^0 K_L^0 \rightarrow \pi^+ \pi^- X$ |
|--------------------------|------|----------------------|------|------------------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |  |            |     |                                     |
|--------------------------|--|------------|-----|-------------------------------------|
| $1.18 \pm 0.12 \pm 0.18$ |  | JOUSSET 90 | DM2 | $J/\psi \rightarrow \text{hadrons}$ |
|--------------------------|--|------------|-----|-------------------------------------|

|                          |    |                 |      |           |
|--------------------------|----|-----------------|------|-----------|
| $1.01 \pm 0.16 \pm 0.09$ | 74 | BALTRUSAIT..85D | MRK3 | $e^+ e^-$ |
|--------------------------|----|-----------------|------|-----------|

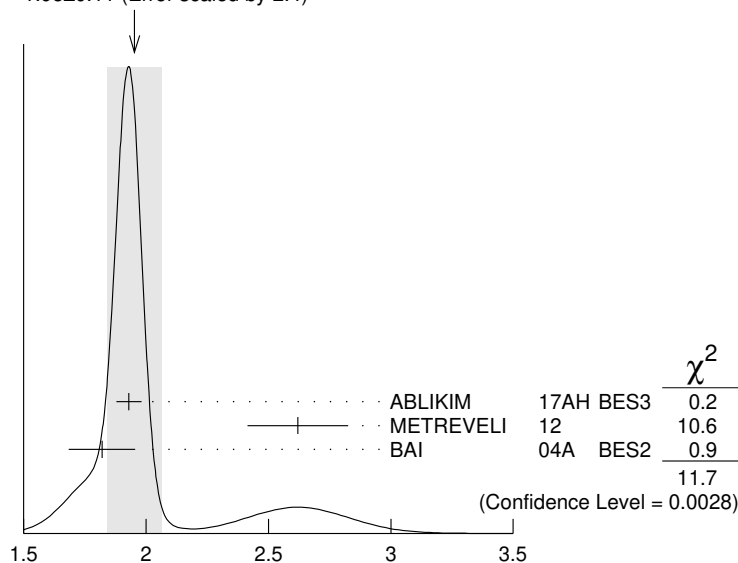
<sup>1</sup> Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

<sup>2</sup> Using  $B(K_S^0 \rightarrow \pi^+ \pi^-) = 0.6868 \pm 0.0027$ .

NODE=M070R75  
NODE=M070R75

NODE=M070R75;LINKAGE=ME  
NODE=M070R;LINKAGE=HZ

WEIGHTED AVERAGE  
 $1.95 \pm 0.11$  (Error scaled by 2.4)



$\Gamma(K_S^0 K_L^0)/\Gamma_{\text{total}}$

 $\Gamma_{195}/\Gamma$  $\Gamma(\Lambda \bar{\Lambda} \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{196}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

|                          |      |             |      |          |
|--------------------------|------|-------------|------|----------|
| $4.30 \pm 0.13 \pm 0.99$ | 2.4k | ABLIKIM 12P | BES2 | $J/\psi$ |
|--------------------------|------|-------------|------|----------|

NODE=M070S78  
NODE=M070S78

$\Gamma(\Lambda\bar{\Lambda}\eta)/\Gamma_{\text{total}}$   $\Gamma_{197}/\Gamma$ 

| VALUE (units $10^{-5}$ )    | EVTS | DOCUMENT ID          | TECN     | COMMENT                                             |
|-----------------------------|------|----------------------|----------|-----------------------------------------------------|
| <b>16.2±1.7 OUR AVERAGE</b> |      |                      |          |                                                     |
| 15.7±0.80±1.54              | 454  | <sup>1</sup> ABLIKIM | 13F BES3 | $J/\psi \rightarrow p\bar{p}\pi^+\pi^-\gamma\gamma$ |
| 26.2±6.0 ±4.4               | 44   | <sup>2</sup> ABLIKIM | 07H BES2 | $e^+e^- \rightarrow \psi(2S)$                       |

<sup>1</sup> Using  $B(\Lambda \rightarrow \pi^- p) = 63.9\%$  and  $B(\eta \rightarrow \gamma\gamma) = 39.31\%$ .

<sup>2</sup> Using  $B(\Lambda \rightarrow \pi^- p) = 63.9\%$  and  $B(\eta \rightarrow \gamma\gamma) = 39.4\%$ .

NODE=M070R07  
NODE=M070R07

NODE=M070R07;LINKAGE=AL  
NODE=M070R07;LINKAGE=AB

 $\Gamma(\Lambda\bar{\Lambda}\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{198}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                             |
|-------------------------------------------------------------------------------|-----|------|----------------------|----------|-----------------------------------------------------|
| <b>3.78±0.27±0.30</b>                                                         |     | 323  | <sup>1</sup> ABLIKIM | 13F BES3 | $J/\psi \rightarrow p\bar{p}\pi^+\pi^-\gamma\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                      |          |                                                     |
| < 6.4                                                                         | 90  |      | <sup>2</sup> ABLIKIM | 07H BES2 | $e^+e^- \rightarrow \psi(2S)$                       |
| 23 ±7 ±8                                                                      |     | 11   | BAI                  | 98G BES  | $e^+e^-$                                            |
| 22 ±5 ±5                                                                      |     | 19   | HENRARD              | 87 DM2   | $e^+e^-$                                            |

<sup>1</sup> Using  $B(\Lambda \rightarrow \pi^- p) = 63.9\%$  and  $B(\pi^0 \rightarrow \gamma\gamma) = 98.8\%$ .

<sup>2</sup> Using  $B(\Lambda \rightarrow \pi^- p) = 63.9\%$ .

NODE=M070S11  
NODE=M070S11

NODE=M070S11;LINKAGE=AL  
NODE=M070S11;LINKAGE=AB

 $\Gamma(\bar{\Lambda}nK_S^0 + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{199}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                     |
|--------------------------|------|----------------------|----------|-----------------------------|
| <b>6.46±0.20±1.07</b>    | 1058 | <sup>1</sup> ABLIKIM | 08C BES2 | $e^+e^- \rightarrow J/\psi$ |

<sup>1</sup> Using  $B(\bar{\Lambda} \rightarrow \bar{p}\pi^+) = 63.9\%$  and  $B(K_S^0 \rightarrow \pi^+\pi^-) = 69.2\%$ .

NODE=M070S56  
NODE=M070S56

NODE=M070S56;LINKAGE=AB

 $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{200}/\Gamma$ 

| VALUE (units $10^{-4}$ )     | EVTS | DOCUMENT ID            | TECN     | COMMENT                              |
|------------------------------|------|------------------------|----------|--------------------------------------|
| <b>1.47±0.14 OUR AVERAGE</b> |      |                        |          |                                      |
| 1.47±0.13±0.13               | 140  | <sup>1</sup> METREVELI | 12       | $\psi(2S) \rightarrow 2(\pi^+\pi^-)$ |
| 1.58±0.20±0.15               | 84   | BALTRUSAIT..85D        | MRK3     | $e^+e^-$                             |
| 1.0 ±0.5                     | 5    | BRANDELIK              | 78B DASP | $e^+e^-$                             |
| 1.6 ±1.6                     | 1    | VANNUCCI               | 77 MRK1  | $e^+e^-$                             |

<sup>1</sup> Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

NODE=M070R6  
NODE=M070R6

NODE=M070R6;LINKAGE=ME

 $\Gamma(\Lambda\bar{\Sigma} + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{201}/\Gamma$ 

| VALUE (units $10^{-5}$ )     | CL%      | EVTS | DOCUMENT ID          | TECN     | COMMENT                                    |
|------------------------------|----------|------|----------------------|----------|--------------------------------------------|
| <b>2.83±0.23 OUR AVERAGE</b> |          |      |                      |          |                                            |
| 2.74±0.24±0.22               | 234 ± 21 |      | <sup>1</sup> ABLIKIM | 12B BES3 | $J/\psi \rightarrow \Lambda\bar{\Sigma}^0$ |
| 2.92±0.22±0.24               | 308 ± 24 |      | <sup>2</sup> ABLIKIM | 12B BES3 | $J/\psi \rightarrow \bar{\Lambda}\Sigma^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |  |                      |         |                                            |
|-----|----|--|----------------------|---------|--------------------------------------------|
| <18 |    |  | <sup>2</sup> HENRARD | 87 DM2  | $J/\psi \rightarrow \bar{\Lambda}\Sigma^0$ |
| <15 | 90 |  | PERUZZI              | 78 MRK1 | $e^+e^- \rightarrow \Lambda X$             |

<sup>1</sup> ABLIKIM 12B quotes  $B(J/\psi \rightarrow \Lambda\bar{\Sigma}^0)$  which we multiply by 2.

<sup>2</sup> ABLIKIM 12B and HENRARD 87 quote results for  $B(J/\psi \rightarrow \bar{\Lambda}\Sigma^0)$  which we multiply by 2.

NODE=M070R61  
NODE=M070R61

OCCUR=2

NODE=M070R61;LINKAGE=AB  
NODE=M070R61;LINKAGE=AC

 $\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{202}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID          | TECN      | COMMENT                                                           |
|----------------------------------|-----|----------------------|-----------|-------------------------------------------------------------------|
| <b>&lt;1.4 × 10<sup>-8</sup></b> | 95  | <sup>1</sup> ABLIKIM | 17AH BES3 | $J/\psi \rightarrow K_S^0 K_S^0 \rightarrow \pi^+\pi^-\pi^+\pi^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                         |    |                              |         |          |
|-------------------------|----|------------------------------|---------|----------|
| <1 × 10 <sup>-6</sup>   | 95 | <sup>1</sup> BAI             | 04D BES | $e^+e^-$ |
| <5.2 × 10 <sup>-6</sup> | 90 | <sup>1</sup> BALTRUSAIT..85C | MRK3    | $e^+e^-$ |

<sup>1</sup> Forbidden by CP.

NODE=M070R14  
NODE=M070R14

NODE=M070R14;LINKAGE=C

## RADIATIVE DECAYS

 $\Gamma(3\gamma)/\Gamma_{\text{total}}$   $\Gamma_{203}/\Gamma$ 

| VALUE (units $10^{-6}$ )    | CL%                                  | EVTS | DOCUMENT ID | TECN     | COMMENT                                  |
|-----------------------------|--------------------------------------|------|-------------|----------|------------------------------------------|
| <b>11.6±2.2 OUR AVERAGE</b> |                                      |      |             |          |                                          |
| 11.3±1.8±2.0                | 113 ± 18                             |      | ABLIKIM     | 13I BES3 | $\psi(2S) \rightarrow \pi^+\pi^- J/\psi$ |
| 12 ±3 ±2                    | 24.2 <sup>+7.2</sup> <sub>-6.0</sub> |      | ADAMS       | 08 CLEO  | $\psi(2S) \rightarrow \pi^+\pi^- J/\psi$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |  |           |         |          |
|-----|----|--|-----------|---------|----------|
| <55 | 90 |  | PARTRIDGE | 80 CBAL | $e^+e^-$ |
|-----|----|--|-----------|---------|----------|

NODE=M070310

NODE=M070R81  
NODE=M070R81

$\Gamma(4\gamma)/\Gamma_{\text{total}}$   $\Gamma_{204}/\Gamma$ 

| VALUE               | CL% | DOCUMENT ID | TECN | COMMENT                                        |
|---------------------|-----|-------------|------|------------------------------------------------|
| $<9 \times 10^{-6}$ | 90  | ADAMS       | 08   | CLEO $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |

NODE=M070S06  
NODE=M070S06

 $\Gamma(5\gamma)/\Gamma_{\text{total}}$   $\Gamma_{205}/\Gamma$ 

| VALUE                | CL% | DOCUMENT ID | TECN | COMMENT                                        |
|----------------------|-----|-------------|------|------------------------------------------------|
| $<15 \times 10^{-6}$ | 90  | ADAMS       | 08   | CLEO $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |

NODE=M070S07  
NODE=M070S07

 $\Gamma(\gamma\pi^0\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{206}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID          | TECN | COMMENT                                    |
|--------------------------|----------------------|------|--------------------------------------------|
| $1.15 \pm 0.05$          | <sup>1</sup> ABLIKIM | 15AE | BES3 $J/\psi \rightarrow \gamma\pi^0\pi^0$ |

NODE=M070B00  
NODE=M070B00

<sup>1</sup> The uncertainty is systematic as statistical is negligible.

NODE=M070B00;LINKAGE=A

 $\Gamma(\gamma\eta\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{207}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                           |
|--------------------------|------|-------------|------|-----------------------------------|
| $21.4 \pm 1.8 \pm 2.5$   | 596  | ABLIKIM     | 16P  | BES3 $J/\psi \rightarrow 5\gamma$ |

NODE=M070P01  
NODE=M070P01

 $\Gamma(\gamma a_0(980)^0 \rightarrow \gamma\eta\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{208}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                           |
|-----------------------|-----|-------------|------|-----------------------------------|
| $<2.5 \times 10^{-6}$ | 95  | ABLIKIM     | 16P  | BES3 $J/\psi \rightarrow 5\gamma$ |

NODE=M070P02  
NODE=M070P02

 $\Gamma(\gamma a_2(1320)^0 \rightarrow \gamma\eta\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{209}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                           |
|-----------------------|-----|-------------|------|-----------------------------------|
| $<6.6 \times 10^{-6}$ | 95  | ABLIKIM     | 16P  | BES3 $J/\psi \rightarrow 5\gamma$ |

NODE=M070P03  
NODE=M070P03

 $\Gamma(\gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{210}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID | TECN | COMMENT                                      |
|--------------------------|-------------|------|----------------------------------------------|
| $8.1 \pm 0.4$            | ABLIKIM     | 18AA | BES3 $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

NODE=M070P73  
NODE=M070P73

 $\Gamma(\gamma\eta_c(1S))/\Gamma_{\text{total}}$   $\Gamma_{211}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS        | DOCUMENT ID                         | TECN | COMMENT |
|--------------------------|-------------|-------------------------------------|------|---------|
| $1.7 \pm 0.4$            | OUR AVERAGE | Error includes scale factor of 1.5. |      |         |

NODE=M070R85  
NODE=M070R85

|                          |                       |    |      |                               |
|--------------------------|-----------------------|----|------|-------------------------------|
| $2.00 \pm 0.31 \pm 0.02$ | <sup>1</sup> MITCHELL | 09 | CLEO | $e^+e^- \rightarrow \gamma X$ |
| $1.27 \pm 0.36$          | GAISER                | 86 | CBAL | $J/\psi \rightarrow \gamma X$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |              |                     |     |      |                                        |
|-----------------|--------------|---------------------|-----|------|----------------------------------------|
| seen            |              | ANASHIN             | 14  | KEDR | $J/\psi \rightarrow \gamma\eta_c$      |
| $0.79 \pm 0.20$ | $273 \pm 43$ | <sup>2</sup> AUBERT | 06E | BABR | $B^\pm \rightarrow K^\pm X_{c\bar{c}}$ |
| seen            | 16           | BALTRUSAITIS        | 86  | MRK3 | $J/\psi \rightarrow 2\phi\gamma$       |

<sup>1</sup> MITCHELL 09 reports  $(1.98 \pm 0.09 \pm 0.30) \times 10^{-2}$  from a measurement of  $[\Gamma(J/\psi(1S) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)]$  assuming  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (35.04 \pm 0.07 \pm 0.77) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (34.68 \pm 0.30) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Calculated by the authors using an average of  $B(J/\psi \rightarrow \gamma\eta_c) \times B(\eta_c \rightarrow K\bar{K}\pi)$  from BALTRUSAITIS 86, BISELLO 91, BAI 04 and  $B(\eta_c \rightarrow K\bar{K}\pi) = (8.5 \pm 1.8)\%$  from AUBERT 06E.

NODE=M070R85;LINKAGE=MI

NODE=M070R85;LINKAGE=AU

 $\Gamma(\gamma\eta_c(1S) \rightarrow 3\gamma)/\Gamma_{\text{total}}$   $\Gamma_{212}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | EVTS        | DOCUMENT ID                         | TECN | COMMENT |
|--------------------------|-------------|-------------------------------------|------|---------|
| $3.8^{+1.3}_{-1.0}$      | OUR AVERAGE | Error includes scale factor of 1.1. |      |         |

NODE=M070S08  
NODE=M070S08

|                             |                     |         |     |      |                                           |
|-----------------------------|---------------------|---------|-----|------|-------------------------------------------|
| $4.5 \pm 1.2 \pm 0.6$       | $33 \pm 9$          | ABLIKIM | 13I | BES3 | $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |
| $1.2^{+2.7}_{-1.1} \pm 0.3$ | $1.2^{+2.8}_{-1.1}$ | ADAMS   | 08  | CLEO | $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |

 $\Gamma(\gamma\eta_c(1S) \rightarrow \gamma\eta\eta')/\Gamma_{\text{total}}$   $\Gamma_{213}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                       |
|--------------------------|------|-------------|------|-----------------------------------------------|
| $4.86 \pm 0.62 \pm 0.45$ | 137  | ABLIKIM     | 21C  | BES3 $J/\psi(1S) \rightarrow \gamma\eta\eta'$ |

NODE=M070P89  
NODE=M070P89

 $\Gamma(\gamma\pi^+\pi^-2\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{214}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID               | TECN | COMMENT                              |
|--------------------------|---------------------------|------|--------------------------------------|
| $8.3 \pm 0.2 \pm 3.1$    | <sup>1</sup> BALTRUSAITIS | 86B  | MRK3 $J/\psi \rightarrow 4\pi\gamma$ |

NODE=M070R99  
NODE=M070R99

<sup>1</sup>  $4\pi$  mass less than 2.0 GeV.

NODE=M070R99;LINKAGE=M

$\Gamma(\gamma\eta\pi\pi)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )**6.1  $\pm 1.0$  OUR AVERAGE**5.85  $\pm 0.3 \pm 1.05$ 7.8  $\pm 1.2 \pm 2.4$ <sup>1</sup> Broad enhancement at 1700 MeV.

| DOCUMENT ID                   | TECN | COMMENT                             |
|-------------------------------|------|-------------------------------------|
| <sup>1</sup> EDWARDS 83B CBAL |      | $J/\psi \rightarrow \eta\pi^+\pi^-$ |
| <sup>1</sup> EDWARDS 83B CBAL |      | $J/\psi \rightarrow \eta 2\pi^0$    |

 $\Gamma_{215}/\Gamma$ NODE=M070R96  
NODE=M070R96

OCCUR=2

NODE=M070R96;LINKAGE=M

 $\Gamma(\gamma\eta_2(1870) \rightarrow \gamma\eta\pi^+\pi^-)/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )**6.2  $\pm 2.2 \pm 0.9$** 

| DOCUMENT ID | TECN | COMMENT                                   |
|-------------|------|-------------------------------------------|
| BAI 99 BES  |      | $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$ |

 $\Gamma_{216}/\Gamma$ NODE=M070S37  
NODE=M070S37 $\Gamma(\gamma\eta(1405/1475) \rightarrow \gamma K \bar{K} \pi)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )**2.8  $\pm 0.6$  OUR AVERAGE**1.66  $\pm 0.1 \pm 0.58$ 3.8  $\pm 0.3 \pm 0.6$ 4.0  $\pm 0.7 \pm 1.0$ 4.3  $\pm 1.7$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.78  $\pm 0.21 \pm 0.33$ 0.83  $\pm 0.13 \pm 0.18$ 0.66  $^{+0.17+0.24}_{-0.16-0.15}$ 1.03  $^{+0.21+0.26}_{-0.18-0.19}$ 

| DOCUMENT ID                      | TECN | COMMENT                                         |
|----------------------------------|------|-------------------------------------------------|
| <sup>1,2</sup> BAI 00D BES       |      | $J/\psi \rightarrow \gamma K^\pm K_S^0 \pi^\mp$ |
| <sup>3</sup> AUGUSTIN 90 DM2     |      | $J/\psi \rightarrow \gamma K \bar{K} \pi$       |
| <sup>3</sup> EDWARDS 82E CBAL    |      | $J/\psi \rightarrow K^+ K^- \pi^0 \gamma$       |
| <sup>3,4</sup> SCHARRE 80 MRK2   |      | $e^+ e^-$                                       |
| <sup>3,5,6</sup> AUGUSTIN 92 DM2 |      | $J/\psi \rightarrow \gamma K \bar{K} \pi$       |
| <sup>3,7,8</sup> AUGUSTIN 92 DM2 |      | $J/\psi \rightarrow \gamma K \bar{K} \pi$       |
| <sup>3,6,9</sup> BAI 90C MRK3    |      | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ |
| <sup>3,8,10</sup> BAI 90C MRK3   |      | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ |

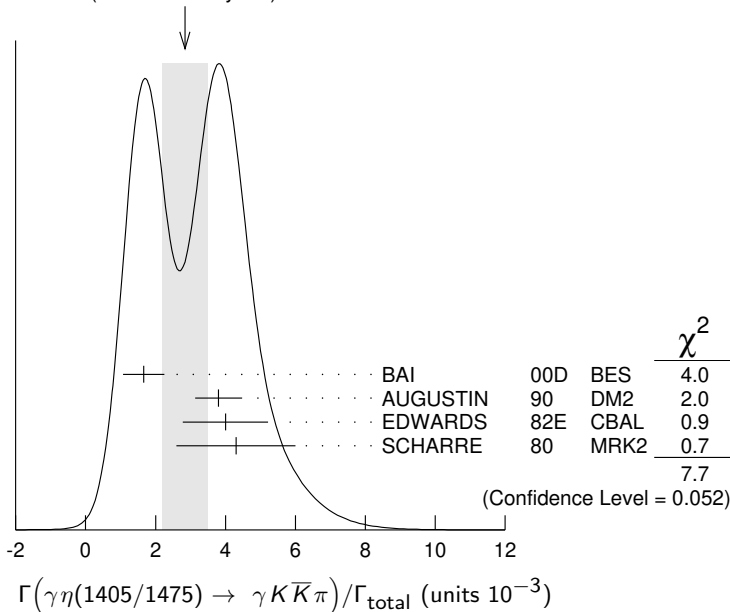
 $\Gamma_{217}/\Gamma$ NODE=M070R89  
NODE=M070R89

OCCUR=2

OCCUR=2

NODE=M070R89;LINKAGE=BD

NODE=M070R89;LINKAGE=BE  
 NODE=M070R89;LINKAGE=B  
 NODE=M070R89;LINKAGE=C  
 NODE=M070R89;LINKAGE=H  
 NODE=M070R89;LINKAGE=K9  
 NODE=M070R89;LINKAGE=J  
 NODE=M070R89;LINKAGE=K8  
 NODE=M070R89;LINKAGE=D  
 NODE=M070R89;LINKAGE=E

<sup>1</sup> Interference with the  $J/\psi(1S)$  radiative transition to the broad  $K \bar{K} \pi$  pseudoscalar state around 1800 is  $(0.15 \pm 0.01 \pm 0.05) \times 10^{-3}$ .<sup>2</sup> Interference with  $J/\psi \rightarrow \gamma f_1(1420)$  is  $(-0.03 \pm 0.01 \pm 0.01) \times 10^{-3}$ .<sup>3</sup> Includes unknown branching fraction  $\eta(1405) \rightarrow K \bar{K} \pi$ .<sup>4</sup> Corrected for spin-zero hypothesis for  $\eta(1405)$ .<sup>5</sup> From fit to the  $a_0(980)\pi 0^-+$  partial wave.<sup>6</sup>  $a_0(980)\pi$  mode.<sup>7</sup> From fit to the  $K^*(892)K 0^-+$  partial wave.<sup>8</sup>  $K^* K$  mode.<sup>9</sup> From  $a_0(980)\pi$  final state.<sup>10</sup> From  $K^*(890)K$  final state.WEIGHTED AVERAGE  
2.8 $\pm 0.6$  (Error scaled by 1.6) $\Gamma(\gamma\eta(1405/1475) \rightarrow \gamma\gamma\rho^0)/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )**0.78  $\pm 0.20$  OUR AVERAGE**1.07  $\pm 0.17 \pm 0.11$ 0.64  $\pm 0.12 \pm 0.07$ <sup>1</sup> Includes unknown branching fraction  $\eta(1405) \rightarrow \gamma\rho^0$ .

| DOCUMENT ID                  | TECN | COMMENT                                     |
|------------------------------|------|---------------------------------------------|
| <sup>1</sup> BAI 04J BES2    |      | $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$ |
| <sup>1</sup> COFFMAN 90 MRK3 |      | $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$ |

 $\Gamma_{218}/\Gamma$ NODE=M070S30  
NODE=M070S30

NODE=M070S30;LINKAGE=C



$\Gamma(\gamma\eta(1405/1475) \rightarrow \gamma\eta\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{219}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | EVTS | DOCUMENT ID           | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------|------|-----------------------|------|------------------------------------------------|
| <b>3.0 <math>\pm</math> 0.5 OUR AVERAGE</b>                                   |      |                       |      |                                                |
| 2.6 $\pm$ 0.7 $\pm$ 0.4                                                       |      | BAI                   | 99   | BES $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$  |
| 3.38 $\pm$ 0.33 $\pm$ 0.64                                                    |      | <sup>1</sup> BOLTON   | 92B  | MRK3 $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |      |                                                |
| 7.0 $\pm$ 0.6 $\pm$ 1.1                                                       | 261  | <sup>2</sup> AUGUSTIN | 90   | DM2 $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$  |

<sup>1</sup> Via  $a_0(980)\pi$ .

<sup>2</sup> Includes unknown branching fraction to  $\eta\pi^+\pi^-$ .

NODE=M070S29  
NODE=M070S29

NODE=M070S29;LINKAGE=RR  
NODE=M070S29;LINKAGE=R

 $\Gamma(\gamma\eta(1405/1475) \rightarrow \gamma\gamma\phi)/\Gamma_{\text{total}}$   $\Gamma_{220}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                      | CL%  | EVTS | DOCUMENT ID          | TECN | COMMENT                                          |
|-------------------------------------------------------------------------------|------|------|----------------------|------|--------------------------------------------------|
| <b>&lt;82</b>                                                                 | 95   |      | BAI                  | 04J  | BES2 $J/\psi \rightarrow \gamma\gamma K^+K^-$    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |      |                      |      |                                                  |
| 7.03 $\pm$ 0.92 $\pm$ 0.91                                                    | 1.3k |      | <sup>1</sup> ABLIKIM | 18I  | BES3 $J/\psi \rightarrow \gamma\gamma\phi(1020)$ |
| 10.36 $\pm$ 1.51 $\pm$ 1.54                                                   | 1.9k |      | <sup>2</sup> ABLIKIM | 18I  | BES3 $J/\psi \rightarrow \gamma\gamma\phi(1020)$ |

<sup>1</sup> Constructive interference between the  $X(1835)$  and  $\eta(1405)/\eta(1475)$  is assumed in a fit to the  $\gamma\phi$  invariant mass.

<sup>2</sup> Destructive interference between the  $X(1835)$  and  $\eta(1405)/\eta(1475)$  is assumed in a fit to the  $\gamma\phi$  invariant mass.

NODE=M070R77  
NODE=M070R77

OCCUR=2

NODE=M070R77;LINKAGE=B

NODE=M070R77;LINKAGE=A

 $\Gamma(\gamma\eta(1405) \rightarrow \gamma\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{221}/\Gamma$ 

| VALUE                                       | CL% | DOCUMENT ID | TECN | COMMENT                                                  |
|---------------------------------------------|-----|-------------|------|----------------------------------------------------------|
| <b>&lt;2.63 <math>\times 10^{-6}</math></b> | 90  | ABLIKIM     | 18O  | BES3 $\psi(2S) \rightarrow \pi^+\pi^-\gamma\gamma\gamma$ |

NODE=M070P38  
NODE=M070P38

 $\Gamma(\gamma\eta(1475) \rightarrow \gamma\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{222}/\Gamma$ 

| VALUE                                       | CL% | DOCUMENT ID | TECN | COMMENT                                                  |
|---------------------------------------------|-----|-------------|------|----------------------------------------------------------|
| <b>&lt;1.86 <math>\times 10^{-6}</math></b> | 90  | ABLIKIM     | 18O  | BES3 $\psi(2S) \rightarrow \pi^+\pi^-\gamma\gamma\gamma$ |

NODE=M070P39  
NODE=M070P39

 $\Gamma(\gamma\rho\rho)/\Gamma_{\text{total}}$   $\Gamma_{223}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                      | CL% | DOCUMENT ID               | TECN | COMMENT                              |
|-------------------------------------------------------------------------------|-----|---------------------------|------|--------------------------------------|
| <b>4.5 <math>\pm</math> 0.8 OUR AVERAGE</b>                                   |     |                           |      |                                      |
| 4.7 $\pm$ 0.3 $\pm$ 0.9                                                       |     | <sup>1</sup> BALTRUSAIT.. | 86B  | MRK3 $J/\psi \rightarrow 4\pi\gamma$ |
| 3.75 $\pm$ 1.05 $\pm$ 1.20                                                    |     | <sup>2</sup> BURKE        | 82   | MRK2 $J/\psi \rightarrow 4\pi\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                           |      |                                      |
| <0.09                                                                         | 90  | <sup>3</sup> BISELLO      | 89B  | $J/\psi \rightarrow 4\pi\gamma$      |

<sup>1</sup>  $4\pi$  mass less than 2.0 GeV.

<sup>2</sup>  $4\pi$  mass less than 2.0 GeV. We have multiplied  $2\rho^0$  measurement by 3 to obtain  $2\rho$ .

<sup>3</sup>  $4\pi$  mass in the range 2.0–25 GeV.

NODE=M070R94  
NODE=M070R94

NODE=M070R94;LINKAGE=N  
NODE=M070R94;LINKAGE=M  
NODE=M070R94;LINKAGE=A

 $\Gamma(\gamma\rho\omega)/\Gamma_{\text{total}}$   $\Gamma_{224}/\Gamma$ 

| VALUE                                      | CL% | DOCUMENT ID | TECN | COMMENT                          |
|--------------------------------------------|-----|-------------|------|----------------------------------|
| <b>&lt;5.4 <math>\times 10^{-4}</math></b> | 90  | ABLIKIM     | 08A  | BES2 $e^+e^- \rightarrow J/\psi$ |

NODE=M070R05  
NODE=M070R05

 $\Gamma(\gamma\rho\phi)/\Gamma_{\text{total}}$   $\Gamma_{225}/\Gamma$ 

| VALUE                                      | CL% | DOCUMENT ID | TECN | COMMENT                          |
|--------------------------------------------|-----|-------------|------|----------------------------------|
| <b>&lt;8.8 <math>\times 10^{-5}</math></b> | 90  | ABLIKIM     | 08A  | BES2 $e^+e^- \rightarrow J/\psi$ |

NODE=M070R06  
NODE=M070R06

 $\Gamma(\gamma\eta'(958))/\Gamma_{\text{total}}$   $\Gamma_{226}/\Gamma$ 

| VALUE (units $10^{-3}$ )                      | EVTS | DOCUMENT ID          | TECN | COMMENT                                                     |
|-----------------------------------------------|------|----------------------|------|-------------------------------------------------------------|
| <b>5.25 <math>\pm</math> 0.07 OUR AVERAGE</b> |      |                      |      | Error includes scale factor of 1.3. See the ideogram below. |
| 5.27 $\pm$ 0.03 $\pm$ 0.05                    | 36k  | ABLIKIM              | 19T  | BES $J/\psi \rightarrow \gamma\eta'$                        |
| 5.43 $\pm$ 0.23 $\pm$ 0.09                    | 5.0k | <sup>1</sup> ABLIKIM | 18O  | BES3 $\psi(2S) \rightarrow \pi^+\pi^-\gamma\gamma\gamma$    |
| 4.77 $\pm$ 0.22 $\pm$ 0.06                    |      | <sup>2</sup> ABLIKIM | 11   | BES3 $J/\psi \rightarrow \eta'\gamma$                       |
| 5.24 $\pm$ 0.12 $\pm$ 0.11                    |      | PEDLAR               | 09   | CLE3 $J/\psi \rightarrow \eta'\gamma$                       |
| 5.55 $\pm$ 0.44                               | 35k  | ABLIKIM              | 06E  | BES2 $J/\psi \rightarrow \eta'\gamma$                       |

• • • We do not use the following data for averages, fits, limits, etc. • • •

4.50  $\pm$  0.14  $\pm$  0.53

BOLTON 92B MRK3  $J/\psi \rightarrow \gamma\pi^+\pi^-\eta, \eta \rightarrow \gamma\gamma$

4.30  $\pm$  0.31  $\pm$  0.71

BOLTON 92B MRK3  $J/\psi \rightarrow \gamma\pi^+\pi^-\eta, \eta \rightarrow \pi^+\pi^-\pi^0$

4.04  $\pm$  0.16  $\pm$  0.85

622 AUGUSTIN 90 DM2  $J/\psi \rightarrow \gamma\eta\pi^+\pi^-$

4.39  $\pm$  0.09  $\pm$  0.66

2420 AUGUSTIN 90 DM2  $J/\psi \rightarrow \gamma\gamma\pi^+\pi^-$

4.1  $\pm$  0.3  $\pm$  0.6

BLOOM 83 CBAL  $e^+e^- \rightarrow 3\gamma + \text{hadrons}$

2.9  $\pm$  1.1

6 BRANDELIK 79C DASP  $e^+e^- \rightarrow 3\gamma$

2.4  $\pm$  0.7

57 BARTEL 76 CNTR  $e^+e^- \rightarrow 2\gamma\rho$

NODE=M070R84  
NODE=M070R84

OCCUR=2

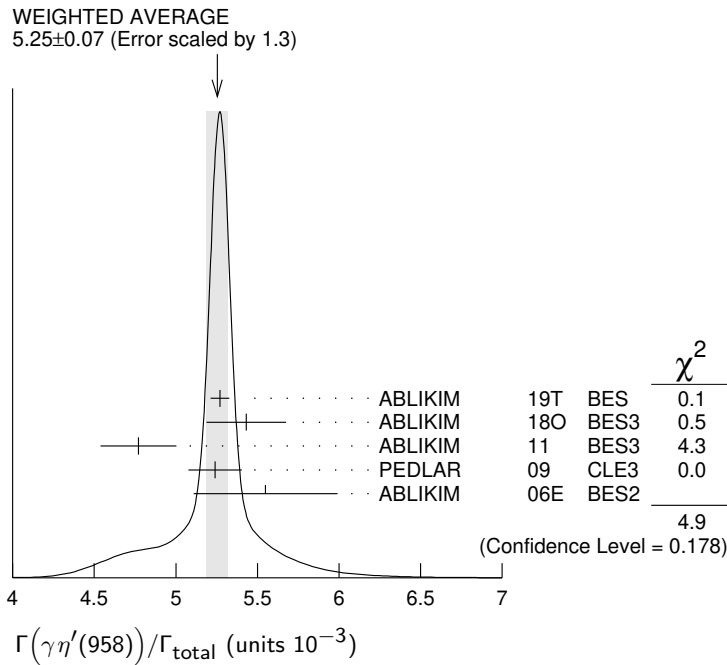
OCCUR=2

<sup>1</sup> ABLIKIM 180 reports  $[\Gamma(J/\psi(1S) \rightarrow \gamma \eta'(958))/\Gamma_{\text{total}}] \times [B(\eta'(958) \rightarrow \gamma \gamma)] = (1.26 \pm 0.02 \pm 0.05) \times 10^{-4}$  from a measurement of  $[\Gamma(J/\psi(1S) \rightarrow \gamma \eta'(958))/\Gamma_{\text{total}}] \times [B(\eta'(958) \rightarrow \gamma \gamma)] \times [B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)]$  assuming  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (34.49 \pm 0.30) \times 10^{-2}$ , which we rescale to our best values  $B(\eta'(958) \rightarrow \gamma \gamma) = (2.307 \pm 0.033) \times 10^{-2}$ ,  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (34.68 \pm 0.30) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

<sup>2</sup> ABLIKIM 11 reports  $(4.84 \pm 0.03 \pm 0.24) \times 10^{-3}$  from a measurement of  $[\Gamma(J/\psi(1S) \rightarrow \gamma \eta'(958))/\Gamma_{\text{total}}] / [B(\eta'(958) \rightarrow \pi^+ \pi^- \eta)] / [B(\eta \rightarrow 2\gamma)]$  assuming  $B(\eta'(958) \rightarrow \pi^+ \pi^- \eta) = (43.2 \pm 0.7) \times 10^{-2}$ ,  $B(\eta \rightarrow 2\gamma) = (39.31 \pm 0.20) \times 10^{-2}$ , which we rescale to our best values  $B(\eta'(958) \rightarrow \pi^+ \pi^- \eta) = (42.5 \pm 0.5) \times 10^{-2}$ ,  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

NODE=M070R84;LINKAGE=A

NODE=M070R84;LINKAGE=AB



$\Gamma(\gamma 2\pi^+ 2\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{227}/\Gamma$

| VALUE (units $10^{-3}$ )    | DOCUMENT ID                                                 | TECN    | COMMENT                          |
|-----------------------------|-------------------------------------------------------------|---------|----------------------------------|
| <b>2.8 ±0.5 OUR AVERAGE</b> | Error includes scale factor of 1.9. See the ideogram below. |         |                                  |
| 4.32±0.14±0.73              | <sup>1</sup> BISELLO                                        | 89B DM2 | $J/\psi \rightarrow 4\pi \gamma$ |
| 2.08±0.13±0.35              | <sup>2</sup> BISELLO                                        | 89B DM2 | $J/\psi \rightarrow 4\pi \gamma$ |
| 3.05±0.08±0.45              | <sup>2</sup> BALTRUSAIT..86B                                | MRK3    | $J/\psi \rightarrow 4\pi \gamma$ |
| 4.85±0.45±1.20              | <sup>3</sup> BURKE                                          | 82 MRK2 | $e^+ e^-$                        |

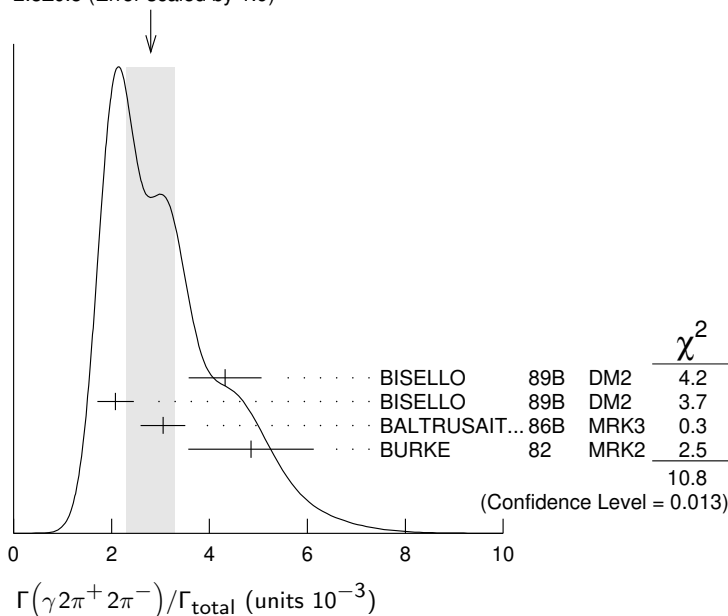
- <sup>1</sup>  $4\pi$  mass less than 3.0 GeV.
- <sup>2</sup>  $4\pi$  mass less than 2.0 GeV.
- <sup>3</sup>  $4\pi$  mass less than 2.5 GeV.

NODE=M070R95  
NODE=M070R95

OCCUR=2

NODE=M070R95;LINKAGE=A  
NODE=M070R95;LINKAGE=B  
NODE=M070R95;LINKAGE=M

WEIGHTED AVERAGE  
2.8±0.5 (Error scaled by 1.9)



### $\Gamma(\gamma f_2(1270) f_2(1270))/\Gamma_{\text{total}}$

$\Gamma_{228}/\Gamma$

| VALUE (units $10^{-4}$ ) | EVTS     | DOCUMENT ID | TECN    | COMMENT                                   |
|--------------------------|----------|-------------|---------|-------------------------------------------|
| <b>9.5±0.7±1.6</b>       | 646 ± 45 | ABLIKIM     | 04M BES | $J/\psi \rightarrow \gamma 2\pi^+ 2\pi^-$ |

NODE=M070S45  
NODE=M070S45

### $\Gamma(\gamma f_2(1270) f_2(1270) (\text{non resonant}))/\Gamma_{\text{total}}$

$\Gamma_{229}/\Gamma$

| VALUE (units $10^{-4}$ ) | DOCUMENT ID          | TECN    | COMMENT                                   |
|--------------------------|----------------------|---------|-------------------------------------------|
| <b>8.2±0.8±1.7</b>       | <sup>1</sup> ABLIKIM | 04M BES | $J/\psi \rightarrow \gamma 2\pi^+ 2\pi^-$ |

NODE=M070S46  
NODE=M070S46

<sup>1</sup> Subtracting contribution from intermediate  $\eta_c(1S)$  decays.

NODE=M070S46;LINKAGE=AB

### $\Gamma(\gamma K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}}$

$\Gamma_{230}/\Gamma$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN    | COMMENT                                         |
|--------------------------|------|-------------|---------|-------------------------------------------------|
| <b>2.1±0.1±0.6</b>       | 1516 | BAI         | 00B BES | $J/\psi \rightarrow \gamma K^+ K^0 \pi^+ \pi^-$ |

NODE=M070B05  
NODE=M070B05

### $\Gamma(\gamma f_4(2050))/\Gamma_{\text{total}}$

$\Gamma_{231}/\Gamma$

| VALUE (units $10^{-3}$ ) | DOCUMENT ID                 | TECN | COMMENT                                 |
|--------------------------|-----------------------------|------|-----------------------------------------|
| <b>2.7±0.5±0.5</b>       | <sup>1</sup> BALTRUSAIT..87 | MRK3 | $J/\psi \rightarrow \gamma \pi^+ \pi^-$ |

NODE=M070S7  
NODE=M070S7

<sup>1</sup> Assuming branching fraction  $f_4(2050) \rightarrow \pi\pi$  / total = 0.167.

NODE=M070S7;LINKAGE=V

### $\Gamma(\gamma \omega \omega)/\Gamma_{\text{total}}$

$\Gamma_{232}/\Gamma$

| VALUE (units $10^{-3}$ )     | EVTS     | DOCUMENT ID     | TECN     | COMMENT                                        |
|------------------------------|----------|-----------------|----------|------------------------------------------------|
| <b>1.61±0.33 OUR AVERAGE</b> |          |                 |          |                                                |
| 6.0 ±4.8 ±1.8                |          | ABLIKIM         | 08A BES2 | $J/\psi \rightarrow \gamma \omega \pi^+ \pi^-$ |
| 1.41±0.2 ±0.42               | 120 ± 17 | BISELLO         | 87 SPEC  | $e^+ e^-$ , hadrons $\gamma$                   |
| 1.76±0.09±0.45               |          | BALTRUSAIT..85C | MRK3     | $e^+ e^- \rightarrow$ hadrons $\gamma$         |

NODE=M070R97  
NODE=M070R97

### $\Gamma(\gamma \eta(1405/1475) \rightarrow \gamma \rho^0 \rho^0)/\Gamma_{\text{total}}$

$\Gamma_{233}/\Gamma$

| VALUE (units $10^{-3}$ )    | DOCUMENT ID                         | TECN    | COMMENT                                             |
|-----------------------------|-------------------------------------|---------|-----------------------------------------------------|
| <b>1.7 ±0.4 OUR AVERAGE</b> | Error includes scale factor of 1.3. |         |                                                     |
| 2.1 ±0.4                    | BUGG                                | 95 MRK3 | $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$ |
| 1.36±0.38                   | <sup>1,2</sup> BISELLO              | 89B DM2 | $J/\psi \rightarrow 4\pi \gamma$                    |

NODE=M070S19  
NODE=M070S19

<sup>1</sup> Estimated by us from various fits.

<sup>2</sup> Includes unknown branching fraction to  $\rho^0 \rho^0$ .

NODE=M070S19;LINKAGE=A  
NODE=M070S19;LINKAGE=B

### $\Gamma(\gamma f_2(1270))/\Gamma_{\text{total}}$

$\Gamma_{234}/\Gamma$

| VALUE (units $10^{-3}$ )                    | EVTS                                                        | DOCUMENT ID          | TECN     | COMMENT                                                     |
|---------------------------------------------|-------------------------------------------------------------|----------------------|----------|-------------------------------------------------------------|
| <b>1.64±0.12 OUR AVERAGE</b>                | Error includes scale factor of 1.3. See the ideogram below. |                      |          |                                                             |
| 2.07±0.16 <sup>+0.02</sup> <sub>-0.07</sub> | 2.4k                                                        | <sup>1,2</sup> DOBBS | 15       | $J/\psi \rightarrow \gamma \pi \pi$                         |
| 1.63±0.26 <sup>+0.02</sup> <sub>-0.06</sub> |                                                             | <sup>3</sup> ABLIKIM | 06V BES2 | $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$ |

NODE=M070R86  
NODE=M070R86

|                                 |     |                           |     |      |                                                            |
|---------------------------------|-----|---------------------------|-----|------|------------------------------------------------------------|
| $1.42 \pm 0.21^{+0.01}_{-0.05}$ |     | <sup>4</sup> ABLIKIM      | 06V | BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma \pi^0 \pi^0$ |
| $1.33 \pm 0.05 \pm 0.20$        |     | <sup>5</sup> AUGUSTIN     | 87  | DM2  | $J/\psi \rightarrow \gamma \pi^+ \pi^-$                    |
| $1.36 \pm 0.09 \pm 0.23$        |     | <sup>5</sup> BALTRUSAIT.. | 87  | MRK3 | $J/\psi \rightarrow \gamma \pi^+ \pi^-$                    |
| $1.48 \pm 0.25 \pm 0.30$        | 178 | EDWARDS                   | 82B | CBAL | $e^+e^- \rightarrow 2\pi^0 \gamma$                         |
| $2.0 \pm 0.7$                   | 35  | ALEXANDER                 | 78  | PLUT | $e^+e^-$                                                   |
| $1.2 \pm 0.6$                   | 30  | <sup>6</sup> BRANDELIK    | 78B | DASP | $e^+e^- \rightarrow \pi^+ \pi^- \gamma$                    |

OCCUR=2

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>2</sup> DOBBS 15 reports  $[\Gamma(J/\psi(1S) \rightarrow \gamma f_2(1270))/\Gamma_{\text{total}}] \times [B(f_2(1270) \rightarrow \pi\pi)] = (1.744 \pm 0.052 \pm 0.122) \times 10^{-3}$  which we divide by our best value  $B(f_2(1270) \rightarrow \pi\pi) = (84.2^{+2.9}_{-0.9}) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070R86;LINKAGE=A  
 NODE=M070R86;LINKAGE=DO

<sup>3</sup> ABLIKIM 06V reports  $[\Gamma(J/\psi(1S) \rightarrow \gamma f_2(1270))/\Gamma_{\text{total}}] \times [B(f_2(1270) \rightarrow \pi\pi)] = (1.371 \pm 0.010 \pm 0.222) \times 10^{-3}$  which we divide by our best value  $B(f_2(1270) \rightarrow \pi\pi) = (84.2^{+2.9}_{-0.9}) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M070R86;LINKAGE=AI

<sup>4</sup> ABLIKIM 06V reports  $[\Gamma(J/\psi(1S) \rightarrow \gamma f_2(1270))/\Gamma_{\text{total}}] \times [B(f_2(1270) \rightarrow \pi\pi)] = (1.200 \pm 0.027 \pm 0.174) \times 10^{-3}$  which we divide by our best value  $B(f_2(1270) \rightarrow \pi\pi) = (84.2^{+2.9}_{-0.9}) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

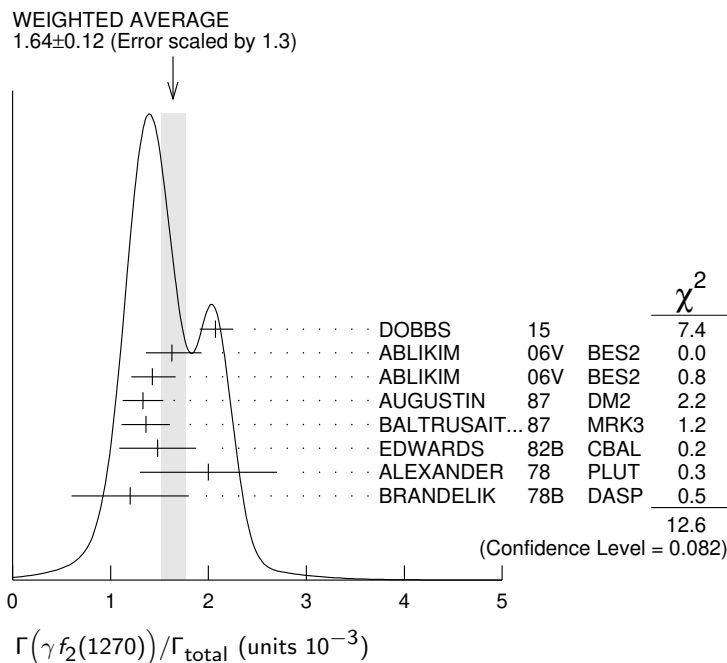
NODE=M070R86;LINKAGE=AL

<sup>5</sup> Estimated using  $B(f_2(1270) \rightarrow \pi\pi) = 0.843 \pm 0.012$ . The errors do not contain the uncertainty in the  $f_2(1270)$  decay.

NODE=M070R86;LINKAGE=X

<sup>6</sup> Restated by us to take account of spread of E1, M2, E3 transitions.

NODE=M070R86;LINKAGE=T



$\Gamma(\gamma f_2(1270) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{235}/\Gamma$

| VALUE (units $10^{-5}$ )         | DOCUMENT ID | TECN      | COMMENT                                 |
|----------------------------------|-------------|-----------|-----------------------------------------|
| $2.58^{+0.08+0.59}_{-0.09-0.20}$ | ABLIKIM     | 18AA BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

NODE=M070P68  
 NODE=M070P68

$\Gamma(\gamma f_0(1370) \rightarrow \gamma K \bar{K})/\Gamma_{\text{total}}$   $\Gamma_{236}/\Gamma$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID           | COMMENT                               |
|--------------------------|------|-----------------------|---------------------------------------|
| $4.19 \pm 0.73 \pm 1.34$ | 478  | <sup>1</sup> DOBBS 15 | $J/\psi \rightarrow \gamma K \bar{K}$ |

NODE=M070R00  
 NODE=M070R00

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M070R00;LINKAGE=A

$\Gamma(\gamma f_0(1370) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{237}/\Gamma$

| VALUE (units $10^{-5}$ )         | DOCUMENT ID | TECN      | COMMENT                                 |
|----------------------------------|-------------|-----------|-----------------------------------------|
| $1.07^{+0.08+0.36}_{-0.07-0.34}$ | ABLIKIM     | 18AA BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

NODE=M070P63  
 NODE=M070P63

$\Gamma(\gamma f_0(1500) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{238}/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

 $1.59 \pm 0.16^{+0.18}_{-0.56}$ 

ABLIKIM

18AA BES3

 $J/\psi \rightarrow \gamma K_S^0 K_S^0$ NODE=M070P64  
NODE=M070P64 $\Gamma(\gamma f_0(1710) \rightarrow \gamma K \bar{K})/\Gamma_{\text{total}}$  $\Gamma_{239}/\Gamma$ VALUE (units  $10^{-4}$ )

CL% EVTS

DOCUMENT ID

TECN

COMMENT

 $9.5 \pm 1.0$ **OUR AVERAGE**

Error includes scale factor of 1.5. See the ideogram

NODE=M070R91  
NODE=M070R91

below.

|                                      |      |                |           |                                          |
|--------------------------------------|------|----------------|-----------|------------------------------------------|
| $8.00 \pm 0.12^{+1.24}_{-0.08-0.40}$ | 1    | ABLIKIM        | 18AA BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$  |
| $11.76 \pm 0.54 \pm 0.94$            | 1.2k | 2              | DOBBS     | 15 $J/\psi \rightarrow \gamma K \bar{K}$ |
| $9.62 \pm 0.29^{+3.51}_{-1.86}$      | 3    | BAI            | 03G BES   | $J/\psi \rightarrow \gamma K \bar{K}$    |
| $5.0 \pm 0.8^{+1.8}_{-0.4}$          | 1.4  | BAI            | 96C BES   | $J/\psi \rightarrow \gamma K^+ K^-$      |
| $9.2 \pm 1.4 \pm 1.4$                | 1    | AUGUSTIN       | 88 DM2    | $J/\psi \rightarrow \gamma K^+ K^-$      |
| $10.4 \pm 1.2 \pm 1.6$               | 1    | AUGUSTIN       | 88 DM2    | $J/\psi \rightarrow \gamma K_S^0 K_S^0$  |
| $9.6 \pm 1.2 \pm 1.8$                | 1    | BALTRUSAIT..87 | MRK3      | $J/\psi \rightarrow \gamma K^+ K^-$      |

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                             |     |                |          |                                         |
|-----------------------------|-----|----------------|----------|-----------------------------------------|
| $1.6 \pm 0.2^{+0.6}_{-0.2}$ | 1.5 | BAI            | 96C BES  | $J/\psi \rightarrow \gamma K^+ K^-$     |
| $< 0.8$                     | 90  | 6              | BISELLO  | 89B $J/\psi \rightarrow 4\pi\gamma$     |
| $1.6 \pm 0.4 \pm 0.3$       | 7   | BALTRUSAIT..87 | MRK3     | $J/\psi \rightarrow \gamma \pi^+ \pi^-$ |
| $3.8 \pm 1.6$               | 8   | EDWARDS        | 82D CBAL | $e^+ e^- \rightarrow \eta \eta \gamma$  |

OCCUR=2

OCCUR=2

<sup>1</sup> Includes unknown branching fraction to  $K^+ K^-$  or  $K_S^0 K_S^0$ . We have multiplied  $K^+ K^-$  measurement by 2, and  $K_S^0 K_S^0$  by 4 to obtain  $K \bar{K}$  result.

<sup>2</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>3</sup> Includes unknown branching ratio to  $K^+ K^-$  or  $K_S^0 K_S^0$ .

<sup>4</sup> Assuming  $J^P = 2^+$  for  $f_0(1710)$ .

<sup>5</sup> Assuming  $J^P = 0^+$  for  $f_0(1710)$ .

<sup>6</sup> Includes unknown branching fraction to  $\rho^0 \rho^0$ .

<sup>7</sup> Includes unknown branching fraction to  $\pi^+ \pi^-$ .

<sup>8</sup> Includes unknown branching fraction to  $\eta \eta$ .

NODE=M070R91;LINKAGE=B

NODE=M070R91;LINKAGE=D

NODE=M070R91;LINKAGE=K9

NODE=M070R91;LINKAGE=A1

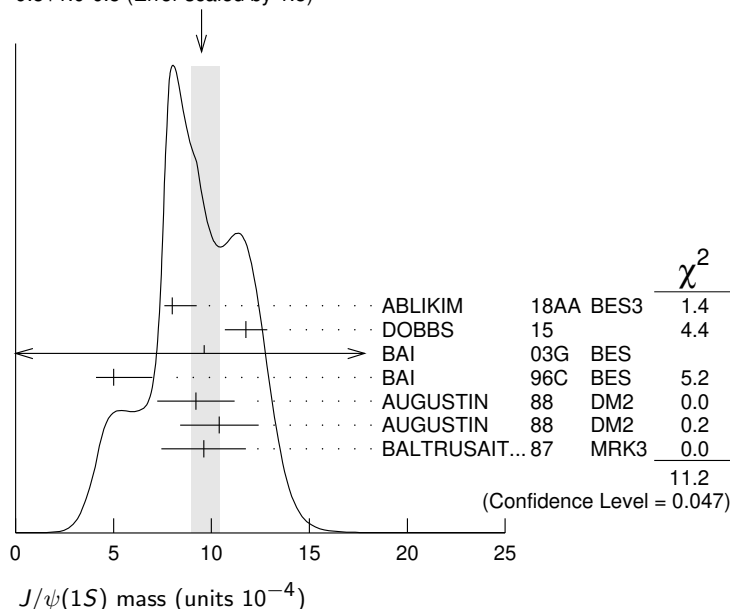
NODE=M070R91;LINKAGE=A2

NODE=M070R91;LINKAGE=C

NODE=M070R91;LINKAGE=Z

NODE=M070R91;LINKAGE=A

WEIGHTED AVERAGE  
9.5+1.0-0.5 (Error scaled by 1.5)

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma \pi \pi)/\Gamma_{\text{total}}$  $\Gamma_{240}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $3.8 \pm 0.5$  **OUR AVERAGE**

|                          |     |   |         |                                                                      |
|--------------------------|-----|---|---------|----------------------------------------------------------------------|
| $3.72 \pm 0.30 \pm 0.43$ | 483 | 1 | DOBBS   | 15 $J/\psi \rightarrow \gamma \pi \pi$                               |
| $3.96 \pm 0.06 \pm 1.12$ |     | 2 | ABLIKIM | 06V BES2 $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$ |
| $3.99 \pm 0.15 \pm 2.64$ |     | 2 | ABLIKIM | 06V BES2 $e^+ e^- \rightarrow J/\psi \rightarrow \gamma \pi^0 \pi^0$ |

NODE=M070B01  
NODE=M070B01

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |  |  |     |                                                 |
|-----------------------|--|--|-----|-------------------------------------------------|
| $2.5 \pm 1.6 \pm 0.8$ |  |  | BAI | 98H BES $J/\psi \rightarrow \gamma \pi^0 \pi^0$ |
|-----------------------|--|--|-----|-------------------------------------------------|

OCCUR=2

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>2</sup> Including unknown branching fraction to  $\pi\pi$ .

### $\Gamma(\gamma f_0(1710) \rightarrow \gamma \omega \omega) / \Gamma_{\text{total}}$

$\Gamma_{241} / \Gamma$

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID | TECN    | COMMENT                                   |
|--------------------------------------------|------|-------------|---------|-------------------------------------------|
| <b><math>0.31 \pm 0.06 \pm 0.08</math></b> | 180  | ABLIKIM     | 06H BES | $J/\psi \rightarrow \gamma \omega \omega$ |

NODE=M070B01;LINKAGE=A  
NODE=M070B01;LINKAGE=AB

NODE=M070R01  
NODE=M070R01

### $\Gamma(\gamma f_0(1710) \rightarrow \gamma \eta \eta) / \Gamma_{\text{total}}$

$\Gamma_{242} / \Gamma$

| VALUE (units $10^{-4}$ )                           | EVTS | DOCUMENT ID          | TECN     | COMMENT                               |
|----------------------------------------------------|------|----------------------|----------|---------------------------------------|
| <b><math>2.35^{+0.13+1.24}_{-0.11-0.74}</math></b> | 5.5k | <sup>1</sup> ABLIKIM | 13N BES3 | $J/\psi \rightarrow \gamma \eta \eta$ |

NODE=M070S84  
NODE=M070S84

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

NODE=M070S84;LINKAGE=A

### $\Gamma(\gamma \eta) / \Gamma_{\text{total}}$

$\Gamma_{243} / \Gamma$

| VALUE (units $10^{-3}$ )                                                      | EVTS  | DOCUMENT ID          | TECN     | COMMENT                                                 |
|-------------------------------------------------------------------------------|-------|----------------------|----------|---------------------------------------------------------|
| <b><math>1.108 \pm 0.027</math> OUR AVERAGE</b>                               |       |                      |          |                                                         |
| $1.12 \pm 0.05 \pm 0.01$                                                      | 18.6k | <sup>1</sup> ABLIKIM | 18O BES3 | $\psi(2S) \rightarrow \pi^+ \pi^- \gamma \gamma \gamma$ |
| $1.101 \pm 0.029 \pm 0.022$                                                   |       | PEDLAR               | 09 CLE3  | $J/\psi \rightarrow \eta \gamma$                        |
| $1.123 \pm 0.089$                                                             | 11k   | ABLIKIM              | 06E BES2 | $J/\psi \rightarrow \eta \gamma$                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                      |          |                                                         |
| $0.88 \pm 0.08 \pm 0.11$                                                      |       | BLOOM                | 83 CBAL  | $e^+ e^-$                                               |
| $0.82 \pm 0.10$                                                               |       | BRANDELIK            | 79C DASP | $e^+ e^-$                                               |
| $1.3 \pm 0.4$                                                                 | 21    | BARTEL               | 77 CNTR  | $e^+ e^-$                                               |

NODE=M070R83  
NODE=M070R83

<sup>1</sup> ABLIKIM 180 reports  $[\Gamma(J/\psi(1S) \rightarrow \gamma \eta) / \Gamma_{\text{total}}] \times [B(\eta \rightarrow 2\gamma)] = (4.42 \pm 0.04 \pm 0.18) \times 10^{-4}$  from a measurement of  $[\Gamma(J/\psi(1S) \rightarrow \gamma \eta) / \Gamma_{\text{total}}] \times [B(\eta \rightarrow 2\gamma)] \times [B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)]$  assuming  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (34.49 \pm 0.30) \times 10^{-2}$ , which we rescale to our best values  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20) \times 10^{-2}$ ,  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (34.68 \pm 0.30) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

NODE=M070R83;LINKAGE=A

### $\Gamma(\gamma f_1(1420) \rightarrow \gamma K \bar{K} \pi) / \Gamma_{\text{total}}$

$\Gamma_{244} / \Gamma$

| VALUE (units $10^{-3}$ )                      | DOCUMENT ID             | TECN     | COMMENT                                         |
|-----------------------------------------------|-------------------------|----------|-------------------------------------------------|
| <b><math>0.79 \pm 0.13</math> OUR AVERAGE</b> |                         |          |                                                 |
| $0.68 \pm 0.04 \pm 0.24$                      | BAI                     | 00D BES  | $J/\psi \rightarrow \gamma K^\pm K_S^0 \pi^\mp$ |
| $0.76 \pm 0.15 \pm 0.21$                      | <sup>1,2</sup> AUGUSTIN | 92 DM2   | $J/\psi \rightarrow \gamma K \bar{K} \pi$       |
| $0.87 \pm 0.14^{+0.14}_{-0.11}$               | <sup>1</sup> BAI        | 90C MRK3 | $J/\psi \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ |

NODE=M070S31  
NODE=M070S31

OCCUR=2

<sup>1</sup> Included unknown branching fraction  $f_1(1420) \rightarrow K \bar{K} \pi$ .

<sup>2</sup> From fit to the  $K^*(892)K$   $1^{++}$  partial wave.

NODE=M070S31;LINKAGE=A  
NODE=M070S31;LINKAGE=D

### $\Gamma(\gamma f_1(1285)) / \Gamma_{\text{total}}$

$\Gamma_{245} / \Gamma$

| VALUE (units $10^{-3}$ )                      | DOCUMENT ID         | TECN     | COMMENT                                         |
|-----------------------------------------------|---------------------|----------|-------------------------------------------------|
| <b><math>0.61 \pm 0.08</math> OUR AVERAGE</b> |                     |          |                                                 |
| $0.69 \pm 0.16 \pm 0.20$                      | <sup>1</sup> BAI    | 04J BES2 | $J/\psi \rightarrow \gamma \gamma \rho^0$       |
| $0.61 \pm 0.04 \pm 0.21$                      | <sup>2</sup> BAI    | 00D BES  | $J/\psi \rightarrow \gamma K^\pm K_S^0 \pi^\mp$ |
| $0.45 \pm 0.09 \pm 0.17$                      | <sup>3</sup> BAI    | 99 BES   | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$    |
| $0.625 \pm 0.063 \pm 0.103$                   | <sup>4</sup> BOLTON | 92 MRK3  | $J/\psi \rightarrow \gamma f_1(1285)$           |
| $0.70 \pm 0.08 \pm 0.16$                      | <sup>5</sup> BOLTON | 92B MRK3 | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$    |

NODE=M070R88  
NODE=M070R88

<sup>1</sup> Assuming  $B(f_1(1285) \rightarrow \rho^0 \gamma) = 0.055 \pm 0.013$ .

<sup>2</sup> Assuming  $\Gamma(f_1(1285) \rightarrow K \bar{K} \pi) / \Gamma_{\text{total}} = 0.090 \pm 0.004$ .

<sup>3</sup> Assuming  $\Gamma(f_1(1285) \rightarrow \eta \pi \pi) / \Gamma_{\text{total}} = 0.5 \pm 0.18$ .

<sup>4</sup> Obtained summing the sequential decay channels

$B(J/\psi \rightarrow \gamma f_1(1285), f_1(1285) \rightarrow \pi \pi \pi \pi) = (1.44 \pm 0.39 \pm 0.27) \times 10^{-4}$ ;  
 $B(J/\psi \rightarrow \gamma f_1(1285), f_1(1285) \rightarrow a_0(980) \pi, a_0(980) \rightarrow \eta \pi) = (3.90 \pm 0.42 \pm 0.87) \times 10^{-4}$ ;

$B(J/\psi \rightarrow \gamma f_1(1285), f_1(1285) \rightarrow a_0(980) \pi, a_0(980) \rightarrow K \bar{K}) = (0.66 \pm 0.26 \pm 0.29) \times 10^{-4}$ ;

$B(J/\psi \rightarrow \gamma f_1(1285), f_1(1285) \rightarrow \gamma \rho^0) = (0.25 \pm 0.07 \pm 0.03) \times 10^{-4}$ .

<sup>5</sup> Using  $B(f_1(1285) \rightarrow a_0(980) \pi) = 0.37$ , and including unknown branching ratio for  $a_0(980) \rightarrow \eta \pi$ .

NODE=M070R88;LINKAGE=BI  
NODE=M070R88;LINKAGE=BD  
NODE=M070R88;LINKAGE=BA  
NODE=M070R88;LINKAGE=B

NODE=M070R88;LINKAGE=A

### $\Gamma(\gamma f_1(1510) \rightarrow \gamma \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

$\Gamma_{246} / \Gamma$

| VALUE (units $10^{-4}$ )                | DOCUMENT ID | TECN   | COMMENT                                      |
|-----------------------------------------|-------------|--------|----------------------------------------------|
| <b><math>4.5 \pm 1.0 \pm 0.7</math></b> | BAI         | 99 BES | $J/\psi \rightarrow \gamma \eta \pi^+ \pi^-$ |

NODE=M070S36  
NODE=M070S36

$\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$  $\Gamma_{247}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**5.7<sup>+0.8</sup><sub>-0.5</sub>** OUR AVERAGE Error includes scale factor of 1.5. See the ideogram below.

|                                 |     |     |                |         |                                         |
|---------------------------------|-----|-----|----------------|---------|-----------------------------------------|
| 8.1 $\pm 0.9 \pm 0.2$           | 750 | 1,2 | DOBBS          | 15      | $J/\psi \rightarrow \gamma K \bar{K}$   |
| 3.85 $\pm 0.17^{+1.91}_{-0.73}$ |     | 3   | BAI            | 03G BES | $J/\psi \rightarrow \gamma K \bar{K}$   |
| 3.6 $\pm 0.4^{+1.4}_{-0.4}$     |     | 3   | BAI            | 96C BES | $J/\psi \rightarrow \gamma K^+ K^-$     |
| 5.6 $\pm 1.4 \pm 0.9$           |     | 3   | AUGUSTIN       | 88 DM2  | $J/\psi \rightarrow \gamma K^+ K^-$     |
| 4.5 $\pm 0.4 \pm 0.9$           |     | 3   | AUGUSTIN       | 88 DM2  | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |
| 6.8 $\pm 1.6 \pm 1.4$           |     | 3   | BALTRUSAIT..87 | MRK3    | $J/\psi \rightarrow \gamma K^+ K^-$     |

OCCUR=3

OCCUR=4

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |   |   |           |          |                                          |
|------|----|---|---|-----------|----------|------------------------------------------|
| <3.4 | 90 | 4 | 4 | BRANDELIK | 79C DASP | $e^+ e^- \rightarrow \pi^+ \pi^- \gamma$ |
| <2.3 | 90 | 3 |   | ALEXANDER | 78 PLUT  | $e^+ e^- \rightarrow K^+ K^- \gamma$     |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>2</sup> DOBBS 15 reports  $[\Gamma(J/\psi(15) \rightarrow \gamma f'_2(1525))/\Gamma_{\text{total}}] \times [B(f'_2(1525) \rightarrow K \bar{K})] = (7.09 \pm 0.46 \pm 0.67) \times 10^{-4}$  which we divide by our best value  $B(f'_2(1525) \rightarrow K \bar{K}) = (87.6 \pm 2.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> Using  $B(f'_2(1525) \rightarrow K \bar{K}) = 0.888$ .

<sup>4</sup> Assuming isotropic production and decay of the  $f'_2(1525)$  and isospin.

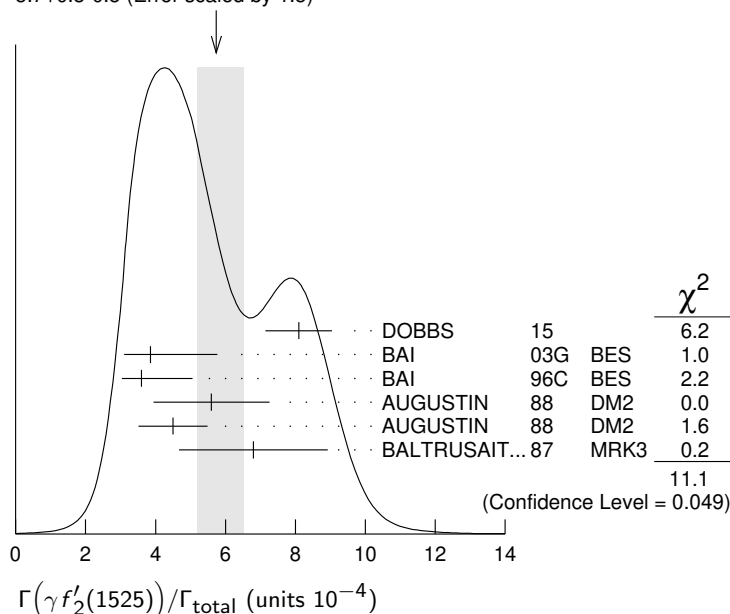
NODE=M070R87;LINKAGE=B

NODE=M070R87;LINKAGE=DO

NODE=M070R87;LINKAGE=A1

NODE=M070R87;LINKAGE=I

WEIGHTED AVERAGE  
5.7+0.8-0.5 (Error scaled by 1.5)

 $\Gamma(\gamma f'_2(1525) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{248}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**7.99<sup>+0.03+0.69</sup><sub>-0.04-0.50</sub>** ABLIKIM 18AA BES3  $J/\psi \rightarrow \gamma K_S^0 K_S^0$

NODE=M070P69

NODE=M070P69

 $\Gamma(\gamma f'_2(1525) \rightarrow \gamma \eta \eta)/\Gamma_{\text{total}}$  $\Gamma_{249}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**3.42<sup>+0.43+1.37</sup><sub>-0.51-1.30</sub>** 5.5k <sup>1</sup> ABLIKIM 13N BES3  $J/\psi \rightarrow \gamma \eta \eta$

NODE=M070S86

NODE=M070S86

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

NODE=M070S86;LINKAGE=A

 $\Gamma(\gamma f_2(1640) \rightarrow \gamma \omega \omega)/\Gamma_{\text{total}}$  $\Gamma_{250}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.28 $\pm 0.05 \pm 0.17$**  141 ABLIKIM 06H BES  $J/\psi \rightarrow \gamma \omega \omega$

NODE=M070R02

NODE=M070R02

 $\Gamma(\gamma f_2(1910) \rightarrow \gamma \omega \omega)/\Gamma_{\text{total}}$  $\Gamma_{251}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.20 $\pm 0.04 \pm 0.13$**  151 ABLIKIM 06H BES  $J/\psi \rightarrow \gamma \omega \omega$

NODE=M070R03

NODE=M070R03

$\Gamma(\gamma f_0(1750) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{252}/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

NODE=M070P65  
NODE=M070P65 $1.11 \pm 0.06^{+0.19}_{-0.32}$ 

ABLIKIM

18AA BES3

 $J/\psi \rightarrow \gamma K_S^0 K_S^0$  $\Gamma(\gamma f_0(1710) \rightarrow \gamma \omega \phi)/\Gamma_{\text{total}}$  $\Gamma_{253}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

NODE=M070S79  
NODE=M070S79 $2.5 \pm 0.6$  OUR AVERAGE $2.00 \pm 0.08^{+1.38}_{-1.64}$ 

1.3k

ABLIKIM

13J

BES3

 $J/\psi \rightarrow \gamma \omega \phi$  $2.61 \pm 0.27 \pm 0.65$ 

95

ABLIKIM

06J

BES2

 $J/\psi \rightarrow \gamma \omega \phi$  $\Gamma(\gamma f_2(1810) \rightarrow \gamma \eta \eta)/\Gamma_{\text{total}}$  $\Gamma_{254}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

COMMENT

NODE=M070S87  
NODE=M070S87 $5.40^{+0.60+3.42}_{-0.67-2.35}$ 

5.5k

<sup>1</sup>

ABLIKIM

13N

 $J/\psi \rightarrow \gamma \eta \eta$ <sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

NODE=M070S87;LINKAGE=A

 $\Gamma(\gamma f_2(1950) \rightarrow \gamma K^*(892) \bar{K}^*(892))/\Gamma_{\text{total}}$  $\Gamma_{255}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

NODE=M070B06  
NODE=M070B06 $0.7 \pm 0.1 \pm 0.2$ 

BAI

00B

BES

 $J/\psi \rightarrow \gamma K^+ K^0 \pi^+ \pi^-$  $\Gamma(\gamma K^*(892) \bar{K}^*(892))/\Gamma_{\text{total}}$  $\Gamma_{256}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

NODE=M070B07  
NODE=M070B07 $4.0 \pm 0.3 \pm 1.3$ 

320

<sup>1</sup>

BAI

00B

BES

 $J/\psi \rightarrow \gamma K^+ K^0 \pi^+ \pi^-$ <sup>1</sup> Summed over all charges.

NODE=M070R;LINKAGE=B7

 $\Gamma(\gamma \phi \phi)/\Gamma_{\text{total}}$  $\Gamma_{257}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

NODE=M070R98  
NODE=M070R98 $4.0 \pm 1.2$  OUR AVERAGE Error includes scale factor of 2.1. See the ideogram below. $7.5 \pm 0.6 \pm 1.2$ 

168

BAI

90B

MRK3

 $J/\psi \rightarrow \gamma 4K$  $3.4 \pm 0.8 \pm 0.6$  $33 \pm 7$ <sup>1</sup>

BISELLO

90

DM2

 $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$  $3.1 \pm 0.7 \pm 0.4$ <sup>1</sup>

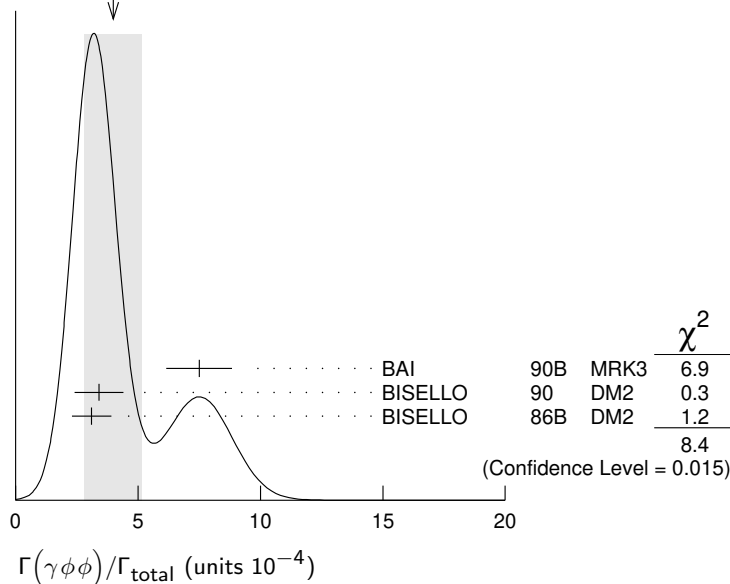
BISELLO

86B

DM2

 $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$ <sup>1</sup>  $\phi \phi$  mass less than 2.9 GeV,  $\eta_c$  excluded.

NODE=M070R98;LINKAGE=C

WEIGHTED AVERAGE  
 $4.0 \pm 1.2$  (Error scaled by 2.1) $\Gamma(\gamma \rho \rho)/\Gamma_{\text{total}}$  $\Gamma_{258}/\Gamma$ VALUE (units  $10^{-3}$ )

CL%

EVTS

DOCUMENT ID

TECN

COMMENT

NODE=M070R90  
NODE=M070R90 $0.38 \pm 0.07 \pm 0.07$ 

49

EATON

84

MRK2

 $e^+ e^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt;0.11

90

PERUZZI

78

MRK1

 $e^+ e^-$



$\Gamma(\gamma\eta(2225))/\Gamma_{\text{total}}$  $\Gamma_{259}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

NODE=M070S21  
NODE=M070S21

**3.14<sup>+0.50</sup><sub>-0.19</sub> OUR AVERAGE**

|                                               |     |                        |          |                                                 |
|-----------------------------------------------|-----|------------------------|----------|-------------------------------------------------|
| 2.40 ± 0.10 <sup>+2.47</sup> <sub>-0.18</sub> | 196 | <sup>1,2</sup> ABLIKIM | 16N BES3 | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 4.4 ± 0.4 ± 0.8                               |     | <sup>2</sup> ABLIKIM   | 08I BES  | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |
| 3.3 ± 0.8 ± 0.5                               |     | <sup>2</sup> BAI       | 90B MRK3 | $J/\psi \rightarrow \gamma K^+ K^- K^+ K^-$     |
| 2.7 ± 0.6 ± 0.6                               |     | <sup>2</sup> BAI       | 90B MRK3 | $J/\psi \rightarrow \gamma K^+ K^- K_S^0 K_L^0$ |
| 2.4 <sup>+1.5</sup> <sub>-1.0</sub>           |     | <sup>3,4</sup> BISELLO | 89B DM2  | $J/\psi \rightarrow 4\pi\gamma$                 |

OCCUR=2

<sup>1</sup> From a partial wave analysis of  $J/\psi \rightarrow \gamma\phi\phi$  that also finds significant signals for  $\eta(2100)$ ,  $0^-+$  phase space,  $f_0(2100)$ ,  $f_2(2010)$ ,  $f_2(2300)$ ,  $f_2(2340)$ , and a previously unseen  $0^-+$  state  $X(2500)$  ( $M = 2470^{+15+101}_{-19-23}$  MeV,  $\Gamma = 230^{+64+56}_{-35-33}$  MeV).

<sup>2</sup> Includes unknown branching fraction to  $\phi\phi$ .

<sup>3</sup> Estimated by us from various fits.

<sup>4</sup> Includes unknown branching fraction to  $\rho^0\rho^0$ .

NODE=M070S21;LINKAGE=C

NODE=M070S21;LINKAGE=U  
NODE=M070S21;LINKAGE=A  
NODE=M070S21;LINKAGE=B

 $\Gamma(\gamma\eta(1760) \rightarrow \gamma\rho^0\rho^0)/\Gamma_{\text{total}}$  $\Gamma_{260}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID            | TECN    | COMMENT                         |
|--------------------------|------------------------|---------|---------------------------------|
| <b>0.13 ± 0.09</b>       | <sup>1,2</sup> BISELLO | 89B DM2 | $J/\psi \rightarrow 4\pi\gamma$ |

<sup>1</sup> Estimated by us from various fits.

<sup>2</sup> Includes unknown branching fraction to  $\rho^0\rho^0$ .

NODE=M070S20  
NODE=M070S20

NODE=M070S20;LINKAGE=A  
NODE=M070S20;LINKAGE=B

 $\Gamma(\gamma\eta(1760) \rightarrow \gamma\omega\omega)/\Gamma_{\text{total}}$  $\Gamma_{261}/\Gamma$ 

| VALUE (units $10^{-3}$ )  | EVTS | DOCUMENT ID | TECN    | COMMENT                                 |
|---------------------------|------|-------------|---------|-----------------------------------------|
| <b>1.98 ± 0.08 ± 0.32</b> | 1045 | ABLIKIM     | 06H BES | $J/\psi \rightarrow \gamma\omega\omega$ |

NODE=M070R04  
NODE=M070R04

 $\Gamma(\gamma\eta(1760) \rightarrow \gamma\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{262}/\Gamma$ 

| VALUE                              | CL% | DOCUMENT ID | TECN     | COMMENT                                             |
|------------------------------------|-----|-------------|----------|-----------------------------------------------------|
| <b>&lt; 4.80 × 10<sup>-6</sup></b> | 90  | ABLIKIM     | 180 BES3 | $\psi(2S) \rightarrow \pi^+\pi^-\gamma\gamma\gamma$ |

NODE=M070P40  
NODE=M070P40

 $\Gamma(\gamma X(1835) \rightarrow \gamma\pi^+\pi^-\eta')/\Gamma_{\text{total}}$  $\Gamma_{263}/\Gamma$ 

| VALUE (units $10^{-4}$ )                             | EVTS | DOCUMENT ID | TECN | COMMENT                                                                       |
|------------------------------------------------------|------|-------------|------|-------------------------------------------------------------------------------|
| <b>2.7<sup>+0.6</sup><sub>-0.8</sub> OUR AVERAGE</b> |      |             |      | Error includes scale factor of 1.6. $[(2.77^{+0.34}_{-0.40}) \times 10^{-4}]$ |
| OUR 2020 AVERAGE Scale factor = 1.1]                 |      |             |      |                                                                               |

NEW

|                                                                               |      |                      |          |                                            |
|-------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------|
| 3.93 ± 0.38 <sup>+0.31</sup> <sub>-0.84</sub>                                 | 264  | <sup>1</sup> ABLIKIM | 16J BES3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$ |
| 2.2 ± 0.4 ± 0.4                                                               |      | ABLIKIM              | 05R BES2 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |          |                                            |
| 2.87 ± 0.09 <sup>+0.49</sup> <sub>-0.52</sub>                                 | 4265 | <sup>2</sup> ABLIKIM | 11C BES3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\eta'$ |

<sup>1</sup> From a fit of the measured  $\pi^+\pi^-\eta'$  lineshape that accounts for the abrupt distortion observed at the  $p\bar{p}$  threshold with a Flatte formula in addition to known backgrounds and contributors, as well as an *ad hoc* Breit-Wigner ( $M \approx 1919$  MeV;  $\Gamma \approx 51$  MeV) that is required for a good fit. Another explanation for the distortion provided by ABLIKIM 16J is that a second resonance near 1870 MeV interferes with the  $X(1835)$ ; fits to this possibility yield product branching fraction values compatible with that shown within the respective systematic uncertainties.

<sup>2</sup> From a fit of the  $\pi^+\pi^-\eta'$  mass distribution to a combination of  $\gamma f_1(1510)$ ,  $\gamma X(1835)$ , and two states  $\gamma X(2120)$  and  $\gamma X(2370)$ , for  $M(\pi^+\pi^-\eta') < 2.8$  GeV, and accounting for backgrounds from non- $\eta'$  events and  $J/\psi \rightarrow \pi^0\pi^+\pi^-\eta'$ .

NODE=M070R78;LINKAGE=A

NODE=M070R78;LINKAGE=A

 $\Gamma(\gamma X(1835) \rightarrow \gamma p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{264}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.77<sup>+0.15</sup><sub>-0.09</sub> OUR AVERAGE**

|                                                  |     |                        |          |                                      |
|--------------------------------------------------|-----|------------------------|----------|--------------------------------------|
| 0.90 <sup>+0.04+0.27</sup> <sub>-0.11-0.55</sub> |     | <sup>1</sup> ABLIKIM   | 12D BES3 | $J/\psi \rightarrow \gamma p\bar{p}$ |
| 1.14 <sup>+0.43+0.42</sup> <sub>-0.30-0.26</sub> | 231 | <sup>2</sup> ALEXANDER | 10 CLEO  | $J/\psi \rightarrow \gamma p\bar{p}$ |
| 0.70 ± 0.04 <sup>+0.19</sup> <sub>-0.08</sub>    |     | BAI                    | 03F BES2 | $J/\psi \rightarrow \gamma p\bar{p}$ |

<sup>1</sup> From the fit including final state interaction effects in isospin 0 S-wave according to SIBIRTSEV 05A.

<sup>2</sup> From a fit of the  $p\bar{p}$  mass distribution to a combination of  $\gamma X(1835)$ ,  $\gamma R$  with  $M(R) = 2100$  MeV and  $\Gamma(R) = 160$  MeV, and  $\gamma p\bar{p}$  phase space, for  $M(p\bar{p}) < 2.85$  GeV.

NODE=M070S71  
NODE=M070S71

NODE=M070S71;LINKAGE=AK

NODE=M070S71;LINKAGE=AL

$$\Gamma(\gamma X(1835) \rightarrow \gamma K_S^0 K_S^0 \eta) / \Gamma_{\text{total}} \quad \Gamma_{265} / \Gamma$$

| VALUE (units $10^{-5}$ )         | DOCUMENT ID | TECN     | COMMENT                                      |
|----------------------------------|-------------|----------|----------------------------------------------|
| $3.31^{+0.33+1.96}_{-0.30-1.29}$ | ABLIKIM     | 15T BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta$ |

NODE=M070S96  
NODE=M070S96

$$\Gamma(\gamma X(1835) \rightarrow \gamma \gamma \phi(1020)) / \Gamma_{\text{total}} \quad \Gamma_{266} / \Gamma$$

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |      |                      |          |                                               |
|--------------------------|------|----------------------|----------|-----------------------------------------------|
| $1.77 \pm 0.35 \pm 0.25$ | 305  | <sup>1</sup> ABLIKIM | 18I BES3 | $J/\psi \rightarrow \gamma \gamma \phi(1020)$ |
| $8.09 \pm 1.99 \pm 1.36$ | 1.3k | <sup>2</sup> ABLIKIM | 18I BES3 | $J/\psi \rightarrow \gamma \gamma \phi(1020)$ |

NODE=M070P37  
NODE=M070P37

<sup>1</sup> Constructive interference between the  $X(1835)$  and  $\eta(1405)/\eta(1475)$  is assumed in a fit to the  $\gamma \phi$  invariant mass.

OCCUR=2

<sup>2</sup> Destructive interference between the  $X(1835)$  and  $\eta(1405)/\eta(1475)$  is assumed in a fit to the  $\gamma \phi$  invariant mass.

NODE=M070P37;LINKAGE=A

NODE=M070P37;LINKAGE=B

$$\Gamma(\gamma X(1835) \rightarrow \gamma \gamma \gamma) / \Gamma_{\text{total}} \quad \Gamma_{267} / \Gamma$$

| VALUE                   | CL% | DOCUMENT ID | TECN     | COMMENT                                                 |
|-------------------------|-----|-------------|----------|---------------------------------------------------------|
| $< 3.56 \times 10^{-6}$ | 90  | ABLIKIM     | 18O BES3 | $\psi(2S) \rightarrow \pi^+ \pi^- \gamma \gamma \gamma$ |

NODE=M070P41  
NODE=M070P41

$$\Gamma(\gamma X(1840) \rightarrow \gamma 3(\pi^+ \pi^-)) / \Gamma_{\text{total}} \quad \Gamma_{271} / \Gamma$$

| VALUE (units $10^{-5}$ )        | EVTS | DOCUMENT ID | TECN     | COMMENT                                    |
|---------------------------------|------|-------------|----------|--------------------------------------------|
| $2.44 \pm 0.36^{+0.60}_{-0.74}$ | 0.6k | ABLIKIM     | 13U BES3 | $J/\psi \rightarrow \gamma 3(\pi^+ \pi^-)$ |

NODE=M070S82  
NODE=M070S82

$$\Gamma(\gamma X(2370) \rightarrow \gamma K^+ K^- \eta') / \Gamma_{\text{total}} \quad \Gamma_{268} / \Gamma$$

| VALUE (units $10^{-5}$ ) | DOCUMENT ID | TECN     | COMMENT                                   |
|--------------------------|-------------|----------|-------------------------------------------|
| $1.79 \pm 0.23 \pm 0.65$ | ABLIKIM     | 20Q BES3 | $J/\psi \rightarrow \gamma K^+ K^- \eta'$ |

NODE=M070P86  
NODE=M070P86

$$\Gamma(\gamma X(2370) \rightarrow \gamma K_S^0 K_S^0 \eta') / \Gamma_{\text{total}} \quad \Gamma_{269} / \Gamma$$

| VALUE (units $10^{-5}$ ) | DOCUMENT ID | TECN     | COMMENT                                       |
|--------------------------|-------------|----------|-----------------------------------------------|
| $1.18 \pm 0.32 \pm 0.39$ | ABLIKIM     | 20Q BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0 \eta'$ |

NODE=M070P87  
NODE=M070P87

$$\Gamma(\gamma X(2370) \rightarrow \gamma \eta \eta \eta') / \Gamma_{\text{total}} \quad \Gamma_{270} / \Gamma$$

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                         |
|--------------------------|-----|-------------|----------|-------------------------------------------------|
| $< 9.2$                  | 90  | ABLIKIM     | 21C BES3 | $J/\psi(1S) \rightarrow \gamma \eta \eta \eta'$ |

NODE=M070P88  
NODE=M070P88

$$\Gamma(\gamma(K \bar{K} \pi) [J^{PC} = 0^{-+}]) / \Gamma_{\text{total}} \quad \Gamma_{272} / \Gamma$$

| VALUE (units $10^{-3}$ )  | DOCUMENT ID                         | TECN    | COMMENT                                         |
|---------------------------|-------------------------------------|---------|-------------------------------------------------|
| $0.7 \pm 0.4$ OUR AVERAGE | Error includes scale factor of 2.1. |         |                                                 |
| $0.58 \pm 0.03 \pm 0.20$  | <sup>1</sup> BAI                    | 00D BES | $J/\psi \rightarrow \gamma K^\pm K_S^0 \pi^\mp$ |
| $2.1 \pm 0.1 \pm 0.7$     | <sup>2</sup> BAI                    | 00D BES | $J/\psi \rightarrow \gamma K^\pm K_S^0 \pi^\mp$ |

NODE=M070S38  
NODE=M070S38

<sup>1</sup> For a broad structure around 1800 MeV.

<sup>2</sup> For a broad structure around 2040 MeV.

OCCUR=2

NODE=M070S38;LINKAGE=BD  
NODE=M070S38;LINKAGE=BE

$$\Gamma(\gamma \pi^0) / \Gamma_{\text{total}} \quad \Gamma_{273} / \Gamma$$

| VALUE (units $10^{-5}$ )    | EVTS | DOCUMENT ID | TECN | COMMENT |
|-----------------------------|------|-------------|------|---------|
| $3.56 \pm 0.17$ OUR AVERAGE |      |             |      |         |

NODE=M070R82  
NODE=M070R82

|                          |      |                      |          |                                                         |
|--------------------------|------|----------------------|----------|---------------------------------------------------------|
| $3.59 \pm 0.20 \pm 0.03$ | 1.6k | <sup>1</sup> ABLIKIM | 18O BES3 | $\psi(2S) \rightarrow \pi^+ \pi^- \gamma \gamma \gamma$ |
| $3.63 \pm 0.36 \pm 0.13$ |      | PEDLAR               | 09 CLE3  | $J/\psi \rightarrow \pi^0 \gamma$                       |
| $3.13^{+0.65}_{-0.47}$   | 586  | ABLIKIM              | 06E BES2 | $J/\psi \rightarrow \pi^0 \gamma$                       |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |    |           |          |           |
|-----------------------|----|-----------|----------|-----------|
| $3.6 \pm 1.1 \pm 0.7$ |    | BLOOM     | 83 CBAL  | $e^+ e^-$ |
| $7.3 \pm 4.7$         | 10 | BRANDELIK | 79C DASP | $e^+ e^-$ |

<sup>1</sup> ABLIKIM 180 reports  $[\Gamma(J/\psi(1S) \rightarrow \gamma \pi^0) / \Gamma_{\text{total}}] \times [B(\pi^0 \rightarrow 2\gamma)] = (3.57 \pm 0.12 \pm 0.16) \times 10^{-5}$  from a measurement of  $[\Gamma(J/\psi(1S) \rightarrow \gamma \pi^0) / \Gamma_{\text{total}}] \times [B(\pi^0 \rightarrow 2\gamma)] \times [B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)]$  assuming  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (34.49 \pm 0.30) \times 10^{-2}$ , which we rescale to our best values  $B(\pi^0 \rightarrow 2\gamma) = (98.823 \pm 0.034) \times 10^{-2}$ ,  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (34.68 \pm 0.30) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

NODE=M070R82;LINKAGE=A

$$\Gamma(\gamma \rho \bar{\rho} \pi^+ \pi^-) / \Gamma_{\text{total}} \quad \Gamma_{274} / \Gamma$$

| VALUE                   | CL% | DOCUMENT ID | TECN    | COMMENT   |
|-------------------------|-----|-------------|---------|-----------|
| $< 0.79 \times 10^{-3}$ | 90  | EATON       | 84 MRK2 | $e^+ e^-$ |

NODE=M070R93  
NODE=M070R93

$\Gamma(\gamma\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$  $\Gamma_{275}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN    | COMMENT  |
|-------------------------------------------------------------------------------|-----|-------------|---------|----------|
| $<0.13 \times 10^{-3}$                                                        | 90  | HENRARD     | 87 DM2  | $e^+e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |         |          |
| $<0.16 \times 10^{-3}$                                                        | 90  | BAI         | 98G BES | $e^+e^-$ |

NODE=M070S8  
 NODE=M070S8

 $\Gamma(\gamma f_0(2100) \rightarrow \gamma\eta\eta)/\Gamma_{\text{total}}$  $\Gamma_{276}/\Gamma$ 

| VALUE (units $10^{-4}$ )         | EVTS | DOCUMENT ID          | TECN     | COMMENT                             |
|----------------------------------|------|----------------------|----------|-------------------------------------|
| $1.13^{+0.09+0.64}_{-0.10-0.28}$ | 5.5k | <sup>1</sup> ABLIKIM | 13N BES3 | $J/\psi \rightarrow \gamma\eta\eta$ |

NODE=M070S85  
 NODE=M070S85

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.

NODE=M070S85;LINKAGE=A

 $\Gamma(\gamma f_0(2100) \rightarrow \gamma\pi\pi)/\Gamma_{\text{total}}$  $\Gamma_{277}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN | COMMENT                           |
|--------------------------|------|--------------------|------|-----------------------------------|
| $6.24 \pm 0.48 \pm 0.87$ | 744  | <sup>1</sup> DOBBS | 15   | $J/\psi \rightarrow \gamma\pi\pi$ |

NODE=M070B08  
 NODE=M070B08

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M070B08;LINKAGE=A

 $\Gamma(\gamma f_0(2200))/\Gamma_{\text{total}}$  $\Gamma_{278}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID           | TECN   | COMMENT                                 |
|--------------------------|-----------------------|--------|-----------------------------------------|
| 1.5                      | <sup>1</sup> AUGUSTIN | 88 DM2 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

NODE=M070S18  
 NODE=M070S18

<sup>1</sup> Includes unknown branching fraction to  $K_S^0 K_S^0$ .

NODE=M070S18;LINKAGE=A

 $\Gamma(\gamma f_0(2200) \rightarrow \gamma K\bar{K})/\Gamma_{\text{total}}$  $\Gamma_{279}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | COMMENT                                 |
|--------------------------|------|--------------------|-----------------------------------------|
| $5.86 \pm 0.49 \pm 1.20$ | 490  | <sup>1</sup> DOBBS | 15 $J/\psi \rightarrow \gamma K\bar{K}$ |

NODE=M070B09  
 NODE=M070B09

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M070B09;LINKAGE=A

 $\Gamma(\gamma f_0(2200) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{280}/\Gamma$ 

| VALUE (units $10^{-4}$ )         | DOCUMENT ID | TECN      | COMMENT                                 |
|----------------------------------|-------------|-----------|-----------------------------------------|
| $2.72^{+0.08+0.17}_{-0.06-0.47}$ | ABLIKIM     | 18AA BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

NODE=M070P66  
 NODE=M070P66

 $\Gamma(\gamma f_J(2220))/\Gamma_{\text{total}}$  $\Gamma_{281}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL%  | EVTS | DOCUMENT ID                  | TECN    | COMMENT                                       |
|-------------------------------------------------------------------------------|------|------|------------------------------|---------|-----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |      |                              |         |                                               |
| >300                                                                          |      |      | <sup>1</sup> BAI             | 96B BES | $e^+e^- \rightarrow \gamma\bar{p}p, K\bar{K}$ |
| >250                                                                          | 99.9 |      | <sup>2</sup> HASAN           | 96 SPEC | $\bar{p}p \rightarrow \pi^+\pi^-$             |
| < 2.3                                                                         | 95   |      | <sup>3</sup> AUGUSTIN        | 88 DM2  | $J/\psi \rightarrow \gamma K^+ K^-$           |
| < 1.6                                                                         | 95   |      | <sup>3</sup> AUGUSTIN        | 88 DM2  | $J/\psi \rightarrow \gamma K_S^0 K_S^0$       |
| $12.4^{+6.4}_{-5.2} \pm 2.8$                                                  |      | 23   | <sup>3</sup> BALTRUSAIT..86D | MRK3    | $J/\psi \rightarrow \gamma K_S^0 K_S^0$       |
| $8.4^{+3.4}_{-2.8} \pm 1.6$                                                   |      | 93   | <sup>3</sup> BALTRUSAIT..86D | MRK3    | $J/\psi \rightarrow \gamma K^+ K^-$           |

NODE=M070R92  
 NODE=M070R92

OCCUR=2

OCCUR=2

<sup>1</sup> Using BARNES 93.

<sup>2</sup> Using BAI 96B.

<sup>3</sup> Includes unknown branching fraction to  $K^+ K^-$  or  $K_S^0 K_S^0$ .

NODE=M070R92;LINKAGE=A  
 NODE=M070R92;LINKAGE=M  
 NODE=M070R92;LINKAGE=W

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma\pi\pi)/\Gamma_{\text{total}}$  $\Gamma_{282}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | DOCUMENT ID          | TECN    | COMMENT                                                  |
|-------------------------------------------------------------------------------|-----|----------------------|---------|----------------------------------------------------------|
| $< 3.9$                                                                       | 90  | <sup>1,2</sup> DOBBS | 15      | $J/\psi \rightarrow \gamma\pi\pi$                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                      |         |                                                          |
| $14 \pm 8 \pm 4$                                                              |     | BAI                  | 98H BES | $J/\psi \rightarrow \gamma\pi^0\pi^0$                    |
| $8.4 \pm 2.6 \pm 3.0$                                                         |     | BAI                  | 96B BES | $e^+e^- \rightarrow J/\psi \rightarrow \gamma\pi^+\pi^-$ |

NODE=M070B02  
 NODE=M070B02

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>2</sup> For  $\Gamma = 20/50$  MeV, the 90% CL upper limits for  $\pi^+\pi^-$  and  $\pi^0\pi^0$  are  $2.6/5.2 \times 10^{-5}$  and  $1.3/1.9 \times 10^{-5}$ , respectively.

NODE=M070B02;LINKAGE=A  
 NODE=M070B02;LINKAGE=D0

$\Gamma(\gamma f_J(2220) \rightarrow \gamma K \bar{K})/\Gamma_{\text{total}}$  $\Gamma_{283}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | DOCUMENT ID                  | TECN    | COMMENT                                                    |
|-------------------------------------------------------------------------------|-----|------------------------------|---------|------------------------------------------------------------|
| <b>&lt; 4.1</b>                                                               | 90  | 1,2 DOBBS                    | 15      | $J/\psi \rightarrow \gamma K \bar{K}$                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                              |         |                                                            |
| < 3.6                                                                         |     | <sup>3</sup> DEL-AMO-SA..100 | BABR    | $e^+e^- \rightarrow J/\psi \rightarrow \gamma K^+ K^-$     |
| < 2.9                                                                         |     | <sup>3</sup> DEL-AMO-SA..100 | BABR    | $e^+e^- \rightarrow J/\psi \rightarrow \gamma K_S^0 K_S^0$ |
| $6.6 \pm 2.9 \pm 2.4$                                                         |     | BAI                          | 96B BES | $e^+e^- \rightarrow J/\psi \rightarrow \gamma K^+ K^-$     |
| $10.8 \pm 4.0 \pm 3.2$                                                        |     | BAI                          | 96B BES | $e^+e^- \rightarrow J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> For  $\Gamma = 20/50$  MeV, the 90% CL upper limits for  $K^+ K^-$  and  $K_S^0 K_S^0$  are  $1.7/3.1 \times 10^{-5}$  and  $1.2/2.0 \times 10^{-5}$ , respectively.<sup>3</sup> For spin 2 and helicity 0; other combinations lead to more stringent upper limits.NODE=M070B03  
NODE=M070B03

OCCUR=2

OCCUR=2

NODE=M070B03;LINKAGE=A  
NODE=M070B03;LINKAGE=DO

NODE=M070B03;LINKAGE=DE

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{284}/\Gamma$ 

| VALUE (units $10^{-5}$ )                | DOCUMENT ID | TECN    | COMMENT                                                  |
|-----------------------------------------|-------------|---------|----------------------------------------------------------|
| <b><math>1.5 \pm 0.6 \pm 0.5</math></b> | BAI         | 96B BES | $e^+e^- \rightarrow J/\psi \rightarrow \gamma p \bar{p}$ |

NODE=M070B04  
NODE=M070B04 $\Gamma(\gamma f_0(2330) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{285}/\Gamma$ 

| VALUE (units $10^{-5}$ )                          | DOCUMENT ID | TECN      | COMMENT                                 |
|---------------------------------------------------|-------------|-----------|-----------------------------------------|
| <b><math>4.95 \pm 0.21^{+0.66}_{-0.72}</math></b> | ABLIKIM     | 18AA BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

NODE=M070P67  
NODE=M070P67 $\Gamma(\gamma f_2(2340) \rightarrow \gamma \eta \eta)/\Gamma_{\text{total}}$  $\Gamma_{286}/\Gamma$ 

| VALUE (units $10^{-5}$ )                           | EVTs | DOCUMENT ID          | TECN     | COMMENT                               |
|----------------------------------------------------|------|----------------------|----------|---------------------------------------|
| <b><math>5.60^{+0.62+2.37}_{-0.65-2.07}</math></b> | 5.5k | <sup>1</sup> ABLIKIM | 13N BES3 | $J/\psi \rightarrow \gamma \eta \eta$ |

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.NODE=M070S88  
NODE=M070S88

NODE=M070S88;LINKAGE=A

 $\Gamma(\gamma f_2(2340) \rightarrow \gamma K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{287}/\Gamma$ 

| VALUE (units $10^{-5}$ )                           | DOCUMENT ID | TECN      | COMMENT                                 |
|----------------------------------------------------|-------------|-----------|-----------------------------------------|
| <b><math>5.54^{+0.34+3.82}_{-0.40-1.49}</math></b> | ABLIKIM     | 18AA BES3 | $J/\psi \rightarrow \gamma K_S^0 K_S^0$ |

NODE=M070P70  
NODE=M070P70 $\Gamma(\gamma f_0(1500) \rightarrow \gamma \pi \pi)/\Gamma_{\text{total}}$  $\Gamma_{288}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | EVTs | DOCUMENT ID          | TECN     | COMMENT                                                    |
|-------------------------------------------------------------------------------|------|----------------------|----------|------------------------------------------------------------|
| <b><math>1.09 \pm 0.24</math> OUR AVERAGE</b>                                 |      |                      |          |                                                            |
| $1.21 \pm 0.29 \pm 0.24$                                                      | 174  | <sup>1</sup> DOBBS   | 15       | $J/\psi \rightarrow \gamma \pi \pi$                        |
| $1.00 \pm 0.03 \pm 0.45$                                                      |      | <sup>2</sup> ABLIKIM | 06v BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma \pi^+ \pi^-$ |
| $1.02 \pm 0.09 \pm 0.45$                                                      |      | <sup>2</sup> ABLIKIM | 06v BES2 | $e^+e^- \rightarrow J/\psi \rightarrow \gamma \pi^0 \pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |          |                                                            |
| $5.7 \pm 0.8$                                                                 |      | <sup>3,4</sup> BUGG  | 95 MRK3  | $J/\psi \rightarrow \gamma \pi^+ \pi^- \pi^+ \pi^-$        |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> Including unknown branching fraction to  $\pi \pi$ .<sup>3</sup> Including unknown branching ratio for  $f_0(1500) \rightarrow \pi^+ \pi^- \pi^+ \pi^-$ .<sup>4</sup> Assuming that  $f_0(1500)$  decays only to two  $S$ -wave dipions.NODE=M070S32  
NODE=M070S32

OCCUR=2

NODE=M070S32;LINKAGE=C  
NODE=M070S32;LINKAGE=AB  
NODE=M070S32;LINKAGE=A  
NODE=M070S32;LINKAGE=B $\Gamma(\gamma f_0(1500) \rightarrow \gamma \eta \eta)/\Gamma_{\text{total}}$  $\Gamma_{289}/\Gamma$ 

| VALUE (units $10^{-5}$ )                           | EVTs | DOCUMENT ID          | TECN     | COMMENT                               |
|----------------------------------------------------|------|----------------------|----------|---------------------------------------|
| <b><math>1.65^{+0.26+0.51}_{-0.31-1.40}</math></b> | 5.5k | <sup>1</sup> ABLIKIM | 13N BES3 | $J/\psi \rightarrow \gamma \eta \eta$ |

<sup>1</sup> From partial wave analysis including all possible combinations of  $0^{++}$ ,  $2^{++}$ , and  $4^{++}$  resonances.NODE=M070S83  
NODE=M070S83

NODE=M070S83;LINKAGE=A

 $\Gamma(\gamma A \rightarrow \gamma \text{invisible})/\Gamma_{\text{total}}$  $\Gamma_{290}/\Gamma$ 

| VALUE                                                                         | CL% | EVTs | DOCUMENT ID          | TECN     | COMMENT                                                                  |
|-------------------------------------------------------------------------------|-----|------|----------------------|----------|--------------------------------------------------------------------------|
| <b><math>&lt; 1.7 \times 10^{-6}</math> (CL = 90%)</b>                        |     |      |                      |          | $[< 6.3 \times 10^{-6} \text{ (CL = 90\%)} \text{ OUR 2020 BEST LIMIT}]$ |
| <b><math>&lt; 1.7 \times 10^{-6}</math></b>                                   | 90  | 88M  | <sup>1</sup> ABLIKIM | 20K BES3 | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$                                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                      |          |                                                                          |
| $< 6.3 \times 10^{-6}$                                                        | 90  | 3.7M | <sup>2</sup> INSLE   | 10 CLEO  | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$                                |

<sup>1</sup> For a narrow state  $A$  with mass  $m_A < 1.2$  GeV. The limit varies with  $m_A$ , reaching its largest value of  $1.7 \times 10^{-6}$  at 1.2 GeV and being  $7.0 \times 10^{-7}$  for  $m_A = 0$ .<sup>2</sup> The limit varies with mass  $m_A$  of a narrow state  $A$  and is  $4.3 \times 10^{-6}$  for  $m_A = 0$ , reaches its largest value of  $6.3 \times 10^{-6}$  at  $m_A = 500$  MeV, and is  $3.6 \times 10^{-6}$  at  $m_A = 960$  MeV.NODE=M070S68  
NODE=M070S68

NODE=M070S68;LINKAGE=A

NODE=M070S68;LINKAGE=IN

$\Gamma(\gamma A^0 \rightarrow \gamma \mu^+ \mu^-)/\Gamma_{\text{total}}$   $\Gamma_{291}/\Gamma$   
 (narrow state  $A^0$  with  $0.2 \text{ GeV} < m_{A^0} < 3 \text{ GeV}$ )

| VALUE                 | CL% | DOCUMENT ID          | TECN     | COMMENT                                 |
|-----------------------|-----|----------------------|----------|-----------------------------------------|
| $<0.5 \times 10^{-5}$ | 90  | <sup>1</sup> ABLIKIM | 16E BES3 | $J/\psi \rightarrow \gamma \mu^+ \mu^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |    |                      |         |                                         |
|-----------------------|----|----------------------|---------|-----------------------------------------|
| $<2.1 \times 10^{-5}$ | 90 | <sup>2</sup> ABLIKIM | 12 BES3 | $J/\psi \rightarrow \gamma \mu^+ \mu^-$ |
|-----------------------|----|----------------------|---------|-----------------------------------------|

<sup>1</sup> For a narrow scalar or pseudoscalar,  $A^0$ , with a mass in the range 0.212–3 GeV. The measured 90% CL limit as a function of  $m_{A^0}$  is in the range  $(2.8\text{--}495.3) \times 10^{-8}$ .

<sup>2</sup> For a narrow scalar or pseudoscalar,  $A^0$ , with a mass in the range 0.21–3.00 GeV. The measured 90% CL limit as a function of  $m_{A^0}$  ranges from  $4 \times 10^{-7}$  to  $2.1 \times 10^{-5}$ .

NODE=M070S76  
 NODE=M070S76

NODE=M070S76;LINKAGE=A

NODE=M070S76;LINKAGE=AB

NODE=M070330

$\Gamma(\pi^0 e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_{292}/\Gamma$

| VALUE (units $10^{-7}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                            |
|--------------------------|------|-------------|----------|------------------------------------|
| $7.56 \pm 1.32 \pm 0.50$ | 39   | ABLIKIM     | 14I BES3 | $J/\psi \rightarrow \pi^0 e^+ e^-$ |

NODE=M070S89  
 NODE=M070S89

$\Gamma(\eta e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_{293}/\Gamma$

| VALUE (units $10^{-5}$ ) | EVTS  | DOCUMENT ID            | TECN     | COMMENT                           |
|--------------------------|-------|------------------------|----------|-----------------------------------|
| $1.43 \pm 0.04 \pm 0.06$ | 2.47k | <sup>1,2</sup> ABLIKIM | 19A BES3 | $J/\psi \rightarrow \eta e^+ e^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |     |                      |          |                                   |
|--------------------------|-----|----------------------|----------|-----------------------------------|
| $1.16 \pm 0.07 \pm 0.06$ | 320 | <sup>1</sup> ABLIKIM | 14I BES3 | $J/\psi \rightarrow \eta e^+ e^-$ |
|--------------------------|-----|----------------------|----------|-----------------------------------|

<sup>1</sup> Using both  $\eta \rightarrow \gamma \gamma$  and  $\eta \rightarrow \pi^+ \pi^- \pi^0$  decays.

<sup>2</sup> Approximation of the transition form factor squared as an incoherent sum of the  $\rho$ -meson and one-pole non-resonant amplitudes gives the pole mass  $m(\Lambda) = 2.84 \pm 0.11 \pm 0.08$  GeV. Supersedes ABLIKIM 14I.

NODE=M070S90  
 NODE=M070S90

NODE=M070S90;LINKAGE=A  
 NODE=M070S90;LINKAGE=C

$\Gamma(\eta'(958) e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_{294}/\Gamma$

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------|------|----------------------|----------|-----------------------------------------|
| $6.59 \pm 0.07 \pm 0.17$ | 8.9k | <sup>1</sup> ABLIKIM | 19H BES3 | $J/\psi \rightarrow \eta'(958) e^+ e^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |      |                        |          |                                         |
|--------------------------|------|------------------------|----------|-----------------------------------------|
| $5.81 \pm 0.16 \pm 0.31$ | 1.4k | <sup>1,2</sup> ABLIKIM | 14I BES3 | $J/\psi \rightarrow \eta'(958) e^+ e^-$ |
|--------------------------|------|------------------------|----------|-----------------------------------------|

<sup>1</sup> Using both  $\eta' \rightarrow \gamma \pi^+ \pi^-$  and  $\eta' \rightarrow \pi^+ \pi^- \eta$  decays.

<sup>2</sup> Superseded by ABLIKIM 19H.

NODE=M070S91  
 NODE=M070S91

NODE=M070S91;LINKAGE=A  
 NODE=M070S91;LINKAGE=B

$\Gamma(\eta U \rightarrow \eta e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_{295}/\Gamma$

| VALUE                  | CL% | DOCUMENT ID          | TECN     | COMMENT                           |
|------------------------|-----|----------------------|----------|-----------------------------------|
| $<9.11 \times 10^{-7}$ | 90  | <sup>1</sup> ABLIKIM | 19A BES3 | $J/\psi \rightarrow \eta e^+ e^-$ |

<sup>1</sup> For a dark photon  $U$  with mass between 10 and 2400 MeV. Obtained 90% C.L. limits as a function of  $m_U$  range from  $1.9 \times 10^{-8}$  to  $91.1 \times 10^{-8}$ .

NODE=M070P42  
 NODE=M070P42

NODE=M070P42;LINKAGE=A

$\Gamma(\eta'(958) U \rightarrow \eta'(958) e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_{296}/\Gamma$

| VALUE                 | CL% | DOCUMENT ID          | TECN     | COMMENT                                 |
|-----------------------|-----|----------------------|----------|-----------------------------------------|
| $<2.0 \times 10^{-7}$ | 90  | <sup>1</sup> ABLIKIM | 19H BES3 | $J/\psi \rightarrow \eta'(958) e^+ e^-$ |

<sup>1</sup> For a dark photon  $U$  with mass between 100 and 2100 MeV. Obtained 90% C.L. limits as a function of  $m_U$  range from  $1.8 \times 10^{-8}$  to  $2.0 \times 10^{-7}$ . The corresponding limits on the branching fraction  $J/\psi \rightarrow \eta' U$  range from  $5.7 \times 10^{-8}$  to  $7.4 \times 10^{-7}$ .

NODE=M070P61  
 NODE=M070P61

NODE=M070P61;LINKAGE=A

$\Gamma(\phi e^+ e^-)/\Gamma_{\text{total}}$   $\Gamma_{297}/\Gamma$

| VALUE (units $10^{-7}$ ) | CL% | DOCUMENT ID          | TECN      | COMMENT                           |
|--------------------------|-----|----------------------|-----------|-----------------------------------|
| $<1.2$                   | 90  | <sup>1</sup> ABLIKIM | 19AB BES3 | $J/\psi \rightarrow \phi e^+ e^-$ |

<sup>1</sup> Using  $B(\phi \rightarrow K^+ K^-) = (48.9 \pm 0.5)\%$  and  $B(\psi(2S) \rightarrow \pi^+ \pi^- J/\psi) = (34.49 \pm 0.30)\%$ .

NODE=M070P82  
 NODE=M070P82

NODE=M070P82;LINKAGE=A

WEAK DECAYS

$\Gamma(D^- e^+ \nu_e + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{298}/\Gamma$

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                      |
|-----------------------|-----|-------------|----------|------------------------------|
| $<1.2 \times 10^{-5}$ | 90  | ABLIKIM     | 06M BES2 | $e^+ e^- \rightarrow J/\psi$ |

NODE=M070320

NODE=M070S53  
 NODE=M070S53

$\Gamma(\bar{D}^0 e^+ e^- + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{299}/\Gamma$ 

| VALUE                                                                                              | CL% | DOCUMENT ID          | TECN      | COMMENT                      |
|----------------------------------------------------------------------------------------------------|-----|----------------------|-----------|------------------------------|
| $< 8.5 \times 10^{-8}$                                                                             | 90  | <sup>1</sup> ABLIKIM | 17AF BES3 | $e^+ e^- \rightarrow J/\psi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                      |     |                      |           |                              |
| $< 1.1 \times 10^{-5}$                                                                             | 90  | ABLIKIM              | 06M BES2  | $e^+ e^- \rightarrow J/\psi$ |
| <sup>1</sup> Using $D^0$ decays to $K^- \pi^+$ , $K^- \pi^+ \pi^0$ , and $K^- \pi^+ \pi^+ \pi^-$ . |     |                      |           |                              |

NODE=M070S54  
NODE=M070S54

NODE=M070S54;LINKAGE=A

 $\Gamma(D_s^- e^+ \nu_e + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{300}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID          | TECN     | COMMENT                      |
|-------------------------------------------------------------------------------|-----|----------------------|----------|------------------------------|
| $< 1.3 \times 10^{-6}$                                                        | 90  | ABLIKIM              | 14R BES3 | $e^+ e^- \rightarrow J/\psi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                      |          |                              |
| $< 3.6 \times 10^{-5}$                                                        | 90  | <sup>1</sup> ABLIKIM | 06M BES2 | $e^+ e^- \rightarrow J/\psi$ |
| <sup>1</sup> Using $B(D_s^- \rightarrow \phi \pi^-) = 4.4 \pm 0.5 \%$ .       |     |                      |          |                              |

NODE=M070S55  
NODE=M070S55

NODE=M070S55;LINKAGE=AB

 $\Gamma(D_s^{*-} e^+ \nu_e + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{301}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                      |
|------------------------|-----|-------------|----------|------------------------------|
| $< 1.8 \times 10^{-6}$ | 90  | ABLIKIM     | 14R BES3 | $e^+ e^- \rightarrow J/\psi$ |

NODE=M070B13  
NODE=M070B13

 $\Gamma(D^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{302}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                      |
|------------------------|-----|-------------|----------|------------------------------|
| $< 7.5 \times 10^{-5}$ | 90  | ABLIKIM     | 08J BES2 | $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S61  
NODE=M070S61

 $\Gamma(\bar{D}^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{303}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                      |
|------------------------|-----|-------------|----------|------------------------------|
| $< 1.7 \times 10^{-4}$ | 90  | ABLIKIM     | 08J BES2 | $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S62  
NODE=M070S62

 $\Gamma(\bar{D}^0 \bar{K}^{*0} + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{304}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                      |
|------------------------|-----|-------------|----------|------------------------------|
| $< 2.5 \times 10^{-6}$ | 90  | ABLIKIM     | 14K BES3 | $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S93  
NODE=M070S93

 $\Gamma(D_s^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{305}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                      |
|------------------------|-----|-------------|----------|------------------------------|
| $< 1.3 \times 10^{-4}$ | 90  | ABLIKIM     | 08J BES2 | $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S63  
NODE=M070S63

 $\Gamma(D_s^- \rho^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{306}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                      |
|------------------------|-----|-------------|----------|------------------------------|
| $< 1.3 \times 10^{-5}$ | 90  | ABLIKIM     | 14K BES3 | $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S92  
NODE=M070S92

———— CHARGE CONJUGATION (C), PARITY (P), ————  
———— LEPTON FAMILY NUMBER (LF) VIOLATING MODES ————

NODE=M070315

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{307}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID        | TECN     | COMMENT                                   |
|-------------------------------------------------------------------------------|-----|--------------------|----------|-------------------------------------------|
| $< 2.7 \times 10^{-7}$                                                        | 90  | ABLIKIM            | 14Q BES3 | $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                    |          |                                           |
| $< 0.5 \times 10^{-5}$                                                        | 90  | ADAMS              | 08 CLEO  | $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |
| $< 1.6 \times 10^{-4}$                                                        | 90  | <sup>1</sup> WICHT | 08 BELL  | $B^\pm \rightarrow K^\pm \gamma\gamma$    |
| $< 2.2 \times 10^{-5}$                                                        | 90  | ABLIKIM            | 07J BES2 | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$ |
| $< 50 \times 10^{-5}$                                                         | 90  | BARTEL             | 77 CNTR  | $e^+ e^-$                                 |

NODE=M070R80  
NODE=M070R80

NODE=M070R80;LINKAGE=WI

<sup>1</sup> WICHT 08 reports  $[\Gamma(J/\psi(1S) \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow J/\psi(1S) K^+)] < 0.16 \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow J/\psi(1S) K^+) = 1.020 \times 10^{-3}$ .

 $\Gamma(\gamma\phi)/\Gamma_{\text{total}}$   $\Gamma_{308}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                                   |
|------------------------|-----|-------------|----------|-------------------------------------------|
| $< 1.4 \times 10^{-6}$ | 90  | ABLIKIM     | 14Q BES3 | $\psi(2S) \rightarrow \pi^+ \pi^- J/\psi$ |

NODE=M070S95  
NODE=M070S95

 $\Gamma(e^\pm \mu^\mp)/\Gamma_{\text{total}}$   $\Gamma_{309}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN     | COMMENT                      |
|-------------------------------------------------------------------------------|-----|-------------|----------|------------------------------|
| $< 1.6 \times 10^{-7}$                                                        | 90  | ABLIKIM     | 13L BES3 | $e^+ e^- \rightarrow J/\psi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                              |
| $< 1.1 \times 10^{-6}$                                                        | 90  | BAI         | 03D BES  | $e^+ e^- \rightarrow J/\psi$ |

NODE=M070S39  
NODE=M070S39

| $\Gamma(e^{\pm}\tau^{\mp})/\Gamma_{\text{total}}$ |     |             |      |         | $\Gamma_{310}/\Gamma$       |
|---------------------------------------------------|-----|-------------|------|---------|-----------------------------|
| VALUE                                             | CL% | DOCUMENT ID | TECN | COMMENT |                             |
| $<8.3 \times 10^{-6}$                             | 90  | ABLIKIM     | 04   | BES     | $e^+e^- \rightarrow J/\psi$ |

NODE=M070S40  
NODE=M070S40

| $\Gamma(\Lambda_c^+ e^- + \text{c.c.})/\Gamma_{\text{total}}$ |     |             |      |         | $\Gamma_{312}/\Gamma$                                                |
|---------------------------------------------------------------|-----|-------------|------|---------|----------------------------------------------------------------------|
| VALUE                                                         | CL% | DOCUMENT ID | TECN | COMMENT |                                                                      |
| $<6.9 \times 10^{-8}$                                         | 90  | ABLIKIM     | 19AF | BES3    | $e^+e^- \rightarrow J/\psi \rightarrow pK^-\pi^+e^- (+ \text{c.c.})$ |

NODE=M070P74  
NODE=M070P74

| $\Gamma(\mu^{\pm}\tau^{\mp})/\Gamma_{\text{total}}$ |     |             |      |         | $\Gamma_{311}/\Gamma$       |
|-----------------------------------------------------|-----|-------------|------|---------|-----------------------------|
| VALUE                                               | CL% | DOCUMENT ID | TECN | COMMENT |                             |
| $<2.0 \times 10^{-6}$                               | 90  | ABLIKIM     | 04   | BES     | $e^+e^- \rightarrow J/\psi$ |

NODE=M070S41  
NODE=M070S41

### OTHER DECAYS

NODE=M070325

| $\Gamma(\text{invisible})/\Gamma(e^+e^-)$ |     |             |      |         | $\Gamma_{313}/\Gamma_5$        |
|-------------------------------------------|-----|-------------|------|---------|--------------------------------|
| VALUE                                     | CL% | DOCUMENT ID | TECN | COMMENT |                                |
| $<6.6 \times 10^{-2}$                     | 90  | LEES        | 13I  | BABR    | $B \rightarrow K^{(*)} J/\psi$ |

NODE=M070S80  
NODE=M070S80

| $\Gamma(\text{invisible})/\Gamma(\mu^+\mu^-)$ |     |             |      |         | $\Gamma_{313}/\Gamma_7$                  |
|-----------------------------------------------|-----|-------------|------|---------|------------------------------------------|
| VALUE                                         | CL% | DOCUMENT ID | TECN | COMMENT |                                          |
| $<1.2 \times 10^{-2}$                         | 90  | ABLIKIM     | 08G  | BES2    | $\psi(2S) \rightarrow \pi^+\pi^- J/\psi$ |

NODE=M070S60  
NODE=M070S60

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NODE=M070

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| ABLIKIM   | 20K  | PR D101 112005 | M. Ablikim <i>et al.</i>     | (BESIII Collab.) | REFID=60316 |
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| SHEN          | 09   | PR D80 031101         | C.P. Shen <i>et al.</i>          | (BELLE Collab.)        | REFID=53000 |
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| AUBERT        | 06E  | PRL 96 052002         | B. Aubert <i>et al.</i>          | (BABAR Collab.)        | REFID=51059 |
| AUBERT,BE     | 06D  | PR D74 091103         | B. Aubert <i>et al.</i>          | (BABAR Collab.)        | REFID=51511 |
| WU            | 06   | PRL 97 162003         | C.-H. Wu <i>et al.</i>           | (BELLE Collab.)        | REFID=51472 |
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| ABLIKIM       | 05H  | PR D72 012002         | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=50759 |
| ABLIKIM       | 05R  | PRL 95 262001         | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=50985 |
| AUBERT        | 05D  | PR D71 052001         | B. Aubert <i>et al.</i>          | (BABAR Collab.)        | REFID=50509 |
| LI            | 05C  | PR D71 111103         | Z. Li <i>et al.</i>              | (CLEO Collab.)         | REFID=50802 |
| SIBIRTSEV     | 05A  | PR D71 054010         | A. Sibirtsev, J. Haidenbauer     |                        | REFID=51038 |
| ABLIKIM       | 04   | PL B598 172           | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=49739 |
| ABLIKIM       | 04M  | PR D70 112008         | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=50329 |
| AUBERT        | 04   | PR D69 011103         | B. Aubert <i>et al.</i>          | (BABAR Collab.)        | REFID=49611 |
| AUBERT,B      | 04N  | PR D70 072004         | B. Aubert <i>et al.</i>          | (BABAR Collab.)        | REFID=50184 |
| BAI           | 04   | PL B578 16            | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49620 |
| BAI           | 04A  | PR D69 012003         | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49607 |
| BAI           | 04D  | PL B589 7             | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49750 |
| BAI           | 04E  | PL B591 42            | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49751 |
| BAI           | 04G  | PR D70 012004         | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49753 |
| BAI           | 04H  | PR D70 012005         | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49754 |
| BAI           | 04J  | PL B594 47            | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=50167 |
| SETH          | 04   | PR D69 097503         | K.K. Seth                        |                        | REFID=49779 |
| AULCHENKO     | 03   | PL B573 63            | V.M. Aulchenko <i>et al.</i>     | (KEDR Collab.)         | REFID=49579 |
| BAI           | 03D  | PL B561 49            | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49403 |
| BAI           | 03F  | PRL 91 022001         | J.Z. Bai <i>et al.</i>           | (BES II Collab.)       | REFID=49473 |
| BAI           | 03G  | PR D68 052003         | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49580 |
| HUANG         | 03   | PRL 91 241802         | H.-C. Huang <i>et al.</i>        | (BELLE Collab.)        | REFID=49621 |



|               |     |               |                                 |                           |             |
|---------------|-----|---------------|---------------------------------|---------------------------|-------------|
| BAI           | 02C | PRL 88 101802 | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=50506 |
| ARTAMONOV     | 00  | PL B474 427   | A.S. Artamonov <i>et al.</i>    |                           | REFID=47424 |
| BAI           | 00  | PRL 84 594    | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=50503 |
| BAI           | 00B | PL B472 200   | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=47427 |
| BAI           | 00D | PL B476 25    | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=47954 |
| BAI           | 99  | PL B446 356   | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=46606 |
| BAI           | 99C | PRL 83 1918   | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=47420 |
| BAI           | 98D | PR D58 092006 | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=46338 |
| BAI           | 98G | PL B424 213   | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=46341 |
| BAI           | 98H | PRL 81 1179   | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=46342 |
| BALDINI       | 98  | PL B444 111   | R. Baldini <i>et al.</i>        | (FENICE Collab.)          | REFID=46608 |
| ARMSTRONG     | 96  | PR D54 7067   | T.A. Armstrong <i>et al.</i>    | (E760 Collab.)            | REFID=45146 |
| BAI           | 96B | PRL 76 3502   | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=44736 |
| BAI           | 96C | PRL 77 3959   | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=45169 |
| BAI           | 96D | PR D54 1221   | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=45198 |
| GRIBUSHIN     | 96  | PR D53 4723   | A. Gribushin <i>et al.</i>      | (E672 and E706 Collab.)   | REFID=44739 |
| HASAN         | 96  | PL B388 376   | A. Hasan, D.V. Bugg             | (BRUN, LOQM)              | REFID=45197 |
| BAI           | 95B | PL B355 374   | J.Z. Bai <i>et al.</i>          | (BES Collab.)             | REFID=44434 |
| BUGG          | 95  | PL B353 378   | D.V. Bugg <i>et al.</i>         | (LOQM, PNPI, WASH)        | REFID=44438 |
| ANTONELLI     | 93  | PL B301 317   | A. Antonelli <i>et al.</i>      | (FENICE Collab.)          | REFID=43314 |
| ARMSTRONG     | 93B | PR D47 772    | T.A. Armstrong <i>et al.</i>    | (FNAL E760 Collab.)       | REFID=43307 |
| BARNES        | 93  | PL B309 469   | P.D. Barnes <i>et al.</i>       | (PS185 Collab.)           | REFID=43601 |
| AUGUSTIN      | 92  | PR D46 1951   | J.E. Augustin, G. Cosme         | (DM2 Collab.)             | REFID=41584 |
| BOLTON        | 92  | PL B278 495   | T. Bolton <i>et al.</i>         | (Mark III Collab.)        | REFID=42175 |
| BOLTON        | 92B | PRL 69 1328   | T. Bolton <i>et al.</i>         | (Mark III Collab.)        | REFID=42176 |
| COFFMAN       | 92  | PRL 68 282    | D.M. Coffman <i>et al.</i>      | (Mark III Collab.)        | REFID=41866 |
| HSUEH         | 92  | PR D45 2181   | S. Hsueh, S. Palestini          | (FNAL, TORI)              | REFID=41899 |
| BISELLO       | 91  | NP B350 1     | D. Bisello <i>et al.</i>        | (DM2 Collab.)             | REFID=41668 |
| AUGUSTIN      | 90  | PR D42 10     | J.E. Augustin <i>et al.</i>     | (DM2 Collab.)             | REFID=41352 |
| BAI           | 90B | PRL 65 1309   | Z. Bai <i>et al.</i>            | (Mark III Collab.)        | REFID=41354 |
| BAI           | 90C | PRL 65 2507   | Z. Bai <i>et al.</i>            | (Mark III Collab.)        | REFID=41578 |
| BISELLO       | 90  | PL B241 617   | D. Bisello <i>et al.</i>        | (DM2 Collab.)             | REFID=41359 |
| COFFMAN       | 90  | PR D41 1410   | D.M. Coffman <i>et al.</i>      | (Mark III Collab.)        | REFID=41350 |
| JOUSSET       | 90  | PR D41 1389   | J. Jousset <i>et al.</i>        | (DM2 Collab.)             | REFID=41349 |
| ALEXANDER     | 89  | NP B320 45    | J.P. Alexander <i>et al.</i>    | (LBL, MICH, SLAC)         | REFID=40345 |
| AUGUSTIN      | 89  | NP B320 1     | J.E. Augustin, G. Cosme         | (DM2 Collab.)             | REFID=41004 |
| BISELLO       | 89B | PR D39 701    | G. Busetto <i>et al.</i>        | (DM2 Collab.)             | REFID=40575 |
| AUGUSTIN      | 88  | PRL 60 2238   | J.E. Augustin <i>et al.</i>     | (DM2 Collab.)             | REFID=40574 |
| COFFMAN       | 88  | PR D38 2695   | D.M. Coffman <i>et al.</i>      | (Mark III Collab.)        | REFID=40346 |
| FALVARD       | 88  | PR D38 2706   | A. Falvard <i>et al.</i>        | (CLER, FRAS, LALO+)       | REFID=40576 |
| AUGUSTIN      | 87  | ZPHY C36 369  | J.E. Augustin <i>et al.</i>     | (LALO, CLER, FRAS+)       | REFID=40268 |
| BAGLIN        | 87  | NP B286 592   | C. Baglin <i>et al.</i>         | (LAPP, CERN, GENO, LYON+) | REFID=40002 |
| BALTRUSAIT... | 87  | PR D35 2077   | R.M. Baltrusaitis <i>et al.</i> | (Mark III Collab.)        | REFID=40010 |
| BECKER        | 87  | PR 59 186     | J.J. Becker <i>et al.</i>       | (Mark III Collab.)        | REFID=40015 |
| BISELLO       | 87  | PL B192 239   | D. Bisello <i>et al.</i>        | (PADO, CLER, FRAS+)       | REFID=40012 |
| COHEN         | 87  | RMP 59 1121   | E.R. Cohen, B.N. Taylor         | (RISC, NBS)               | REFID=41616 |
| HENRARD       | 87  | NP B292 670   | P. Henrard <i>et al.</i>        | (CLER, FRAS, LALO+)       | REFID=40261 |
| PALLIN        | 87  | NP B292 653   | D. Pallin <i>et al.</i>         | (CLER, FRAS, LALO, PADO)  | REFID=40243 |
| BALTRUSAIT... | 86  | PR D33 629    | R.M. Baltrusaitis <i>et al.</i> | (Mark III Collab.)        | REFID=22009 |
| BALTRUSAIT... | 86B | PR D33 1222   | R.M. Baltrusaitis <i>et al.</i> | (Mark III Collab.)        | REFID=22100 |
| BALTRUSAIT... | 86D | PRL 56 107    | R.M. Baltrusaitis               | (CIT, UCSC, ILL, SLAC+)   | REFID=21865 |
| BISELLO       | 86B | PL B179 294   | D. Bisello <i>et al.</i>        | (DM2 Collab.)             | REFID=22101 |
| GAISER        | 86  | PR D34 711    | J. Gaiser <i>et al.</i>         | (Crystal Ball Collab.)    | REFID=22012 |
| BALTRUSAIT... | 85C | PRL 55 1723   | R.M. Baltrusaitis <i>et al.</i> | (CIT, UCSC+)              | REFID=22095 |
| BALTRUSAIT... | 85D | PR D32 566    | R.M. Baltrusaitis <i>et al.</i> | (CIT, UCSC+)              | REFID=22097 |
| KURAEV        | 85  | SJNP 41 466   | E.A. Kuraev, V.S. Fadin         | (NOVO)                    | REFID=40033 |
| BALTRUSAIT... | 84  | PRL 52 2126   | R.M. Baltrusaitis <i>et al.</i> | (CIT, UCSC+)              | REFID=22006 |
| EATON         | 84  | PR D29 804    | M.W. Eaton <i>et al.</i>        | (LBL, SLAC)               | REFID=22092 |
| BLOOM         | 83  | ARNS 33 143   | E.D. Bloom, C. Peck             | (SLAC, CIT)               | REFID=21682 |
| EDWARDS       | 83B | PRL 51 859    | C. Edwards <i>et al.</i>        | (CIT, HARV, PRIN+)        | REFID=21318 |
| FRANKLIN      | 83  | PRL 51 963    | M.E.B. Franklin <i>et al.</i>   | (LBL, SLAC)               | REFID=22216 |
| BURKE         | 82  | PRL 49 632    | D.L. Burke <i>et al.</i>        | (LBL, SLAC)               | REFID=21676 |
| EDWARDS       | 82B | PR D25 3065   | C. Edwards <i>et al.</i>        | (CIT, HARV, PRIN+)        | REFID=22080 |
| EDWARDS       | 82D | PRL 48 458    | C. Edwards <i>et al.</i>        | (CIT, HARV, PRIN+)        | REFID=21677 |
| Also          |     | ARNS 33 143   | E.D. Bloom, C. Peck             | (SLAC, CIT)               | REFID=21682 |
| EDWARDS       | 82E | PRL 49 259    | C. Edwards <i>et al.</i>        | (CIT, HARV, PRIN+)        | REFID=21314 |
| LEMOIGNE      | 82  | PL 113B 509   | Y. Lemoigne <i>et al.</i>       | (SACL, LOIC, SHMP+)       | REFID=22084 |
| BESCH         | 81  | ZPHY C8 1     | H.J. Besch <i>et al.</i>        | (BONN, DESY, MAINZ)       | REFID=22077 |
| GIDAL         | 81  | PL 107B 153   | G. Gidal <i>et al.</i>          | (SLAC, LBL)               | REFID=20386 |
| PARTRIDGE     | 80  | PRL 44 712    | R. Partridge <i>et al.</i>      | (CIT, HARV, PRIN+)        | REFID=22073 |
| SCHARRE       | 80  | PL 97B 329    | D.L. Scharre <i>et al.</i>      | (SLAC, LBL)               | REFID=21329 |
| ZHOLENTZ      | 80  | PL 96B 214    | A.A. Zholents <i>et al.</i>     | (NOVO)                    | REFID=10320 |
| Also          |     | SJNP 34 814   | A.A. Zholents <i>et al.</i>     | (NOVO)                    | REFID=10321 |
| BRANDELIK     | 79C | ZPHY C1 233   | R. Brandelik <i>et al.</i>      | (DASP Collab.)            | REFID=22114 |
| ALEXANDER     | 78  | PL 72B 493    | G. Alexander <i>et al.</i>      | (DESY, HAMB, SIEG+)       | REFID=22065 |
| BESCH         | 78  | PL 78B 347    | H.J. Besch <i>et al.</i>        | (BONN, DESY, MAINZ)       | REFID=22066 |
| BRANDELIK     | 78B | PL 74B 292    | R. Brandelik <i>et al.</i>      | (DASP Collab.)            | REFID=22067 |
| PERUZZI       | 78  | PR D17 2901   | I. Peruzzi <i>et al.</i>        | (SLAC, LBL)               | REFID=22068 |
| BARTEL        | 77  | PL 66B 489    | W. Bartel <i>et al.</i>         | (DESY, HEIDP)             | REFID=22058 |
| BURMESTER     | 77D | PL 72B 135    | J. Burmester <i>et al.</i>      | (DESY, HAMB, SIEG+)       | REFID=22060 |
| FELDMAN       | 77  | PRPL 33C 285  | G.J. Feldman, M.L. Perl         | (LBL, SLAC)               | REFID=22062 |
| VANNUCCI      | 77  | PR D15 1814   | F. Vannucci <i>et al.</i>       | (SLAC, LBL)               | REFID=22063 |
| BARTEL        | 76  | PL 64B 483    | W. Bartel <i>et al.</i>         | (DESY, HEIDP)             | REFID=22192 |
| BRAUNSCH...   | 76  | PL 63B 487    | W. Braunschweig <i>et al.</i>   | (DASP Collab.)            | REFID=22054 |
| JEAN-MARIE    | 76  | PRL 36 291    | B. Jean-Marie <i>et al.</i>     | (SLAC, LBL) IG            | REFID=22056 |
| BALDINI...    | 75  | PL 58B 471    | R. Baldini-Celio <i>et al.</i>  | (FRAS, ROMA)              | REFID=22026 |
| BOYARSKI      | 75  | PRL 34 1357   | A.M. Boyarski <i>et al.</i>     | (SLAC, LBL) JPC           | REFID=22030 |
| DASP          | 75  | PL 56B 491    | W. Braunschweig <i>et al.</i>   | (DASP Collab.)            | REFID=22036 |
| ESPOSITO      | 75B | LNC 14 73     | B. Esposito <i>et al.</i>       | (FRAS, NAPL, PADO+)       | REFID=22038 |
| FORD          | 75  | PRL 34 604    | R.L. Ford <i>et al.</i>         | (SLAC, PENN)              | REFID=22039 |

## BRANCHING RATIOS OF $\psi(2S)$ AND $\chi_{c0,1,2}$

Updated March 2020 by J.J. Hernández-Rey (IFIC, Valencia), S. Navas (U. of Granada), and C. Patrignani (Bologna Univ., INFN)

Since 2002, the treatment of the branching ratios of the  $\psi(2S)$  and  $\chi_{c0,1,2}$  has undergone an important restructuring.

When measuring a branching ratio experimentally, it is not always possible to normalize the number of events observed in the corresponding decay mode to the total number of particles produced. Therefore, the experimenters sometimes report the number of observed decays with respect to another decay mode of the same or another particle in the relevant decay chain. This is actually equivalent to measuring combinations of branching fractions of several decay modes.

To extract the branching ratio of a given decay mode, the collaborations use some previously reported measurements of the required branching ratios. However, the values are frequently taken from the *Review of Particle Physics* (RPP), which in turn uses the branching ratio reported by the experiment in the following edition, giving rise either to correlations or to plain vicious circles, as discussed in more detail in earlier editions of this review [1,2].

The way to avoid these dependencies and correlations is to extract the branching ratios through a fit that uses the truly measured combinations of branching fractions and partial widths. This fit, in fact, should involve decays from the four concerned particles,  $\psi(2S)$ ,  $\chi_{c0}$ ,  $\chi_{c1}$ , and  $\chi_{c2}$ , and occasionally some combinations of branching ratios of more than one of them. This is what is done since the 2002 edition [3].

The PDG policy is to quote the results of the collaborations in a manner as close as possible to what appears in their original publications. However, in order to avoid the problems mentioned above, we had in some cases to work out the values originally measured, using the number of events and detection efficiencies given by the collaborations, or rescaling back the published results. The information was sometimes spread over several articles, and some articles referred to papers still unpublished, which in turn contained the relevant numbers in footnotes.

Even though the experimental collaborations are entitled to extract whatever branching ratios they consider appropriate by using other published results, we would like to encourage them to also quote explicitly in their articles the actual quantities

measured, so that they can be used directly in averages and fits of different experimental determinations.

To inform the reader how we computed some of the values used in this edition of RPP, we use footnotes to indicate the branching ratios actually given by the experiments and the quantities they use to derive them from the true combination of branching ratios actually measured.

None of the branching ratios of the  $\chi_{c0,1,2}$  are measured independently of the  $\psi(2S)$  radiative decays. We tried to identify those branching ratios which can be correlated in a non-trivial way, and although we cannot preclude the existence of other cases, we are confident that the most relevant correlations have already been removed. Nevertheless, correlations in the errors of different quantities measured by the same experiment have not been taken into account.

## Fit information

This is an overall fit to 4 total widths, 1 partial width, 26 combinations of partial widths, 24 branching ratios, and 108 combinations of branching ratios. Of the latter 62 involve decays of more than one particle.

The overall fit uses 248 measurements to determine 49 parameters and has a  $\chi^2$  of 378.1 for 199 degrees of freedom.

The relatively high  $\chi^2$  of the fit, 1.9 per d.o.f., can be traced back to a few specific discrepancies in the data. No scaling factors to fit uncertainties have been applied.

In the listing we provide the inter-particle correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the corresponding parameter  $x_i$ .

## References

1. Y.F. Gu and X.H. Li, Phys. Lett. **B449**, 361 (1999).
  2. C. Patrignani, Phys. Rev. **D64**, 034017 (2001).
  3. Particle Data Group, K.Hagiwara *et al.*, Phys. Rev. **D68**, 010001 (2002).
-

$\chi_{c0}(1P)$ 

$$I^G(J^{PC}) = 0^+(0^{++})$$

NODE=M056

 $\chi_{c0}(1P)$  MASS

NODE=M056M

NODE=M056M

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID             | TECN      | COMMENT                                                         |
|-------------------------------------------------------------------------------|------|-------------------------|-----------|-----------------------------------------------------------------|
| <b>3414.71 ± 0.30 OUR AVERAGE</b>                                             |      |                         |           |                                                                 |
| 3413.0 ± 1.9 ± 0.6                                                            | 933  | <sup>1</sup> AAIJ       | 17BB LHCb | $pp \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$               |
| 3414.2 ± 0.5 ± 2.3                                                            | 5.4k | UEHARA                  | 08 BELL   | $\gamma\gamma \rightarrow \chi_{c0} \rightarrow \text{hadrons}$ |
| 3406 ± 7 ± 6                                                                  | 230  | <sup>2</sup> ABE        | 07 BELL   | $e^+e^- \rightarrow J/\psi(c\bar{c})$                           |
| 3414.21 ± 0.39 ± 0.27                                                         |      | ABLIKIM                 | 05G BES2  | $\psi(2S) \rightarrow \gamma\chi_{c0}$                          |
| 3414.7 $^{+0.7}_{-0.6}$ ± 0.2                                                 |      | <sup>3</sup> ANDREOTTI  | 03 E835   | $\bar{p}p \rightarrow \chi_{c0} \rightarrow \pi^0\pi^0$         |
| 3415.5 ± 0.4 ± 0.4                                                            | 392  | <sup>4</sup> BAGNASCO   | 02 E835   | $\bar{p}p \rightarrow \chi_{c0} \rightarrow J/\psi\gamma$       |
| 3417.4 $^{+1.8}_{-1.9}$ ± 0.2                                                 |      | <sup>3</sup> AMBROGIANI | 99B E835  | $\bar{p}p \rightarrow e^+e^-\gamma$                             |
| 3414.1 ± 0.6 ± 0.8                                                            |      | BAI                     | 99B BES   | $\psi(2S) \rightarrow \gamma X$                                 |
| 3417.8 ± 0.4 ± 4                                                              |      | <sup>3</sup> GAISER     | 86 CBAL   | $\psi(2S) \rightarrow \gamma X$                                 |
| 3416 ± 3 ± 4                                                                  |      | <sup>5</sup> TANENBAUM  | 78 MRK1   | $e^+e^-$                                                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                         |           |                                                                 |
| 3414.6 ± 1.1                                                                  | 266  | UEHARA                  | 13 BELL   | $\gamma\gamma \rightarrow K_S^0 K_S^0$                          |
| 3416.5 ± 3.0                                                                  |      | EISENSTEIN              | 01 CLE2   | $e^+e^- \rightarrow e^+e^-\chi_{c0}$                            |
| 3422 ± 10                                                                     |      | <sup>5</sup> BARTEL     | 78B CNTR  | $e^+e^- \rightarrow J/\psi 2\gamma$                             |
| 3415 ± 9                                                                      |      | <sup>5</sup> BIDDICK    | 77 CNTR   | $e^+e^- \rightarrow \gamma X$                                   |

<sup>1</sup> From a fit of the  $\phi\phi$  invariant mass with the width of  $\chi_{c0}(1P)$  fixed to the PDG 16 value.

<sup>2</sup> From a fit of the  $J/\psi$  recoil mass spectrum. Supersedes ABE,K 02 and ABE 04G.

<sup>3</sup> Using mass of  $\psi(2S) = 3686.0$  MeV.

<sup>4</sup> Recalculated by ANDREOTTI 05A, using the value of  $\psi(2S)$  mass from AULCHENKO 03.

<sup>5</sup> Mass value shifted by us by amount appropriate for  $\psi(2S)$  mass = 3686 MeV and  $J/\psi(1S)$  mass = 3097 MeV.

NODE=M056M;LINKAGE=A

NODE=M056M;LINKAGE=EB

NODE=M056M;LINKAGE=C

NODE=M056M;LINKAGE=NW

NODE=M056M;LINKAGE=D

 $\chi_{c0}(1P)$  WIDTH

NODE=M056W

NODE=M056W

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID           | TECN     | COMMENT                                                         |
|-------------------------------------------------------------------------------|------|-----------------------|----------|-----------------------------------------------------------------|
| <b>10.8 ± 0.6 OUR FIT</b>                                                     |      |                       |          |                                                                 |
| <b>10.5 ± 0.8 OUR AVERAGE</b> Error includes scale factor of 1.1.             |      |                       |          |                                                                 |
| 10.6 ± 1.9 ± 2.6                                                              | 5.4k | UEHARA                | 08 BELL  | $\gamma\gamma \rightarrow \chi_{c0} \rightarrow \text{hadrons}$ |
| 12.6 $^{+1.5+0.9}_{-1.6-1.1}$                                                 |      | ABLIKIM               | 05G BES2 | $\psi(2S) \rightarrow \gamma\chi_{c0}$                          |
| 8.6 $^{+1.7}_{-1.3}$ ± 0.1                                                    |      | ANDREOTTI             | 03 E835  | $\bar{p}p \rightarrow \chi_{c0} \rightarrow \pi^0\pi^0$         |
| 9.7 ± 1.0                                                                     | 392  | <sup>1</sup> BAGNASCO | 02 E835  | $\bar{p}p \rightarrow \chi_{c0} \rightarrow J/\psi\gamma$       |
| 16.6 $^{+5.2}_{-3.7}$ ± 0.1                                                   |      | AMBROGIANI            | 99B E835 | $\bar{p}p \rightarrow e^+e^-\gamma$                             |
| 14.3 ± 2.0 ± 3.0                                                              |      | BAI                   | 98I BES  | $\psi(2S) \rightarrow \gamma\pi^+\pi^-$                         |
| 13.5 ± 3.3 ± 4.2                                                              |      | GAISER                | 86 CBAL  | $\psi(2S) \rightarrow \gamma X, \gamma\pi^0\pi^0$               |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |          |                                                                 |
| 13.2 ± 2.1                                                                    | 266  | UEHARA                | 13 BELL  | $\gamma\gamma \rightarrow K_S^0 K_S^0$                          |

<sup>1</sup> Recalculated by ANDREOTTI 05A.

NODE=M056W;LINKAGE=AN

 $\chi_{c0}(1P)$  DECAY MODES

NODE=M056215;NODE=M056

| Mode | Fraction ( $\Gamma_i/\Gamma$ ) | Scale factor/<br>Confidence level |
|------|--------------------------------|-----------------------------------|
|------|--------------------------------|-----------------------------------|

## Hadronic decays

|            |                                  |                                |
|------------|----------------------------------|--------------------------------|
| $\Gamma_1$ | $2(\pi^+\pi^-)$                  | (2.34 ± 0.18) %                |
| $\Gamma_2$ | $\rho^0\pi^+\pi^-$               | (9.1 ± 2.9) × 10 <sup>-3</sup> |
| $\Gamma_3$ | $\rho^0\rho^0$                   |                                |
| $\Gamma_4$ | $f_0(980)f_0(980)$               | (6.6 ± 2.1) × 10 <sup>-4</sup> |
| $\Gamma_5$ | $\pi^+\pi^-\pi^0\pi^0$           | (3.3 ± 0.4) %                  |
| $\Gamma_6$ | $\rho^+\pi^-\pi^0 + \text{c.c.}$ | (2.9 ± 0.4) %                  |
| $\Gamma_7$ | $4\pi^0$                         | (3.3 ± 0.4) × 10 <sup>-3</sup> |
| $\Gamma_8$ | $\pi^+\pi^-K^+K^-$               | (1.81 ± 0.14) %                |

NODE=M056;CLUMP=A

DESIG=3

DESIG=9

DESIG=54

DESIG=20

DESIG=61

DESIG=62

DESIG=70

DESIG=5

|               |                                                                                   |                                          |        |          |
|---------------|-----------------------------------------------------------------------------------|------------------------------------------|--------|----------|
| $\Gamma_9$    | $K_0^*(1430)^0 \bar{K}_0^*(1430)^0 \rightarrow \pi^+ \pi^- K^+ K^-$               | $(9.8 \pm_{-2.8}^{+4.0}) \times 10^{-4}$ |        | DESIG=31 |
| $\Gamma_{10}$ | $K_0^*(1430)^0 \bar{K}_2^*(1430)^0 + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-$ | $(8.0 \pm_{-2.4}^{+2.0}) \times 10^{-4}$ |        | DESIG=32 |
| $\Gamma_{11}$ | $K_1(1270)^+ K^- + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-$                   | $(6.3 \pm 1.9) \times 10^{-3}$           |        | DESIG=33 |
| $\Gamma_{12}$ | $K_1(1400)^+ K^- + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-$                   | $< 2.7 \times 10^{-3}$                   | CL=90% | DESIG=34 |
| $\Gamma_{13}$ | $f_0(980) f_0(980)$                                                               | $(1.6 \pm_{-0.9}^{+1.0}) \times 10^{-4}$ |        | DESIG=23 |
| $\Gamma_{14}$ | $f_0(980) f_0(2200)$                                                              | $(7.9 \pm_{-2.5}^{+2.0}) \times 10^{-4}$ |        | DESIG=24 |
| $\Gamma_{15}$ | $f_0(1370) f_0(1370)$                                                             | $< 2.7 \times 10^{-4}$                   | CL=90% | DESIG=25 |
| $\Gamma_{16}$ | $f_0(1370) f_0(1500)$                                                             | $< 1.7 \times 10^{-4}$                   | CL=90% | DESIG=26 |
| $\Gamma_{17}$ | $f_0(1370) f_0(1710)$                                                             | $(6.7 \pm_{-2.3}^{+3.5}) \times 10^{-4}$ |        | DESIG=27 |
| $\Gamma_{18}$ | $f_0(1500) f_0(1370)$                                                             | $< 1.3 \times 10^{-4}$                   | CL=90% | DESIG=28 |
| $\Gamma_{19}$ | $f_0(1500) f_0(1500)$                                                             | $< 5 \times 10^{-5}$                     | CL=90% | DESIG=29 |
| $\Gamma_{20}$ | $f_0(1500) f_0(1710)$                                                             | $< 7 \times 10^{-5}$                     | CL=90% | DESIG=30 |
| $\Gamma_{21}$ | $K^+ K^- \pi^+ \pi^- \pi^0$                                                       | $(8.6 \pm 0.9) \times 10^{-3}$           |        | DESIG=75 |
| $\Gamma_{22}$ | $K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$                                                 | $(4.2 \pm 0.4) \times 10^{-3}$           |        | DESIG=87 |
| $\Gamma_{23}$ | $K^+ K^- \pi^0 \pi^0$                                                             | $(5.6 \pm 0.9) \times 10^{-3}$           |        | DESIG=63 |
| $\Gamma_{24}$ | $K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$                                         | $(2.49 \pm 0.33) \%$                     |        | DESIG=65 |
| $\Gamma_{25}$ | $\rho^+ K^- K^0 + \text{c.c.}$                                                    | $(1.21 \pm 0.21) \%$                     |        | DESIG=66 |
| $\Gamma_{26}$ | $K^*(892)^- K^+ \pi^0 \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$        | $(4.6 \pm 1.2) \times 10^{-3}$           |        | DESIG=67 |
| $\Gamma_{27}$ | $K_S^0 K_S^0 \pi^+ \pi^-$                                                         | $(5.7 \pm 1.1) \times 10^{-3}$           |        | DESIG=41 |
| $\Gamma_{28}$ | $K^+ K^- \eta \pi^0$                                                              | $(3.0 \pm 0.7) \times 10^{-3}$           |        | DESIG=68 |
| $\Gamma_{29}$ | $3(\pi^+ \pi^-)$                                                                  | $(1.20 \pm 0.18) \%$                     |        | DESIG=4  |
| $\Gamma_{30}$ | $K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$                                        | $(7.5 \pm 1.6) \times 10^{-3}$           |        | DESIG=10 |
| $\Gamma_{31}$ | $K^*(892)^0 \bar{K}^*(892)^0$                                                     | $(1.7 \pm 0.6) \times 10^{-3}$           |        | DESIG=21 |
| $\Gamma_{32}$ | $\pi \pi$                                                                         | $(8.51 \pm 0.33) \times 10^{-3}$         |        | DESIG=18 |
| $\Gamma_{33}$ | $\pi^0 \eta$                                                                      | $< 1.8 \times 10^{-4}$                   |        | DESIG=35 |
| $\Gamma_{34}$ | $\pi^0 \eta'$                                                                     | $< 1.1 \times 10^{-3}$                   |        | DESIG=36 |
| $\Gamma_{35}$ | $\pi^0 \eta_c$                                                                    | $< 1.6 \times 10^{-3}$                   | CL=90% | DESIG=86 |
| $\Gamma_{36}$ | $\eta \eta$                                                                       | $(3.01 \pm 0.19) \times 10^{-3}$         |        | DESIG=13 |
| $\Gamma_{37}$ | $\eta \eta'$                                                                      | $(9.1 \pm 1.1) \times 10^{-5}$           |        | DESIG=37 |
| $\Gamma_{38}$ | $\eta' \eta'$                                                                     | $(2.17 \pm 0.12) \times 10^{-3}$         |        | DESIG=46 |
| $\Gamma_{39}$ | $\omega \omega$                                                                   | $(9.7 \pm 1.1) \times 10^{-4}$           |        | DESIG=22 |
| $\Gamma_{40}$ | $\omega \phi$                                                                     | $(1.41 \pm 0.13) \times 10^{-4}$         |        | DESIG=76 |
| $\Gamma_{41}$ | $\omega K^+ K^-$                                                                  | $(1.94 \pm 0.21) \times 10^{-3}$         |        | DESIG=88 |
| $\Gamma_{42}$ | $K^+ K^-$                                                                         | $(6.05 \pm 0.31) \times 10^{-3}$         |        | DESIG=2  |
| $\Gamma_{43}$ | $K_S^0 K_S^0$                                                                     | $(3.16 \pm 0.17) \times 10^{-3}$         |        | DESIG=15 |
| $\Gamma_{44}$ | $\pi^+ \pi^- \eta$                                                                | $< 2.0 \times 10^{-4}$                   | CL=90% | DESIG=50 |
| $\Gamma_{45}$ | $\pi^+ \pi^- \eta'$                                                               | $< 4 \times 10^{-4}$                     | CL=90% | DESIG=53 |
| $\Gamma_{46}$ | $\bar{K}^0 K^+ \pi^- + \text{c.c.}$                                               | $< 9 \times 10^{-5}$                     | CL=90% | DESIG=17 |
| $\Gamma_{47}$ | $K^+ K^- \pi^0$                                                                   | $< 6 \times 10^{-5}$                     | CL=90% | DESIG=47 |
| $\Gamma_{48}$ | $K^+ K^- \eta$                                                                    | $< 2.3 \times 10^{-4}$                   | CL=90% | DESIG=51 |
| $\Gamma_{49}$ | $K^+ K^- K_S^0 K_S^0$                                                             | $(1.4 \pm 0.5) \times 10^{-3}$           |        | DESIG=42 |
| $\Gamma_{50}$ | $K_S^0 K_S^0 K_S^0 K_S^0$                                                         | $(5.8 \pm 0.5) \times 10^{-4}$           |        | DESIG=94 |
| $\Gamma_{51}$ | $K^+ K^- K^+ K^-$                                                                 | $(2.82 \pm 0.29) \times 10^{-3}$         |        | DESIG=14 |
| $\Gamma_{52}$ | $K^+ K^- \phi$                                                                    | $(9.7 \pm 2.5) \times 10^{-4}$           |        | DESIG=44 |
| $\Gamma_{53}$ | $\bar{K}^0 K^+ \pi^- \phi + \text{c.c.}$                                          | $(3.7 \pm 0.6) \times 10^{-3}$           |        | DESIG=91 |
| $\Gamma_{54}$ | $K^+ K^- \pi^0 \phi$                                                              | $(1.90 \pm 0.35) \times 10^{-3}$         |        | DESIG=92 |
| $\Gamma_{55}$ | $\phi \pi^+ \pi^- \pi^0$                                                          | $(1.18 \pm 0.15) \times 10^{-3}$         |        | DESIG=89 |
| $\Gamma_{56}$ | $\phi \phi$                                                                       | $(8.0 \pm 0.7) \times 10^{-4}$           |        | DESIG=16 |
| $\Gamma_{57}$ | $\phi \phi \eta$                                                                  | $(8.4 \pm 1.0) \times 10^{-4}$           |        | DESIG=96 |
| $\Gamma_{58}$ | $p \bar{p}$                                                                       | $(2.21 \pm 0.08) \times 10^{-4}$         |        | DESIG=11 |
| $\Gamma_{59}$ | $p \bar{p} \pi^0$                                                                 | $(7.0 \pm 0.7) \times 10^{-4}$           | S=1.3  | DESIG=48 |

|     |                                                  |                                  |        |           |
|-----|--------------------------------------------------|----------------------------------|--------|-----------|
| Г60 | $p\bar{p}\eta$                                   | $(3.5 \pm 0.4) \times 10^{-4}$   |        | DESIG=52  |
| Г61 | $p\bar{p}\omega$                                 | $(5.2 \pm 0.6) \times 10^{-4}$   |        | DESIG=69  |
| Г62 | $p\bar{p}\phi$                                   | $(6.0 \pm 1.4) \times 10^{-5}$   |        | DESIG=74  |
| Г63 | $p\bar{p}\pi^+\pi^-$                             | $(2.1 \pm 0.7) \times 10^{-3}$   | S=1.4  | DESIG=8   |
| Г64 | $p\bar{p}\pi^0\pi^0$                             | $(1.04 \pm 0.28) \times 10^{-3}$ |        | DESIG=64  |
| Г65 | $p\bar{p}K^+K^-$ (non-resonant)                  | $(1.22 \pm 0.26) \times 10^{-4}$ |        | DESIG=71  |
| Г66 | $p\bar{p}K_S^0 K_S^0$                            | $< 8.8 \times 10^{-4}$           | CL=90% | DESIG=40  |
| Г67 | $p\bar{n}\pi^-$                                  | $(1.27 \pm 0.11) \times 10^{-3}$ |        | DESIG=43  |
| Г68 | $\bar{p}n\pi^+$                                  | $(1.37 \pm 0.12) \times 10^{-3}$ |        | DESIG=82  |
| Г69 | $p\bar{n}\pi^-\pi^0$                             | $(2.34 \pm 0.21) \times 10^{-3}$ |        | DESIG=83  |
| Г70 | $\bar{p}n\pi^+\pi^0$                             | $(2.21 \pm 0.18) \times 10^{-3}$ |        | DESIG=84  |
| Г71 | $\Lambda\bar{\Lambda}$                           | $(3.27 \pm 0.24) \times 10^{-4}$ |        | DESIG=19  |
| Г72 | $\Lambda\bar{\Lambda}\pi^+\pi^-$                 | $(1.18 \pm 0.13) \times 10^{-3}$ |        | DESIG=38  |
| Г73 | $\Lambda\bar{\Lambda}\pi^+\pi^-$ (non-resonant)  | $< 5 \times 10^{-4}$             | CL=90% | DESIG=77  |
| Г74 | $\Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.}$ | $< 5 \times 10^{-4}$             | CL=90% | DESIG=78  |
| Г75 | $\Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.}$ | $< 5 \times 10^{-4}$             | CL=90% | DESIG=79  |
| Г76 | $K^+\bar{p}\Lambda + \text{c.c.}$                | $(1.25 \pm 0.12) \times 10^{-3}$ | S=1.3  | DESIG=49  |
| Г77 | $K^*(892)^+\bar{p}\Lambda + \text{c.c.}$         | $(4.8 \pm 0.9) \times 10^{-4}$   |        | DESIG=98  |
| Г78 | $K^+\bar{p}\Lambda(1520) + \text{c.c.}$          | $(2.9 \pm 0.7) \times 10^{-4}$   |        | DESIG=72  |
| Г79 | $\Lambda(1520)\bar{\Lambda}(1520)$               | $(3.1 \pm 1.2) \times 10^{-4}$   |        | DESIG=73  |
| Г80 | $\Sigma^0\bar{\Sigma}^0$                         | $(4.68 \pm 0.32) \times 10^{-4}$ |        | DESIG=58  |
| Г81 | $\Sigma^+\bar{p}K_S^0 + \text{c.c.}$             | $(3.52 \pm 0.27) \times 10^{-4}$ |        | DESIG=97  |
| Г82 | $\Sigma^0\bar{p}K^+ + \text{c.c.}$               | $(3.03 \pm 0.20) \times 10^{-4}$ |        | DESIG=100 |
| Г83 | $\Sigma^+\bar{\Sigma}^-$                         | $(4.6 \pm 0.8) \times 10^{-4}$   | S=2.6  | DESIG=59  |
| Г84 | $\Sigma^-\bar{\Sigma}^+$                         | $(5.1 \pm 0.5) \times 10^{-4}$   |        | DESIG=99  |
| Г85 | $\Sigma(1385)^+\bar{\Sigma}(1385)^-$             | $(1.6 \pm 0.6) \times 10^{-4}$   |        | DESIG=80  |
| Г86 | $\Sigma(1385)^-\bar{\Sigma}(1385)^+$             | $(2.3 \pm 0.7) \times 10^{-4}$   |        | DESIG=81  |
| Г87 | $K^-\Lambda\Xi^+ + \text{c.c.}$                  | $(1.94 \pm 0.35) \times 10^{-4}$ |        | DESIG=85  |
| Г88 | $\Xi^0\Xi^0$                                     | $(3.1 \pm 0.8) \times 10^{-4}$   |        | DESIG=60  |
| Г89 | $\Xi^-\Xi^+$                                     | $(4.8 \pm 0.7) \times 10^{-4}$   |        | DESIG=39  |
| Г90 | $\eta_c\pi^+\pi^-$                               | $< 7 \times 10^{-4}$             | CL=90% | DESIG=90  |

**Radiative decays**

|     |                         |                                  |        |                              |
|-----|-------------------------|----------------------------------|--------|------------------------------|
| Г91 | $\gamma J/\psi(1S)$     | $(1.40 \pm 0.05) \%$             |        | NODE=M056;CLUMP=B<br>DESIG=6 |
| Г92 | $\gamma\rho^0$          | $< 9 \times 10^{-6}$             | CL=90% | DESIG=55                     |
| Г93 | $\gamma\omega$          | $< 8 \times 10^{-6}$             | CL=90% | DESIG=56                     |
| Г94 | $\gamma\phi$            | $< 6 \times 10^{-6}$             | CL=90% | DESIG=57                     |
| Г95 | $\gamma\gamma$          | $(2.04 \pm 0.09) \times 10^{-4}$ |        | DESIG=7                      |
| Г96 | $e^+e^- J/\psi(1S)$     | $(1.33 \pm 0.29) \times 10^{-4}$ |        | DESIG=93                     |
| Г97 | $\mu^+\mu^- J/\psi(1S)$ | $< 1.9 \times 10^{-5}$           | CL=90% | DESIG=95                     |

**CONSTRAINED FIT INFORMATION**

A multiparticle fit to  $\chi_{c1}(1P)$ ,  $\chi_{c0}(1P)$ ,  $\chi_{c2}(1P)$ , and  $\psi(2S)$  with 4 total widths, a partial width, 25 combinations of partial widths obtained from integrated cross section, and 84 branching ratios uses 248 measurements to determine 49 parameters. The overall fit has a  $\chi^2 = 378.1$  for 199 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ .

|          |          |          |          |          |          |          |          |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| $x_2$    | 24       |          |          |          |          |          |          |          |          |          |
| $x_8$    | 9        | 2        |          |          |          |          |          |          |          |          |
| $x_{30}$ | 5        | 1        | 28       |          |          |          |          |          |          |          |
| $x_{32}$ | 8        | 2        | 10       | 3        |          |          |          |          |          |          |
| $x_{36}$ | 4        | 1        | 5        | 1        | 14       |          |          |          |          |          |
| $x_{42}$ | 8        | 2        | 8        | 3        | 18       | 11       |          |          |          |          |
| $x_{43}$ | 7        | 2        | 8        | 2        | 18       | 10       | 14       |          |          |          |
| $x_{51}$ | 5        | 1        | 5        | 2        | 9        | 5        | 7        | 7        |          |          |
| $x_{56}$ | 7        | 2        | 6        | 2        | 9        | 5        | 7        | 7        | 4        |          |
| $x_{58}$ | 3        | 1        | 4        | 1        | 3        | -1       | 7        | 7        | 3        | 3        |
| $x_{71}$ | 4        | 1        | 5        | 1        | 13       | 8        | 10       | 10       | 5        | 5        |
| $x_{91}$ | 5        | 1        | 6        | 2        | 17       | 11       | 13       | 12       | 6        | 6        |
| $x_{95}$ | -8       | -2       | -2       | -3       | 14       | 9        | 10       | 10       | 3        | 1        |
| $\Gamma$ | -26      | -6       | -19      | -10      | -15      | -7       | -14      | -12      | -10      | -13      |
|          | $x_1$    | $x_2$    | $x_8$    | $x_{30}$ | $x_{32}$ | $x_{36}$ | $x_{42}$ | $x_{43}$ | $x_{51}$ | $x_{56}$ |
| $x_{71}$ | 5        |          |          |          |          |          |          |          |          |          |
| $x_{91}$ | -19      | 9        |          |          |          |          |          |          |          |          |
| $x_{95}$ | 6        | 9        | 13       |          |          |          |          |          |          |          |
| $\Gamma$ | -4       | -7       | -9       | -38      |          |          |          |          |          |          |
|          | $x_{58}$ | $x_{71}$ | $x_{91}$ | $x_{95}$ |          |          |          |          |          |          |

### $\chi_{c0}(1P)$ PARTIAL WIDTHS

NODE=M056217

$$\chi_{c0}(1P) \Gamma(i) \Gamma(\gamma J/\psi(1S)) / \Gamma(\text{total})$$

NODE=M056223

$$\Gamma(p\bar{p}) \times \Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}}$$

$$\Gamma_{58} \Gamma_{91} / \Gamma$$

VALUE (eV) EVTS DOCUMENT ID TECN COMMENT

**33.6 ± 2.3 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

26.6 ± 2.6 ± 1.4 392 <sup>1,2</sup> BAGNASCO 02 E835  $\bar{p}p \rightarrow \chi_{c0} \rightarrow J/\psi \gamma$

48.7 <sup>+11.3</sup> <sub>-8.9</sub> ± 2.4 <sup>1,2</sup> AMBROGIANI 99B E835  $\bar{p}p \rightarrow \gamma J/\psi$

<sup>1</sup> Calculated by us using  $B(J/\psi(1S) \rightarrow e^+ e^-) = 0.0593 \pm 0.0010$ .

<sup>2</sup> Values in  $(\Gamma(p\bar{p}) \times \Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}})$  and  $(\Gamma(p\bar{p}) / \Gamma_{\text{total}} \times \Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}})$  are not independent. The latter is used in the fit since it is less correlated to the total width.

NODE=M056G;LINKAGE=7A

NODE=M056G;LINKAGE=KS

$$\chi_{c0}(1P) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$$

NODE=M056224

$$\Gamma(2(\pi^+ \pi^-)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$$

$$\Gamma_1 \Gamma_{95} / \Gamma$$

VALUE (eV) EVTS DOCUMENT ID TECN COMMENT

**52 ± 4 OUR FIT**

**49 ± 10 OUR AVERAGE** Error includes scale factor of 1.8.

44.7 ± 3.6 ± 4.9 3.6k UEHARA 08 BELL  $\gamma\gamma \rightarrow \chi_{c0} \rightarrow 2(\pi^+ \pi^-)$

75 ± 13 ± 8 EISENSTEIN 01 CLE2  $e^+ e^- \rightarrow e^+ e^- \chi_{c0}$

NODE=M056G2

NODE=M056G2

$$\Gamma(\rho^0 \rho^0) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$$

$$\Gamma_3 \Gamma_{95} / \Gamma$$

VALUE (eV) CL% EVTS DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

<12 90 <252 UEHARA 08 BELL  $\gamma\gamma \rightarrow \chi_{c0} \rightarrow 2(\pi^+ \pi^-)$

NODE=M056G07

NODE=M056G07

$$\Gamma(\pi^+\pi^-K^+K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_8\Gamma_{95}/\Gamma$$

| VALUE (eV)              | EVTS | DOCUMENT ID | TECN | COMMENT                                                                |
|-------------------------|------|-------------|------|------------------------------------------------------------------------|
| <b>40.0±3.5 OUR FIT</b> |      |             |      |                                                                        |
| <b>38.8±3.7±4.7</b>     | 1.7k | UEHARA      | 08   | BELL $\gamma\gamma \rightarrow \chi_{c0} \rightarrow K^+K^-\pi^+\pi^-$ |

NODE=M056G08  
NODE=M056G08

$$\Gamma(K^+K^-\pi^+\pi^-\pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{21}\Gamma_{95}/\Gamma$$

| VALUE (eV)    | EVTS | DOCUMENT ID     | TECN | COMMENT                                          |
|---------------|------|-----------------|------|--------------------------------------------------|
| <b>26±4±4</b> | 1094 | DEL-AMO-SA..11M | BABR | $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$ |

NODE=M056G01  
NODE=M056G01

$$\Gamma(K^+\bar{K}^*(892)^0\pi^- + \text{c.c.}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{30}\Gamma_{95}/\Gamma$$

| VALUE (eV)           | EVTS      | DOCUMENT ID | TECN | COMMENT                                                                |
|----------------------|-----------|-------------|------|------------------------------------------------------------------------|
| <b>16 ±4 OUR FIT</b> |           |             |      |                                                                        |
| <b>16.7±6.1±3.0</b>  | 495 ± 182 | UEHARA      | 08   | BELL $\gamma\gamma \rightarrow \chi_{c0} \rightarrow K^+K^-\pi^+\pi^-$ |

NODE=M056G09  
NODE=M056G09

$$\Gamma(K^*(892)^0\bar{K}^*(892)^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{31}\Gamma_{95}/\Gamma$$

| VALUE (eV) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|-----|------|-------------|------|---------|
|------------|-----|------|-------------|------|---------|

NODE=M056G10  
NODE=M056G10

• • • We do not use the following data for averages, fits, limits, etc. • • •

|    |    |      |        |    |                                                                        |
|----|----|------|--------|----|------------------------------------------------------------------------|
| <6 | 90 | <148 | UEHARA | 08 | BELL $\gamma\gamma \rightarrow \chi_{c0} \rightarrow K^+K^-\pi^+\pi^-$ |
|----|----|------|--------|----|------------------------------------------------------------------------|

$$\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{32}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**18.8± 1.3 OUR FIT**

**23 ± 5 OUR AVERAGE**

|                                              |                                   |                       |    |      |                                            |
|----------------------------------------------|-----------------------------------|-----------------------|----|------|--------------------------------------------|
| 29.7 <sup>+17.4</sup> <sub>-12.0</sub> ± 4.8 | 103 <sup>+60</sup> <sub>-42</sub> | <sup>1</sup> UEHARA   | 09 | BELL | 10.6 $e^+e^- \rightarrow e^+e^-\pi^0\pi^0$ |
| 22.7 ± 3.2 ± 3.5                             | 129 ± 18                          | <sup>2</sup> NAKAZAWA | 05 | BELL | 10.6 $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$ |

<sup>1</sup>We multiplied the measurement by 3 to convert from  $\pi^0\pi^0$  to  $\pi\pi$ . Interference with the continuum included.

<sup>2</sup>We have multiplied  $\pi^+\pi^-$  measurement by 3/2 to obtain  $\pi\pi$ .

NODE=M056G3  
NODE=M056G3

NODE=M056G3;LINKAGE=UE

NODE=M056G;LINKAGE=NA

$$\Gamma(\eta\eta) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{36}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**9.4±2.3±1.2** 22 <sup>1</sup> UEHARA 10A BELL 10.6  $e^+e^- \rightarrow e^+e^-\eta\eta$

<sup>1</sup>Interference with the continuum not included.

NODE=M056G06  
NODE=M056G06

NODE=M056G06;LINKAGE=UE

$$\Gamma(\omega\omega) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{39}\Gamma_{95}/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                  |     |      |                                               |
|------|----|------------------|-----|------|-----------------------------------------------|
| <3.9 | 90 | <sup>1</sup> LIU | 12B | BELL | $\gamma\gamma \rightarrow 2(\pi^+\pi^-\pi^0)$ |
|------|----|------------------|-----|------|-----------------------------------------------|

<sup>1</sup>Using  $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7)\%$ .

NODE=M056G02  
NODE=M056G02

NODE=M056G02;LINKAGE=LI

$$\Gamma(\omega\phi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{40}\Gamma_{95}/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                  |     |      |                                                  |
|-------|----|------------------|-----|------|--------------------------------------------------|
| <0.34 | 90 | <sup>1</sup> LIU | 12B | BELL | $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$ |
|-------|----|------------------|-----|------|--------------------------------------------------|

<sup>1</sup>Using  $B(\phi \rightarrow K^+K^-) = (48.9 \pm 0.5)\%$  and  $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7)\%$ .

NODE=M056G03  
NODE=M056G03

NODE=M056G03;LINKAGE=LI

$$\Gamma(K^+K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{42}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**13.4±1.0 OUR FIT**

**14.3±1.6±2.3** 153 ± 17 NAKAZAWA 05 BELL 10.6  $e^+e^- \rightarrow e^+e^-K^+K^-$

NODE=M056G4  
NODE=M056G4

$$\Gamma(K_S^0\bar{K}_S^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{43}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**7.0 ±0.5 OUR FIT**

**8.7 ±1.7 ±0.9** 266 <sup>1</sup> UEHARA 13 BELL  $\gamma\gamma \rightarrow K_S^0\bar{K}_S^0$

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |          |      |     |      |                                      |
|----------------|----------|------|-----|------|--------------------------------------|
| 7.00±0.65±0.71 | 134 ± 12 | CHEN | 07B | BELL | $e^+e^- \rightarrow e^+e^-\chi_{c0}$ |
|----------------|----------|------|-----|------|--------------------------------------|

<sup>1</sup>Supersedes CHEN 07B.

NODE=M056G5  
NODE=M056G5

NODE=M056G5;LINKAGE=UE

$$\Gamma(K^+K^-K^+K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{51}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**6.2±0.7 OUR FIT**

**7.9±1.3±1.1** 215 ± 36 UEHARA 08 BELL  $\gamma\gamma \rightarrow \chi_{c0} \rightarrow 2(K^+K^-)$

NODE=M056G11  
NODE=M056G11



| $\Gamma(\phi\phi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$                        | $\Gamma_{56}\Gamma_{95}/\Gamma$               |
|---------------------------------------------------------------------------------------------|-----------------------------------------------|
| VALUE (eV)                                                                                  | EVTS                                          |
| <b>1.76±0.18 OUR FIT</b>                                                                    |                                               |
| <b>1.72±0.33±0.14</b>                                                                       | 56 ± 11                                       |
| • • • We do not use the following data for averages, fits, limits, etc. • • •               |                                               |
| 2.3 ± 0.9 ± 0.4                                                                             | 23.6 ± 9.6                                    |
| UEHARA                                                                                      | 08 BELL $\gamma\gamma \rightarrow 2(K^+ K^-)$ |
| <sup>1</sup> Supersedes UEHARA 08. Using $B(\phi \rightarrow K^+ K^-) = (48.9 \pm 0.5)\%$ . |                                               |

NODE=M056G12  
NODE=M056G12

NODE=M056G12;LINKAGE=LI

## $\chi_{c0}(1P)$ BRANCHING RATIOS

NODE=M056220

### HADRONIC DECAYS

NODE=M056305

| $\Gamma(2(\pi^+ \pi^-))/\Gamma_{\text{total}}$                        | $\Gamma_1/\Gamma$                                         |
|-----------------------------------------------------------------------|-----------------------------------------------------------|
| VALUE                                                                 | DOCUMENT ID                                               |
| <b>0.0234±0.0018 OUR FIT</b>                                          |                                                           |
| <b><math>\Gamma(\rho^0 \pi^+ \pi^-)/\Gamma(2(\pi^+ \pi^-))</math></b> | <b><math>\Gamma_2/\Gamma_1</math></b>                     |
| VALUE                                                                 | DOCUMENT ID                                               |
| <b>0.39±0.12 OUR FIT</b>                                              |                                                           |
| <b>0.39±0.12</b>                                                      | TANENBAUM 78 MRK1 $\psi(2S) \rightarrow \gamma \chi_{c0}$ |
| <b><math>\Gamma(\rho^0 \pi^+ \pi^-)/\Gamma_{\text{total}}</math></b>  | <b><math>\Gamma_2/\Gamma</math></b>                       |
| VALUE                                                                 | DOCUMENT ID                                               |
| <b>0.0091±0.0029 OUR FIT</b>                                          |                                                           |

NODE=M056R2  
NODE=M056R2

NODE=M056R54  
NODE=M056R54

NODE=M056R9  
NODE=M056R9

| $\Gamma(f_0(980) f_0(980))/\Gamma_{\text{total}}$                                                                                                                                                                                                                                                                                                                                                                                                     | $\Gamma_4/\Gamma$ |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                              | EVTS              |
| <b>6.6±2.1±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    | 36 ± 9            |
| <sup>1</sup> ABLIKIM 04G BES $\psi(2S) \rightarrow \gamma 2\pi^+ 2\pi^-$                                                                                                                                                                                                                                                                                                                                                                              |                   |
| <sup>1</sup> ABLIKIM 04G reports $[\Gamma(\chi_{c0}(1P) \rightarrow f_0(980) f_0(980))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ = $(6.5 \pm 1.6 \pm 1.3) \times 10^{-5}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |                   |

NODE=M056R24  
NODE=M056R24

NODE=M056R24;LINKAGE=AB

| $\Gamma(\pi^+ \pi^- \pi^0 \pi^0)/\Gamma_{\text{total}}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | $\Gamma_5/\Gamma$ |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| VALUE (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EVTS              |
| <b>3.3±0.4±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1751.4            |
| <sup>1</sup> HE 08B CLEO $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                   |
| <sup>1</sup> HE 08B reports $3.54 \pm 0.10 \pm 0.43 \pm 0.18 \%$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \pi^+ \pi^- \pi^0 \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |                   |

NODE=M056R62  
NODE=M056R62

NODE=M056R62;LINKAGE=HE

| $\Gamma(\rho^+ \pi^- \pi^0 + \text{c.c.})/\Gamma_{\text{total}}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | $\Gamma_6/\Gamma$ |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| VALUE (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | EVTS              |
| <b>2.9±0.4±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1358.5            |
| <sup>1,2</sup> HE 08B CLEO $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                   |
| <sup>1</sup> HE 08B reports $3.04 \pm 0.18 \pm 0.42 \pm 0.16 \%$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \rho^+ \pi^- \pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |                   |
| <sup>2</sup> Calculated by us. We have added the values from HE 08B for $\rho^+ \pi^- \pi^0$ and $\rho^- \pi^+ \pi^0$ decays assuming uncorrelated statistical and fully correlated systematic uncertainties.                                                                                                                                                                                                                                                                                                                                                                          |                   |

NODE=M056R63  
NODE=M056R63

NODE=M056R63;LINKAGE=HE

NODE=M056R63;LINKAGE=OC

| $\Gamma(4\pi^0)/\Gamma_{\text{total}}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | $\Gamma_7/\Gamma$ |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| VALUE (units $10^{-3}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | EVTS              |
| <b>3.3±0.4±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3296              |
| <sup>1</sup> ABLIKIM 11A BES3 $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                   |
| <sup>1</sup> ABLIKIM 11A reports $(3.34 \pm 0.06 \pm 0.44) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow 4\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |                   |

NODE=M056R71  
NODE=M056R71

NODE=M056R71;LINKAGE=AB

| $\Gamma(\pi^+ \pi^- K^+ K^-)/\Gamma_{\text{total}}$ | $\Gamma_8/\Gamma$ |
|-----------------------------------------------------|-------------------|
| VALUE (units $10^{-3}$ )                            | DOCUMENT ID       |
| <b>18.1±1.4 OUR FIT</b>                             |                   |

NODE=M056R3  
NODE=M056R3

$$\Gamma(K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}) / \Gamma(\pi^+ \pi^- K^+ K^-)$$

 $\Gamma_{30}/\Gamma_8$ 

VALUE

DOCUMENT ID

TECN

COMMENT

**0.41±0.09 OUR FIT****0.41±0.10**TANENBAUM 78 MRK1  $\psi(2S) \rightarrow \gamma \chi_{c0}$ NODE=M056R55  
NODE=M056R55

$$\Gamma(K_0^*(1430)^0 \bar{K}_0^*(1430)^0 \rightarrow \pi^+ \pi^- K^+ K^-) / \Gamma_{\text{total}}$$

 $\Gamma_9/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**9.8<sup>+3.6</sup><sub>-2.8</sub>±0.2**

83

<sup>1</sup> ABLIKIM 05Q BES2  $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$ NODE=M056R36  
NODE=M056R36

<sup>1</sup> ABLIKIM 05Q reports  $(10.44 \pm 2.37^{+3.05}_{-1.90}) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K_0^*(1430)^0 \bar{K}_0^*(1430)^0 \rightarrow \pi^+ \pi^- K^+ K^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R36;LINKAGE=AB

$$\Gamma(K_0^*(1430)^0 \bar{K}_2^*(1430)^0 + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-) / \Gamma_{\text{total}}$$

 $\Gamma_{10}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**8.0<sup>+2.0</sup><sub>-2.4</sub>±0.2**

62

<sup>1</sup> ABLIKIM 05Q BES2  $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$ NODE=M056R37  
NODE=M056R37

<sup>1</sup> ABLIKIM 05Q reports  $(8.49 \pm 1.66^{+1.32}_{-1.99}) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K_0^*(1430)^0 \bar{K}_2^*(1430)^0 + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R37;LINKAGE=AB

$$\Gamma(K_1(1270)^+ K^- + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-) / \Gamma_{\text{total}}$$

 $\Gamma_{11}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**6.3±1.9±0.1**

68

<sup>1</sup> ABLIKIM 05Q BES2  $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$ NODE=M056R38  
NODE=M056R38

<sup>1</sup> ABLIKIM 05Q reports  $(6.66 \pm 1.31^{+1.60}_{-1.51}) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K_1(1270)^+ K^- + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. The measurement assumes  $B(K_1(1270) \rightarrow K \rho(770)) = 42 \pm 6\%$ .

NODE=M056R38;LINKAGE=AB

$$\Gamma(K_1(1400)^+ K^- + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-) / \Gamma_{\text{total}}$$

 $\Gamma_{12}/\Gamma$ VALUE (units  $10^{-3}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**<2.7**

90

<sup>1</sup> ABLIKIM 05Q BES2  $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$ NODE=M056R39  
NODE=M056R39

<sup>1</sup> ABLIKIM 05Q reports  $< 2.85 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K_1(1400)^+ K^- + \text{c.c.} \rightarrow \pi^+ \pi^- K^+ K^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . The measurement assumes  $B(K_1(1400) \rightarrow K^*(892)\pi) = 94 \pm 6\%$ .

NODE=M056R39;LINKAGE=AB

$$\Gamma(f_0(980) f_0(980)) / \Gamma_{\text{total}}$$

 $\Gamma_{13}/\Gamma$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**16.2<sup>+10.4</sup><sub>-9.0</sub>±0.3**

28

<sup>1</sup> ABLIKIM 05Q BES2  $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$ NODE=M056R28  
NODE=M056R28

<sup>1</sup> ABLIKIM 05Q reports  $[\Gamma(\chi_{c0}(1P) \rightarrow f_0(980) f_0(980)) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))] = (1.59 \pm 0.50^{+0.89}_{-0.72}) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. One of the  $f_0(980)$  mesons is identified via decay to  $\pi^+ \pi^-$  while the other via  $K^+ K^-$  decay.

NODE=M056R28;LINKAGE=AB

$$\Gamma(f_0(980) f_0(2200)) / \Gamma_{\text{total}}$$

 $\Gamma_{14}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**7.9<sup>+2.0</sup><sub>-2.5</sub>±0.2**

77

<sup>1</sup> ABLIKIM 05Q BES2  $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$ NODE=M056R29  
NODE=M056R29

<sup>1</sup> ABLIKIM 05Q reports  $(8.42 \pm 1.42^{+1.65}_{-2.29}) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow f_0(980)f_0(2200))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. The  $f_0$  mesons are identified via  $f_0(980) \rightarrow \pi^+\pi^-$  and  $f_0(2200) \rightarrow K^+K^-$  decays.

NODE=M056R29;LINKAGE=AB

### $\Gamma(f_0(1370)f_0(1370))/\Gamma_{\text{total}}$ $\Gamma_{15}/\Gamma$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                       |
|--------------------------|-----|----------------------|----------|-----------------------------------------------|
| <b>&lt;2.7</b>           | 90  | <sup>1</sup> ABLIKIM | 05Q BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-K^+K^-$ |

NODE=M056R30  
NODE=M056R30

<sup>1</sup> ABLIKIM 05Q reports  $< 2.9 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow f_0(1370)f_0(1370))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . One of the  $f_0(1370)$  mesons is identified via decay to  $\pi^+\pi^-$  while the other via  $K^+K^-$  decay. Both branching fractions for these  $f_0$  decays are implicitly included in the quoted result.

NODE=M056R30;LINKAGE=AB

### $\Gamma(f_0(1370)f_0(1500))/\Gamma_{\text{total}}$ $\Gamma_{16}/\Gamma$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                       |
|--------------------------|-----|----------------------|----------|-----------------------------------------------|
| <b>&lt;1.7</b>           | 90  | <sup>1</sup> ABLIKIM | 05Q BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-K^+K^-$ |

NODE=M056R31  
NODE=M056R31

<sup>1</sup> ABLIKIM 05Q reports  $< 1.8 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow f_0(1370)f_0(1500))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . The  $f_0$  mesons are identified via  $f_0(1370) \rightarrow \pi^+\pi^-$  and  $f_0(1500) \rightarrow K^+K^-$  decays. Both branching fractions for these  $f_0$  decays are implicitly included in the quoted result.

NODE=M056R31;LINKAGE=AB

### $\Gamma(f_0(1370)f_0(1710))/\Gamma_{\text{total}}$ $\Gamma_{17}/\Gamma$

| VALUE (units $10^{-4}$ )                      | EVTS | DOCUMENT ID          | TECN     | COMMENT                                       |
|-----------------------------------------------|------|----------------------|----------|-----------------------------------------------|
| <b><math>6.7^{+3.5}_{-2.3} \pm 0.1</math></b> | 61   | <sup>1</sup> ABLIKIM | 05Q BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-K^+K^-$ |

NODE=M056R32  
NODE=M056R32

<sup>1</sup> ABLIKIM 05Q reports  $(7.12 \pm 1.85^{+3.28}_{-1.68}) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow f_0(1370)f_0(1710))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. The  $f_0$  mesons are identified via  $f_0(1370) \rightarrow \pi^+\pi^-$  and  $f_0(1710) \rightarrow K^+K^-$  decays. Both branching fractions for these  $f_0$  decays are implicitly included in the quoted result.

NODE=M056R32;LINKAGE=AB

### $\Gamma(f_0(1500)f_0(1370))/\Gamma_{\text{total}}$ $\Gamma_{18}/\Gamma$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                       |
|--------------------------|-----|----------------------|----------|-----------------------------------------------|
| <b>&lt;1.3</b>           | 90  | <sup>1</sup> ABLIKIM | 05Q BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-K^+K^-$ |

NODE=M056R33  
NODE=M056R33

<sup>1</sup> ABLIKIM 05Q reports  $< 1.4 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow f_0(1500)f_0(1370))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . The  $f_0$  mesons are identified via  $f_0(1500) \rightarrow \pi^+\pi^-$  and  $f_0(1370) \rightarrow K^+K^-$  decays. Both branching fractions for these  $f_0$  decays are implicitly included in the quoted result.

NODE=M056R33;LINKAGE=AB

### $\Gamma(f_0(1500)f_0(1500))/\Gamma_{\text{total}}$ $\Gamma_{19}/\Gamma$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                       |
|--------------------------|-----|----------------------|----------|-----------------------------------------------|
| <b>&lt;0.5</b>           | 90  | <sup>1</sup> ABLIKIM | 05Q BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-K^+K^-$ |

NODE=M056R34  
NODE=M056R34

<sup>1</sup> ABLIKIM 05Q reports  $< 0.55 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow f_0(1500)f_0(1500))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . One of the  $f_0(1500)$  is identified via decay to  $\pi^+\pi^-$  while the other via  $K^+K^-$  decay. Both branching fractions for these  $f_0$  decays are implicitly included in the quoted result.

NODE=M056R34;LINKAGE=AB

$\Gamma(f_0(1500)f_0(1710))/\Gamma_{\text{total}}$  $\Gamma_{20}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                           |
|--------------------------|-----|----------------------|----------|---------------------------------------------------|
| <b>&lt;0.7</b>           | 90  | <sup>1</sup> ABLIKIM | 05Q BES2 | $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$ |

NODE=M056R35  
 NODE=M056R35

<sup>1</sup> ABLIKIM 05Q reports  $< 0.73 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow f_0(1500)f_0(1710))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . The  $f_0$  mesons are identified via  $f_0(1500) \rightarrow \pi^+ \pi^-$  and  $f_0(1710) \rightarrow K^+ K^-$  decays. Both branching fractions for these  $f_0$  decays are implicitly included in the quoted result.

NODE=M056R35;LINKAGE=AB

 $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                     |
|--------------------------------------------|------|----------------------|----------|-------------------------------------------------------------|
| <b><math>8.61 \pm 0.13 \pm 0.94</math></b> | 9.0k | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$ |

NODE=M056R85  
 NODE=M056R85

<sup>1</sup> Using  $1.06 \times 10^8$   $\psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c0} \gamma) = (9.68 \pm 0.31)\%$ .

NODE=M056R85;LINKAGE=A

 $\Gamma(K_S^0 K^\pm \pi^\mp \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{22}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                     |
|--------------------------------------------|------|----------------------|----------|-------------------------------------------------------------|
| <b><math>4.22 \pm 0.10 \pm 0.43</math></b> | 2.7k | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$ |

NODE=M056R86  
 NODE=M056R86

<sup>1</sup> Using  $1.06 \times 10^8$   $\psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c0} \gamma) = (9.68 \pm 0.31)\%$ .

NODE=M056R86;LINKAGE=A

 $\Gamma(K^+ K^- \pi^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{23}/\Gamma$ 

| VALUE (%)                                  | EVTS  | DOCUMENT ID     | TECN     | COMMENT                                      |
|--------------------------------------------|-------|-----------------|----------|----------------------------------------------|
| <b><math>0.56 \pm 0.09 \pm 0.01</math></b> | 213.5 | <sup>1</sup> HE | 08B CLEO | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M056R64  
 NODE=M056R64

<sup>1</sup> HE 08B reports  $0.59 \pm 0.05 \pm 0.08 \pm 0.03\%$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ K^- \pi^0 \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R64;LINKAGE=HE

 $\Gamma(K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ 

| VALUE (%)                                  | EVTS  | DOCUMENT ID     | TECN     | COMMENT                                      |
|--------------------------------------------|-------|-----------------|----------|----------------------------------------------|
| <b><math>2.49 \pm 0.33 \pm 0.05</math></b> | 401.7 | <sup>1</sup> HE | 08B CLEO | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M056R66  
 NODE=M056R66

<sup>1</sup> HE 08B reports  $2.64 \pm 0.15 \pm 0.31 \pm 0.14\%$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R66;LINKAGE=HE

 $\Gamma(\rho^+ K^- K^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

| VALUE (%)                                  | EVTS  | DOCUMENT ID     | TECN     | COMMENT                                      |
|--------------------------------------------|-------|-----------------|----------|----------------------------------------------|
| <b><math>1.21 \pm 0.21 \pm 0.02</math></b> | 179.7 | <sup>1</sup> HE | 08B CLEO | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M056R67  
 NODE=M056R67

<sup>1</sup> HE 08B reports  $1.28 \pm 0.16 \pm 0.15 \pm 0.07\%$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \rho^+ K^- K^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R67;LINKAGE=HE

 $\Gamma(K^*(892)^- K^+ \pi^0 \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ 

| VALUE (%)                                  | EVTS | DOCUMENT ID     | TECN     | COMMENT                                      |
|--------------------------------------------|------|-----------------|----------|----------------------------------------------|
| <b><math>0.46 \pm 0.12 \pm 0.01</math></b> | 64.1 | <sup>1</sup> HE | 08B CLEO | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M056R68  
 NODE=M056R68

<sup>1</sup> HE 08B reports  $0.49 \pm 0.10 \pm 0.07 \pm 0.03\%$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K^*(892)^- K^+ \pi^0 \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R68;LINKAGE=HE

 $\Gamma(K_S^0 K_S^0 \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ 

| VALUE (units $10^{-3}$ )                | EVTS         | DOCUMENT ID          | TECN     | COMMENT                                 |
|-----------------------------------------|--------------|----------------------|----------|-----------------------------------------|
| <b><math>5.7 \pm 1.0 \pm 0.1</math></b> | 152 $\pm$ 14 | <sup>1</sup> ABLIKIM | 05o BES2 | $\psi(2S) \rightarrow \gamma \chi_{c0}$ |

NODE=M056R47  
 NODE=M056R47

<sup>1</sup> ABLIKIM 05o reports  $[\Gamma(\chi_{c0}(1P) \rightarrow K_S^0 K_S^0 \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$   $= (0.558 \pm 0.051 \pm 0.089) \times 10^{-3}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R47;LINKAGE=AB

### $\Gamma(K^+ K^- \eta \pi^0)/\Gamma_{\text{total}}$ $\Gamma_{28}/\Gamma$

| VALUE (%)             | EVTS | DOCUMENT ID     | TECN     | COMMENT                                      |
|-----------------------|------|-----------------|----------|----------------------------------------------|
| <b>0.30±0.07±0.01</b> | 56.4 | <sup>1</sup> HE | 08B CLEO | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

<sup>1</sup> HE 08B reports  $0.32 \pm 0.05 \pm 0.05 \pm 0.02$  % from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ K^- \eta \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R69  
NODE=M056R69

NODE=M056R69;LINKAGE=HE

### $\Gamma(3(\pi^+ \pi^-))/\Gamma_{\text{total}}$ $\Gamma_{29}/\Gamma$

| VALUE (units $10^{-3}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**12.0±1.8 OUR EVALUATION** Treating systematic error as correlated.

**12.0±1.7 OUR AVERAGE**

|              |                        |         |                                         |
|--------------|------------------------|---------|-----------------------------------------|
| 11.7±1.0±1.9 | <sup>1</sup> BAI       | 99B BES | $\psi(2S) \rightarrow \gamma \chi_{c0}$ |
| 12.5±2.9±0.5 | <sup>1</sup> TANENBAUM | 78 MRK1 | $\psi(2S) \rightarrow \gamma \chi_{c0}$ |

<sup>1</sup> Rescaled by us using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}) = (9.4 \pm 0.4)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (32.6 \pm 0.5)\%$ .

NODE=M056R4  
NODE=M056R4

→ UNCHECKED ←

NODE=M056R;LINKAGE=X1

### $\Gamma(K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.})/\Gamma_{\text{total}}$ $\Gamma_{30}/\Gamma$

| VALUE | DOCUMENT ID |
|-------|-------------|
|-------|-------------|

**0.0075±0.0016 OUR FIT**

NODE=M056R10  
NODE=M056R10

### $\Gamma(K^*(892)^0 \bar{K}^*(892)^0)/\Gamma_{\text{total}}$ $\Gamma_{31}/\Gamma$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**1.72<sup>+0.60</sup><sub>-0.54</sub>±0.04** 64 <sup>1</sup> ABLIKIM 05Q BES2  $\psi(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^-$

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.56±0.40±0.03 30 ± 6 <sup>2,3</sup> ABLIKIM 04H BES Repl. by ABLIKIM 05Q

<sup>1</sup> ABLIKIM 05Q reports  $[\Gamma(\chi_{c0}(1P) \rightarrow K^*(892)^0 \bar{K}^*(892)^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))] = (0.168 \pm 0.035^{+0.047}_{-0.040}) \times 10^{-3}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Assumes  $B(K^*(892)^0 \rightarrow K^- \pi^+) = 2/3$ .

<sup>3</sup> ABLIKIM 04H reports  $[\Gamma(\chi_{c0}(1P) \rightarrow K^*(892)^0 \bar{K}^*(892)^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))] = (1.53 \pm 0.29 \pm 0.26) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R26  
NODE=M056R26

NODE=M056R26;LINKAGE=AI

NODE=M056R;LINKAGE=AL  
NODE=M056R26;LINKAGE=AB

### $\Gamma(\pi\pi)/\Gamma_{\text{total}}$ $\Gamma_{32}/\Gamma$

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
|--------------------------|-------------|

**8.51±0.33 OUR FIT**

NODE=M056R22  
NODE=M056R22

### $\Gamma(\pi^0 \eta_c)/\Gamma_{\text{total}}$ $\Gamma_{35}/\Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

**<1.6 × 10<sup>-3</sup>** 90 <sup>1</sup> ABLIKIM 15N BES3  $\psi(2S) e^+ e^- \rightarrow \gamma \pi^0 \eta_c$

<sup>1</sup> Using  $B(\eta_c \rightarrow K_S^0 K^\pm \pi^\mp) \times B(K_S^0 \rightarrow \pi^+ \pi^-) \times B(\pi^0 \rightarrow \gamma\gamma) = (1.66 \pm 0.11) \times 10^{-2}$ .

NODE=M056R00  
NODE=M056R00

NODE=M056R00;LINKAGE=A

### $\Gamma(\eta\eta)/\Gamma_{\text{total}}$ $\Gamma_{36}/\Gamma$

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
|--------------------------|-------------|

**3.01±0.19 OUR FIT**

NODE=M056R13  
NODE=M056R13

### $\Gamma(\eta\eta)/\Gamma(\pi\pi)$ $\Gamma_{36}/\Gamma_{32}$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.353±0.025 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.26 ± 0.09 <sup>+0.03</sup><sub>-0.02</sub> <sup>1</sup> ANDREOTTI 05C E835  $\bar{p} p \rightarrow 2 \text{ mesons}$

0.24 ± 0.10 ± 0.08 <sup>1</sup> BAI 03C BES  $\psi(2S) \rightarrow 5\gamma$

<sup>1</sup> We have multiplied  $\pi^0 \pi^0$  measurement by 3 to obtain  $\pi\pi$ .

NODE=M056R20  
NODE=M056R20

NODE=M056R;LINKAGE=D1

$\Gamma(\eta\eta')/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS    | DOCUMENT ID          | TECN      | COMMENT                                |
|-------------------------------------------------------------------------------|-----|---------|----------------------|-----------|----------------------------------------|
| <b>9.1±1.1±0.2</b>                                                            |     | 85      | <sup>1</sup> ABLIKIM | 17AI BES3 | $\psi(2S) \rightarrow \gamma\eta'\eta$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |         |                      |           |                                        |
| <24                                                                           | 90  | 35 ± 13 | <sup>2</sup> ASNER   | 09 CLEO   | $\psi(2S) \rightarrow \gamma\eta'\eta$ |
| <50                                                                           | 90  |         | <sup>3</sup> ADAMS   | 07 CLEO   | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |

<sup>1</sup> ABLIKIM 17AI reports  $(8.92 \pm 0.84 \pm 0.65) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \eta\eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.99 \pm 0.27) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ASNER 09 reports  $< 0.25 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \eta\eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .

<sup>3</sup> Superseded by ASNER 09. ADAMS 07 reports  $< 0.5 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \eta\eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .

NODE=M056R03  
NODE=M056R03

NODE=M056R03;LINKAGE=A

NODE=M056R03;LINKAGE=AS

NODE=M056R03;LINKAGE=AD

 $\Gamma(\eta'\eta')/\Gamma_{\text{total}}$  $\Gamma_{38}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                      | EVTS | DOCUMENT ID          | TECN      | COMMENT                                 |
|-------------------------------------------------------------------------------|------|----------------------|-----------|-----------------------------------------|
| <b>2.17±0.12 OUR AVERAGE</b>                                                  |      |                      |           |                                         |
| 2.23±0.13±0.05                                                                | 2.5k | <sup>1</sup> ABLIKIM | 17AI BES3 | $\psi(2S) \rightarrow \gamma\eta'\eta'$ |
| 2.00±0.21±0.04                                                                | 0.4k | <sup>2</sup> ASNER   | 09 CLEO   | $\psi(2S) \rightarrow \gamma\eta'\eta'$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |           |                                         |
| 1.60±0.41±0.03                                                                | 23   | <sup>3</sup> ADAMS   | 07 CLEO   | $\psi(2S) \rightarrow \gamma\chi_{c0}$  |

<sup>1</sup> ABLIKIM 17AI reports  $(2.19 \pm 0.03 \pm 0.14) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \eta'\eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.99 \pm 0.27) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ASNER 09 reports  $(2.12 \pm 0.13 \pm 0.21) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \eta'\eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> Superseded by ASNER 09. ADAMS 07 reports  $(1.7 \pm 0.4 \pm 0.2) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \eta'\eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 0.0922 \pm 0.0011 \pm 0.0046$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R04  
NODE=M056R04

NODE=M056R04;LINKAGE=A

NODE=M056R04;LINKAGE=AS

NODE=M056R04;LINKAGE=AD

 $\Gamma(\omega\omega)/\Gamma_{\text{total}}$  $\Gamma_{39}/\Gamma$ 

| VALUE (units $10^{-3}$ )     | EVTS       | DOCUMENT ID          | TECN     | COMMENT                                                        |
|------------------------------|------------|----------------------|----------|----------------------------------------------------------------|
| <b>0.97±0.11 OUR AVERAGE</b> |            |                      |          |                                                                |
| 0.93±0.11±0.02               | 991        | <sup>1</sup> ABLIKIM | 11K BES3 | $\psi(2S) \rightarrow \gamma \text{ hadrons}$                  |
| 2.16±0.66±0.04               | 38.1 ± 9.6 | <sup>2</sup> ABLIKIM | 05N BES2 | $\psi(2S) \rightarrow \gamma\chi_{c0} \rightarrow \gamma 6\pi$ |

<sup>1</sup> ABLIKIM 11K reports  $(0.95 \pm 0.03 \pm 0.11) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \omega\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ABLIKIM 05N reports  $[\Gamma(\chi_{c0}(1P) \rightarrow \omega\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  =  $(0.212 \pm 0.053 \pm 0.037) \times 10^{-3}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R27  
NODE=M056R27

NODE=M056R27;LINKAGE=AL

NODE=M056R27;LINKAGE=AB

 $\Gamma(\omega\phi)/\Gamma_{\text{total}}$  $\Gamma_{40}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | EVTS | DOCUMENT ID            | TECN     | COMMENT                                       |
|-------------------------------------------------------------------------------|------|------------------------|----------|-----------------------------------------------|
| <b>1.41±0.13±0.03</b>                                                         | 486  | <sup>1</sup> ABLIKIM   | 19J BES3 | $\psi(2S) \rightarrow \gamma \text{ hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |          |                                               |
| 1.18±0.22±0.02                                                                | 76   | <sup>2,3</sup> ABLIKIM | 11K BES3 | $\psi(2S) \rightarrow \gamma \text{ hadrons}$ |

NODE=M056R76  
NODE=M056R76

<sup>1</sup> ABLIKIM 19J reports  $[\Gamma(\chi_{c0}(1P) \rightarrow \omega\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))] = (13.83 \pm 0.70 \pm 1.01) \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ABLIKIM 11K reports  $(1.2 \pm 0.1 \pm 0.2) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \omega\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> Superseded by ABLIKIM 19J.

NODE=M056R76;LINKAGE=A

NODE=M056R76;LINKAGE=AL

NODE=M056R76;LINKAGE=B

### $\Gamma(\omega K^+ K^-)/\Gamma_{\text{total}}$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|--------------------------|------|----------------------|----------|-----------------------------------------------------------|
| <b>1.94±0.06±0.20</b>    | 1.4k | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c0}$ |

<sup>1</sup> Using  $1.06 \times 10^8$   $\psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c0}\gamma) = (9.68 \pm 0.31)\%$ .

NODE=M056R87  
NODE=M056R87

NODE=M056R87;LINKAGE=A

### $\Gamma(K^+ K^-)/\Gamma_{\text{total}}$

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>6.05±0.31 OUR FIT</b> |             |

NODE=M056R6  
NODE=M056R6

### $\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}}$

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>3.16±0.17 OUR FIT</b> |             |

NODE=M056R15  
NODE=M056R15

### $\Gamma(K_S^0 K_S^0)/\Gamma(\pi\pi)$

| VALUE                      | DOCUMENT ID | TECN | COMMENT |
|----------------------------|-------------|------|---------|
| <b>0.371±0.023 OUR FIT</b> |             |      |         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.31 ±0.05 ±0.05 <sup>1,2</sup> CHEN 07B BELL  $e^+e^- \rightarrow e^+e^-\chi_{c0}$

<sup>1</sup> Using  $\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  from the  $\pi^+\pi^-$  measurement of NAKAZAWA 05 rescaled by 3/2 to convert to  $\pi\pi$ .

<sup>2</sup> Not independent from other measurements.

NODE=M056R53  
NODE=M056R53

NODE=M056R53;LINKAGE=CH

NODE=M056R53;LINKAGE=NI

### $\Gamma(K_S^0 K_S^0)/\Gamma(K^+ K^-)$

| VALUE                    | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
| <b>0.52±0.04 OUR FIT</b> |             |      |         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.49±0.07±0.08 <sup>1,2</sup> CHEN 07B BELL  $e^+e^- \rightarrow e^+e^-\chi_{c0}$

<sup>1</sup> Using  $\Gamma(K^+ K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  from NAKAZAWA 05.

<sup>2</sup> Not independent from other measurements.

NODE=M056R52  
NODE=M056R52

NODE=M056R52;LINKAGE=CH  
NODE=M056R52;LINKAGE=NI

### $\Gamma(\pi^+ \pi^- \eta)/\Gamma_{\text{total}}$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID        | TECN    | COMMENT                                   |
|--------------------------|-----|--------------------|---------|-------------------------------------------|
| <b>&lt;0.20</b>          | 90  | <sup>1</sup> ATHAR | 07 CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<1.0 90 <sup>2</sup> ABLIKIM 06R BES2  $\psi(2S) \rightarrow \gamma\chi_{c0}$

<sup>1</sup> ATHAR 07 reports  $< 0.21 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \pi^+\pi^-\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .

<sup>2</sup> ABLIKIM 06R reports  $< 1.1 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \pi^+\pi^-\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .

NODE=M056R08  
NODE=M056R08

NODE=M056R08;LINKAGE=AT

NODE=M056R08;LINKAGE=AB

### $\Gamma(\pi^+ \pi^- \eta')/\Gamma_{\text{total}}$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID        | TECN    | COMMENT                                   |
|--------------------------|-----|--------------------|---------|-------------------------------------------|
| <b>&lt;0.4</b>           | 90  | <sup>1</sup> ATHAR | 07 CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |

<sup>1</sup> ATHAR 07 reports  $< 0.38 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \pi^+\pi^-\eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .

NODE=M056R51  
NODE=M056R51

NODE=M056R51;LINKAGE=AT

### $\Gamma(\bar{K}^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$ $\Gamma_{46}/\Gamma$

| VALUE (units $10^{-3}$ )                                                      | CL% | DOCUMENT ID            | TECN     | COMMENT                                   |
|-------------------------------------------------------------------------------|-----|------------------------|----------|-------------------------------------------|
| <b>&lt;0.09</b>                                                               | 90  | <sup>1</sup> ATHAR     | 07 CLEO  | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                        |          |                                           |
| <0.7                                                                          | 90  | <sup>2,3</sup> ABLIKIM | 06R BES2 | $\psi(2S) \rightarrow \gamma \chi_{c0}$   |
| <0.7                                                                          | 90  | <sup>3,4</sup> BAI     | 99B BES  | $\psi(2S) \rightarrow \gamma \chi_{c0}$   |

<sup>1</sup> ATHAR 07 reports  $< 0.10 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \bar{K}^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .

<sup>2</sup> ABLIKIM 06R reports  $< 0.70 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \bar{K}^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .

<sup>3</sup> We have multiplied the  $K_S^0 K^+ \pi^-$  measurement by a factor of 2 to convert to  $K^0 K^+ \pi^-$ .

<sup>4</sup> Rescaled by us using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}) = (9.4 \pm 0.4)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (32.6 \pm 0.5)\%$ .

NODE=M056R17  
NODE=M056R17

NODE=M056R17;LINKAGE=AT

NODE=M056R17;LINKAGE=AB

NODE=M056R17;LINKAGE=BA

NODE=M056R17;LINKAGE=X1

### $\Gamma(K^+ K^- \pi^0)/\Gamma_{\text{total}}$ $\Gamma_{47}/\Gamma$

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                                                                                                                                                                                                                  | CL% | DOCUMENT ID        | TECN    | COMMENT                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------|---------|-------------------------------------------|
| <b>&lt;0.06</b>                                                                                                                                                                                                                                                                                                                                                                                                           | 90  | <sup>1</sup> ATHAR | 07 CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |
| <sup>1</sup> ATHAR 07 reports $< 0.06 \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . |     |                    |         |                                           |

NODE=M056R05  
NODE=M056R05

NODE=M056R05;LINKAGE=AT

### $\Gamma(K^+ K^- \eta)/\Gamma_{\text{total}}$ $\Gamma_{48}/\Gamma$

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                                                                                                                                                                                                                 | CL% | DOCUMENT ID        | TECN    | COMMENT                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------|---------|-------------------------------------------|
| <b>&lt;0.23</b>                                                                                                                                                                                                                                                                                                                                                                                                          | 90  | <sup>1</sup> ATHAR | 07 CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |
| <sup>1</sup> ATHAR 07 reports $< 0.24 \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ K^- \eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . |     |                    |         |                                           |

NODE=M056R09  
NODE=M056R09

NODE=M056R09;LINKAGE=AT

### $\Gamma(K^+ K^- K_S^0 K_S^0)/\Gamma_{\text{total}}$ $\Gamma_{49}/\Gamma$

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                      | EVTS           | DOCUMENT ID          | TECN     | COMMENT                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------------|----------|-----------------------------------------|
| <b><math>1.41 \pm 0.47 \pm 0.03</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                    | $16.8 \pm 4.8$ | <sup>1</sup> ABLIKIM | 050 BES2 | $\psi(2S) \rightarrow \gamma \chi_{c0}$ |
| <sup>1</sup> ABLIKIM 050 reports $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ K^- K_S^0 K_S^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ $= (0.138 \pm 0.039 \pm 0.025) \times 10^{-3}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |                |                      |          |                                         |

NODE=M056R48  
NODE=M056R48

NODE=M056R48;LINKAGE=AB

### $\Gamma(K_S^0 K_S^0 K_S^0 K_S^0)/\Gamma_{\text{total}}$ $\Gamma_{50}/\Gamma$

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID          | TECN      | COMMENT                              |
|-----------------------------------------|------|----------------------|-----------|--------------------------------------|
| <b><math>5.8 \pm 0.5 \pm 0.1</math></b> | 319  | <sup>1</sup> ABLIKIM | 19AA BES3 | $\psi(2S) \rightarrow \gamma 4K_S^0$ |

<sup>1</sup> Using  $B(K_S^0 \rightarrow \pi^+ \pi^-) = (69.20 \pm 0.05)\%$ . ABLIKIM 19AA reports  $[\Gamma(\chi_{c0}(1P) \rightarrow K_S^0 K_S^0 K_S^0 K_S^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$   $= (5.64 \pm 0.33 \pm 0.37) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value..

NODE=M056R95  
NODE=M056R95

NODE=M056R95;LINKAGE=A

### $\Gamma(K^+ K^- K^+ K^-)/\Gamma_{\text{total}}$ $\Gamma_{51}/\Gamma$

| VALUE (units $10^{-3}$ )                  | DOCUMENT ID |
|-------------------------------------------|-------------|
| <b><math>2.82 \pm 0.29</math> OUR FIT</b> |             |

NODE=M056R14  
NODE=M056R14

### $\Gamma(K^+ K^- \phi)/\Gamma_{\text{total}}$ $\Gamma_{52}/\Gamma$

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------------------------|------|----------------------|----------|-----------------------------------------|
| <b><math>0.97 \pm 0.25 \pm 0.02</math></b> | 38   | <sup>1</sup> ABLIKIM | 06T BES2 | $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ |

<sup>1</sup> ABLIKIM 06T reports  $(1.03 \pm 0.22 \pm 0.15) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ K^- \phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R01  
NODE=M056R01

NODE=M056R01;LINKAGE=AB



$\Gamma(\bar{K}^0 K^+ \pi^- \phi + \text{c.c.})/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )**3.68±0.30±0.50**

DOCUMENT ID

TECN

COMMENT

ABLIKIM

15M

BES3

 $\psi(2S) \rightarrow \gamma \chi_{c0}$  $\Gamma_{53}/\Gamma$ NODE=M056R90  
NODE=M056R90 $\Gamma(K^+ K^- \pi^0 \phi)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )**1.90±0.14±0.32**

DOCUMENT ID

TECN

COMMENT

ABLIKIM

15M

BES3

 $\psi(2S) \rightarrow \gamma \chi_{c0}$  $\Gamma_{54}/\Gamma$ NODE=M056R91  
NODE=M056R91 $\Gamma(\phi \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )**1.18±0.07±0.13**

EVTS

538

DOCUMENT ID

TECN

COMMENT

1

ABLIKIM

13B

BES3

 $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$  $\Gamma_{55}/\Gamma$ NODE=M056R88  
NODE=M056R88<sup>1</sup> Using  $1.06 \times 10^8$   $\psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c0} \gamma) = (9.68 \pm 0.31)\%$ .

NODE=M056R88;LINKAGE=A

 $\Gamma(\phi\phi)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )**0.80±0.07 OUR FIT**

DOCUMENT ID

 $\Gamma_{56}/\Gamma$ NODE=M056R16  
NODE=M056R16 $\Gamma(\phi\phi\eta)/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )**8.4±0.7±0.6**

EVTS

186.6

DOCUMENT ID

TECN

COMMENT

1

ABLIKIM

20B

BES3

 $\psi(2S) \rightarrow \gamma \phi \phi \eta$  $\Gamma_{57}/\Gamma$ NODE=M056R98  
NODE=M056R98<sup>1</sup> ABLIKIM 20B reports  $(8.41 \pm 0.74 \pm 0.62) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \phi \phi \eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ .

NODE=M056R98;LINKAGE=A

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )**2.21±0.08 OUR FIT**

DOCUMENT ID

 $\Gamma_{58}/\Gamma$ NODE=M056R11  
NODE=M056R11 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )**0.70±0.07 OUR AVERAGE**

Error includes scale factor of 1.3.

0.73±0.06±0.01

1 ONYISI

10

CLE3

 $\psi(2S) \rightarrow \gamma p \bar{p} X$ 

0.56±0.12±0.01

2 ATHAR

07

CLEO

 $\psi(2S) \rightarrow \gamma h^+ h^- h^0$  $\Gamma_{59}/\Gamma$ NODE=M056R06  
NODE=M056R06<sup>1</sup> ONYISI 10 reports  $(7.76 \pm 0.37 \pm 0.51 \pm 0.39) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow p \bar{p} \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R06;LINKAGE=ON

<sup>2</sup> ATHAR 07 reports  $(0.59 \pm 0.10 \pm 0.08) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow p \bar{p} \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R06;LINKAGE=AT

 $\Gamma(p\bar{p}\eta)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )**0.35±0.04 OUR AVERAGE**

DOCUMENT ID

TECN

COMMENT

0.35±0.04±0.01

1 ONYISI

10

CLE3

 $\psi(2S) \rightarrow \gamma p \bar{p} X$ 

0.37±0.11±0.01

2 ATHAR

07

CLEO

 $\psi(2S) \rightarrow \gamma h^+ h^- h^0$  $\Gamma_{60}/\Gamma$ NODE=M056R50  
NODE=M056R50<sup>1</sup> ONYISI 10 reports  $(3.73 \pm 0.38 \pm 0.28 \pm 0.19) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow p \bar{p} \eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R50;LINKAGE=ON

<sup>2</sup> ATHAR 07 reports  $(0.39 \pm 0.11 \pm 0.04) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow p \bar{p} \eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R50;LINKAGE=AT

$\Gamma(p\bar{p}\omega)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{61}/\Gamma$ NODE=M056R70  
NODE=M056R70**0.52±0.06±0.01**<sup>1</sup>

ONLYSI

10

CLE3

 $\psi(2S) \rightarrow \gamma p\bar{p}X$ 

<sup>1</sup> ONLYSI 10 reports  $(5.57 \pm 0.48 \pm 0.42 \pm 0.14) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow p\bar{p}\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R70;LINKAGE=ON

 $\Gamma(p\bar{p}\phi)/\Gamma_{\text{total}}$ VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{62}/\Gamma$ NODE=M056R75  
NODE=M056R75**6.0±1.4±0.1**

42 ± 8

<sup>1</sup>

ABLIKIM

11F

BES3

 $\psi(2S) \rightarrow \gamma p\bar{p}K^+K^-$ 

<sup>1</sup> ABLIKIM 11F reports  $(6.12 \pm 1.18 \pm 0.86) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow p\bar{p}\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R75;LINKAGE=AB

 $\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{63}/\Gamma$ NODE=M056R7  
NODE=M056R7**2.1 ±0.7 OUR EVALUATION**

Error includes scale factor of 1.4. Treating systematic error as correlated.

**2.1 ±1.0 OUR AVERAGE**

Error includes scale factor of 2.0.

1.57±0.21±0.53

<sup>1</sup>

BAI

99B

BES

 $\psi(2S) \rightarrow \gamma\chi_{c0}$ 

4.20±1.15±0.18

<sup>1</sup>

TANENBAUM 78

MRK1

 $\psi(2S) \rightarrow \gamma\chi_{c0}$ 

<sup>1</sup> Rescaled by us using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}) = (9.4 \pm 0.4)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$ .

NODE=M056R7;LINKAGE=X1

 $\Gamma(p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}$ 

VALUE (%)

EVTS

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{64}/\Gamma$ NODE=M056R65  
NODE=M056R65**0.104±0.028±0.002**

39.5

<sup>1</sup>

HE

08B

CLEO

 $e^+e^- \rightarrow \gamma h^+h^-h^0h^0$ 

<sup>1</sup> HE 08B reports  $0.11 \pm 0.02 \pm 0.02 \pm 0.01\%$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R65;LINKAGE=HE

 $\Gamma(p\bar{p}K^+K^- \text{ (non-resonant)})/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{65}/\Gamma$ NODE=M056R72  
NODE=M056R72**1.22±0.26±0.02**

48 ± 8

<sup>1</sup>

ABLIKIM

11F

BES3

 $\psi(2S) \rightarrow \gamma p\bar{p}K^+K^-$ 

<sup>1</sup> ABLIKIM 11F reports  $(1.24 \pm 0.20 \pm 0.18) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow p\bar{p}K^+K^- \text{ (non-resonant)})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R72;LINKAGE=AB

 $\Gamma(p\bar{p}K_S^0K_S^0)/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )

CL%

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{66}/\Gamma$ NODE=M056R46  
NODE=M056R46**<8.8**

90

<sup>1</sup>

ABLIKIM

06D

BES2

 $\psi(2S) \rightarrow \chi_{c0}\gamma$ 

<sup>1</sup> Using  $B(\psi(2S) \rightarrow \chi_{c0}\gamma) = (9.2 \pm 0.5)\%$

NODE=M056R;LINKAGE=AB

 $\Gamma(p\bar{n}\pi^-)/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{67}/\Gamma$ NODE=M056R49  
NODE=M056R49**12.7±1.1 OUR AVERAGE**

12.9±1.1±0.3

5150

<sup>1</sup>

ABLIKIM

12J

BES3

 $\psi(2S) \rightarrow \gamma p\bar{n}\pi^-$ 

11.2±3.1±0.2

<sup>2</sup>

ABLIKIM

06I

BES2

 $\psi(2S) \rightarrow \gamma p\pi^-X$ 

<sup>1</sup> ABLIKIM 12J reports  $[\Gamma(\chi_{c0}(1P) \rightarrow p\bar{n}\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  =  $(1.26 \pm 0.02 \pm 0.11) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R49;LINKAGE=AL

<sup>2</sup> ABLIKIM 06I reports  $[\Gamma(\chi_{c0}(1P) \rightarrow p\bar{n}\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  =  $(1.10 \pm 0.24 \pm 0.18) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R49;LINKAGE=AB

$\Gamma(\bar{p}n\pi^+)/\Gamma_{\text{total}}$  $\Gamma_{68}/\Gamma$ 

| VALUE (units $10^{-4}$ )                          | EVTS | DOCUMENT ID          | TECN     | COMMENT                                     |
|---------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b>13.7<math>\pm</math>1.2<math>\pm</math>0.3</b> | 5808 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma \bar{p}n\pi^+$ |

NODE=M056R82  
 NODE=M056R82

<sup>1</sup> ABLIKIM 12J reports  $[\Gamma(\chi_{c0}(1P) \rightarrow \bar{p}n\pi^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))] = (1.34 \pm 0.03 \pm 0.11) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R82;LINKAGE=AL

 $\Gamma(p\bar{n}\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{69}/\Gamma$ 

| VALUE (units $10^{-4}$ )                          | EVTS | DOCUMENT ID          | TECN     | COMMENT                                          |
|---------------------------------------------------|------|----------------------|----------|--------------------------------------------------|
| <b>23.4<math>\pm</math>2.0<math>\pm</math>0.5</b> | 2480 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma p\bar{n}\pi^-\pi^0$ |

NODE=M056R83  
 NODE=M056R83

<sup>1</sup> ABLIKIM 12J reports  $[\Gamma(\chi_{c0}(1P) \rightarrow p\bar{n}\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))] = (2.29 \pm 0.08 \pm 0.18) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R83;LINKAGE=AL

 $\Gamma(\bar{p}n\pi^+\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{70}/\Gamma$ 

| VALUE (units $10^{-4}$ )                          | EVTS | DOCUMENT ID          | TECN     | COMMENT                                          |
|---------------------------------------------------|------|----------------------|----------|--------------------------------------------------|
| <b>22.1<math>\pm</math>1.8<math>\pm</math>0.5</b> | 2757 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma \bar{p}n\pi^+\pi^0$ |

NODE=M056R84  
 NODE=M056R84

<sup>1</sup> ABLIKIM 12J reports  $[\Gamma(\chi_{c0}(1P) \rightarrow \bar{p}n\pi^+\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))] = (2.16 \pm 0.07 \pm 0.16) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R84;LINKAGE=AL

 $\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$  $\Gamma_{71}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | DOCUMENT ID |
|-----------------------------------------|-------------|
| <b>3.27<math>\pm</math>0.24 OUR FIT</b> |             |

NODE=M056R23  
 NODE=M056R23

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{72}/\Gamma$ 

| VALUE (units $10^{-5}$ )                      | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                      |
|-----------------------------------------------|-----|------|----------------------|----------|--------------------------------------------------------------|
| <b>118<math>\pm</math>12<math>\pm</math>2</b> |     | 426  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda\bar{\Lambda}\pi^+\pi^-$ |

NODE=M056R44  
 NODE=M056R44

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                      |          |                                        |
|------|----|----------------------|----------|----------------------------------------|
| <400 | 90 | <sup>2</sup> ABLIKIM | 06D BES2 | $\psi(2S) \rightarrow \chi_{c0}\gamma$ |
|------|----|----------------------|----------|----------------------------------------|

<sup>1</sup> ABLIKIM 12I reports  $(119.0 \pm 6.4 \pm 11.4) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.68 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R44;LINKAGE=AL

<sup>2</sup> Using  $B(\psi(2S) \rightarrow \chi_{c0}\gamma) = (9.2 \pm 0.5)\%$

NODE=M056R44;LINKAGE=AB

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^- (\text{non-resonant}))/\Gamma_{\text{total}}$  $\Gamma_{73}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                                      |
|--------------------------|-----|----------------------|----------|--------------------------------------------------------------|
| <b>&lt;50</b>            | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda\bar{\Lambda}\pi^+\pi^-$ |

NODE=M056R77  
 NODE=M056R77

<sup>1</sup> ABLIKIM 12I reports  $< 54 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \Lambda\bar{\Lambda}\pi^+\pi^- (\text{non-resonant}))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.68 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .

NODE=M056R77;LINKAGE=AL

 $\Gamma(\Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{74}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                                        |
|--------------------------|-----|----------------------|----------|----------------------------------------------------------------|
| <b>&lt;50</b>            | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^+\bar{\Lambda}\pi^-$ |

NODE=M056R78  
 NODE=M056R78

<sup>1</sup> ABLIKIM 12I reports  $< 55 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.68 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .

NODE=M056R78;LINKAGE=AL

 $\Gamma(\Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{75}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                                        |
|--------------------------|-----|----------------------|----------|----------------------------------------------------------------|
| <b>&lt;50</b>            | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^-\bar{\Lambda}\pi^+$ |

NODE=M056R79  
 NODE=M056R79

<sup>1</sup> ABLIKIM 12I reports  $< 50 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.68 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .

NODE=M056R79;LINKAGE=AL

$\Gamma(K^+ \bar{p} \Lambda + c.c.) / \Gamma_{\text{total}}$  $\Gamma_{76} / \Gamma$ 

| VALUE (units $10^{-3}$ )       | EVTS | DOCUMENT ID            | TECN     | COMMENT                                           |
|--------------------------------|------|------------------------|----------|---------------------------------------------------|
| <b>1.25 ± 0.12 OUR AVERAGE</b> |      |                        |          | Error includes scale factor of 1.3.               |
| 1.30 ± 0.09 ± 0.03             | 9k   | <sup>1,2</sup> ABLIKIM | 13D BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{p} K^+$ |
| 1.01 ± 0.19 ± 0.02             |      | <sup>3</sup> ATHAR     | 07 CLEO  | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$         |

<sup>1</sup> ABLIKIM 13D reports  $(1.32 \pm 0.03 \pm 0.10) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ \bar{p} \Lambda + c.c.) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.68 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Using  $B(\Lambda \rightarrow p \pi^-) = 63.9\%$ .

<sup>3</sup> ATHAR 07 reports  $(1.07 \pm 0.17 \pm 0.12) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ \bar{p} \Lambda + c.c.) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R07  
NODE=M056R07

NODE=M056R07;LINKAGE=AB

NODE=M056R07;LINKAGE=LB  
NODE=M056R07;LINKAGE=AT

 $\Gamma(K^*(892)^+ \bar{p} \Lambda + c.c.) / \Gamma_{\text{total}}$  $\Gamma_{77} / \Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN      | COMMENT                                              |
|--------------------------|------|----------------------|-----------|------------------------------------------------------|
| <b>4.8 ± 0.9 ± 0.1</b>   | 254  | <sup>1</sup> ABLIKIM | 19AU BES3 | $\psi(2S) \rightarrow \gamma K^{*+} \bar{p} \Lambda$ |

<sup>1</sup> ABLIKIM 19AU reports  $[\Gamma(\chi_{c0}(1P) \rightarrow K^*(892)^+ \bar{p} \Lambda + c.c.) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$   $= (4.7 \pm 0.7 \pm 0.5) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R99  
NODE=M056R99

NODE=M056R99;LINKAGE=A

 $\Gamma(K^+ \bar{p} \Lambda(1520) + c.c.) / \Gamma_{\text{total}}$  $\Gamma_{78} / \Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS    | DOCUMENT ID          | TECN     | COMMENT                                         |
|--------------------------|---------|----------------------|----------|-------------------------------------------------|
| <b>2.9 ± 0.7 ± 0.1</b>   | 62 ± 12 | <sup>1</sup> ABLIKIM | 11F BES3 | $\psi(2S) \rightarrow \gamma p \bar{p} K^+ K^-$ |

<sup>1</sup> ABLIKIM 11F reports  $(3.00 \pm 0.58 \pm 0.50) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow K^+ \bar{p} \Lambda(1520) + c.c.) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R73  
NODE=M056R73

NODE=M056R73;LINKAGE=AB

 $\Gamma(\Lambda(1520) \bar{\Lambda}(1520)) / \Gamma_{\text{total}}$  $\Gamma_{79} / \Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS    | DOCUMENT ID          | TECN     | COMMENT                                         |
|--------------------------|---------|----------------------|----------|-------------------------------------------------|
| <b>3.1 ± 1.2 ± 0.1</b>   | 28 ± 10 | <sup>1</sup> ABLIKIM | 11F BES3 | $\psi(2S) \rightarrow \gamma p \bar{p} K^+ K^-$ |

<sup>1</sup> ABLIKIM 11F reports  $(3.18 \pm 1.11 \pm 0.53) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \Lambda(1520) \bar{\Lambda}(1520)) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M056R74  
NODE=M056R74

NODE=M056R74;LINKAGE=AB

 $\Gamma(\Sigma^0 \bar{\Sigma}^0) / \Gamma_{\text{total}}$  $\Gamma_{80} / \Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | EVTS    | DOCUMENT ID            | TECN     | COMMENT                                               |
|-------------------------------------------------------------------------------|---------|------------------------|----------|-------------------------------------------------------|
| <b>4.68 ± 0.32 OUR AVERAGE</b>                                                |         |                        |          |                                                       |
| 4.82 ± 0.34 ± 0.10                                                            | 1046    | <sup>1</sup> ABLIKIM   | 18V BES3 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |
| 4.2 ± 0.7 ± 0.1                                                               | 78 ± 10 | <sup>2</sup> NAIK      | 08 CLEO  | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |         |                        |          |                                                       |
| 1.7 ± 0.5 ± 0.1                                                               | 243     | <sup>3,4</sup> ABLIKIM | 13H BES3 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |

<sup>1</sup> ABLIKIM 18V reports  $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma^0 \bar{\Sigma}^0) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$   $= (4.72 \pm 0.18 \pm 0.28) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> NAIK 08 reports  $(4.41 \pm 0.56 \pm 0.47) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma^0 \bar{\Sigma}^0) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> ABLIKIM 13H reports  $(4.78 \pm 0.34 \pm 0.39) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma^0 \bar{\Sigma}^0) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>4</sup> Superseded by ABLIKIM 18V

NODE=M056R59  
NODE=M056R59

NODE=M056R59;LINKAGE=A

NODE=M056R59;LINKAGE=NA

NODE=M056R59;LINKAGE=AB

NODE=M056R59;LINKAGE=B

$\Gamma(\Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}$  $\Gamma_{83}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | EVTS                                | DOCUMENT ID            | TECN     | COMMENT                                               |
|-------------------------------------------------------------------------------|-------------------------------------|------------------------|----------|-------------------------------------------------------|
| <b>4.6 ± 0.8 OUR AVERAGE</b>                                                  | Error includes scale factor of 2.6. |                        |          |                                                       |
| 5.10 ± 0.35 ± 0.10                                                            | 747                                 | <sup>1</sup> ABLIKIM   | 18V BES3 | $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{\Sigma}^-$ |
| 3.1 ± 0.7 ± 0.1                                                               | 39 ± 7                              | <sup>2</sup> NAIK      | 08 CLEO  | $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{\Sigma}^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                     |                        |          |                                                       |
| 4.5 ± 0.5 ± 0.1                                                               | 148                                 | <sup>3,4</sup> ABLIKIM | 13H BES3 | $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{\Sigma}^-$ |

<sup>1</sup> ABLIKIM 18V reports  $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))] = (4.99 \pm 0.24 \pm 0.24) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> NAIK 08 reports  $(3.25 \pm 0.57 \pm 0.43) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> ABLIKIM 13H reports  $(4.54 \pm 0.42 \pm 0.30) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>4</sup> Superseded by ABLIKIM 18V

NODE=M056R60;LINKAGE=A

NODE=M056R60;LINKAGE=NA

NODE=M056R60;LINKAGE=AB

NODE=M056R60;LINKAGE=B

 $\Gamma(\Sigma^- \bar{\Sigma}^+)/\Gamma_{\text{total}}$  $\Gamma_{84}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                              | EVTS | DOCUMENT ID          | TECN     | COMMENT                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|-------------------------------------------------------|
| <b>5.1 ± 0.2 ± 0.4</b>                                                                                                                                                                                                                                                                                                                | 2143 | <sup>1</sup> ABLIKIM | 20I BES3 | $\psi(2S) \rightarrow \gamma \Sigma^- \bar{\Sigma}^+$ |
| <sup>1</sup> ABLIKIM 20I reports $(5.13 \pm 0.24 \pm 0.41) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma^- \bar{\Sigma}^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . |      |                      |          |                                                       |

NODE=M056P00  
NODE=M056P00

NODE=M056P00;LINKAGE=A

 $\Gamma(\Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}}$  $\Gamma_{85}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|-----------------------------------------------------------------|
| <b>16.2 ± 5.8 ± 0.3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 27   | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda} \pi^+ \pi^-$ |
| <sup>1</sup> ABLIKIM 12I reports $(16.4 \pm 5.7 \pm 1.6) \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.68 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                                                 |

NODE=M056R80  
NODE=M056R80

NODE=M056R80;LINKAGE=AL

 $\Gamma(\Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}}$  $\Gamma_{86}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|-----------------------------------------------------------------|
| <b>23.2 ± 6.5 ± 0.5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 33   | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda} \pi^+ \pi^-$ |
| <sup>1</sup> ABLIKIM 12I reports $(23.5 \pm 6.2 \pm 2.3) \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.68 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                                                 |

NODE=M056R81  
NODE=M056R81

NODE=M056R81;LINKAGE=AL

 $\Gamma(K^- \Lambda \Xi^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{87}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                             | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------------------------|
| <b>1.94 ± 0.35 ± 0.04</b>                                                                                                                                                                                                                                                                                                                                                                                                                                            | 57   | <sup>1</sup> ABLIKIM | 15I BES3 | $\psi(2S) \rightarrow \gamma K^- \Lambda \Xi^+ + \text{c.c.}$ |
| <sup>1</sup> ABLIKIM 15I reports $[\Gamma(\chi_{c0}(1P) \rightarrow K^- \Lambda \Xi^+ + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))] = (1.90 \pm 0.30 \pm 0.16) \times 10^{-5}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                                               |

NODE=M056R92  
NODE=M056R92

NODE=M056R92;LINKAGE=A

 $\Gamma(\Xi^0 \Xi^0)/\Gamma_{\text{total}}$  $\Gamma_{88}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | EVTS       | DOCUMENT ID       | TECN    | COMMENT                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------|---------|-------------------------------------------|
| <b>3.1 ± 0.8 ± 0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 23.3 ± 4.9 | <sup>1</sup> NAIK | 08 CLEO | $\psi(2S) \rightarrow \gamma \Xi^0 \Xi^0$ |
| <sup>1</sup> NAIK 08 reports $(3.34 \pm 0.70 \pm 0.48) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \Xi^0 \Xi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |            |                   |         |                                           |

NODE=M056R61  
NODE=M056R61

NODE=M056R61;LINKAGE=NA

$\Gamma(\Xi^- \Xi^+)/\Gamma_{\text{total}}$  $\Gamma_{89}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | CL%         | EVTS | DOCUMENT ID       | TECN    | COMMENT                                   |
|-----------------------------------------|-------------|------|-------------------|---------|-------------------------------------------|
| <b><math>4.8 \pm 0.7 \pm 0.1</math></b> | 95 $\pm$ 11 |      | <sup>1</sup> NAIK | 08 CLEO | $\psi(2S) \rightarrow \gamma \Xi^+ \Xi^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

$< 10.3$  90 <sup>2</sup> ABLIKIM 06D BES2  $\psi(2S) \rightarrow \chi_{c0} \gamma$

<sup>1</sup> NAIK 08 reports  $(5.14 \pm 0.60 \pm 0.47) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c0}(1P) \rightarrow \Xi^- \Xi^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Using  $B(\psi(2S) \rightarrow \chi_{c0} \gamma) = (9.2 \pm 0.5)\%$

NODE=M056R45  
NODE=M056R45

NODE=M056R45;LINKAGE=NA

NODE=M056R45;LINKAGE=AB

 $\Gamma(\eta_c \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{90}/\Gamma$ 

| VALUE                                     | CL% | DOCUMENT ID                | TECN | COMMENT                                                     |
|-------------------------------------------|-----|----------------------------|------|-------------------------------------------------------------|
| <b><math>&lt; 7 \times 10^{-4}</math></b> | 90  | <sup>1,2</sup> ABLIKIM 13B | BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

$< 41 \times 10^{-4}$  90 <sup>1,3</sup> ABLIKIM 13B BES3  $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$

<sup>1</sup> Using  $1.06 \times 10^8$   $\psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c0} \gamma) = (9.68 \pm 0.31)\%$ .

<sup>2</sup> From the  $\eta_c \rightarrow K_S^0 K^\pm \pi^\mp$  decays.

<sup>3</sup> From the  $\eta_c \rightarrow K^+ K^- \pi^0$  decays.

OCCUR=2

NODE=M056R89;LINKAGE=A

NODE=M056R89;LINKAGE=B

NODE=M056R89;LINKAGE=C

 $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\pi\pi)/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma \times \Gamma_{32}/\Gamma$ 

| VALUE (units $10^{-7}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**$18.8 \pm 1.0$  OUR FIT**

**$15.3 \pm 2.4 \pm 0.8$**

<sup>1</sup> ANDREOTTI 03 E835  $\bar{p}p \rightarrow \chi_{c0} \rightarrow \pi^0 \pi^0$

<sup>1</sup> We have multiplied  $B(p\bar{p}) \cdot B(\pi^0 \pi^0)$  measurement by 3 to obtain  $B(p\bar{p}) \cdot B(\pi\pi)$ .

NODE=M056R21  
NODE=M056R21

NODE=M056R;LINKAGE=AD

 $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\pi^0 \eta)/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma \times \Gamma_{33}/\Gamma$ 

| VALUE (units $10^{-7}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**$< 0.4$**

ANDREOTTI 05C E835  $\bar{p}p \rightarrow \pi^0 \eta$

NODE=M056R41  
NODE=M056R41

 $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\pi^0 \eta')/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma \times \Gamma_{34}/\Gamma$ 

| VALUE (units $10^{-7}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**$< 2.5$**

ANDREOTTI 05C E835  $\bar{p}p \rightarrow \pi^0 \eta$

NODE=M056R42  
NODE=M056R42

 $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\eta\eta)/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma \times \Gamma_{36}/\Gamma$ 

| VALUE (units $10^{-7}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**$6.7 \pm 0.5$  OUR FIT**

**$4.0 \pm 1.2^{+0.5}_{-0.3}$**

ANDREOTTI 05C E835  $\bar{p}p \rightarrow \eta\eta$

NODE=M056R40  
NODE=M056R40

 $\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\eta'\eta)/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma \times \Gamma_{37}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

$2.1^{+2.3}_{-1.5}$

ANDREOTTI 05C E835  $\bar{p}p \rightarrow \pi^0 \eta$

NODE=M056R43  
NODE=M056R43

## ———— RADIATIVE DECAYS ————

 $\Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}}$  $\Gamma_{91}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**$1.40 \pm 0.05$  OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.25 \pm 0.16 \pm 2.15$  12k <sup>1</sup> ABLIKIM 17U BES3  $e^+ e^- \rightarrow \gamma X$

$2.0 \pm 0.2 \pm 0.2$  <sup>2</sup> ADAM 05A CLEO  $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$

<sup>1</sup> Not independent from  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))$  and the product  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) \times B(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S))$  also measured in ABLIKIM 17U.

<sup>2</sup> Uses  $B(\psi(2S) \rightarrow \gamma \chi_{c0} \rightarrow \gamma \gamma J/\psi)$  from ADAM 05A and  $B(\psi(2S) \rightarrow \gamma \chi_{c0})$  from ATHAR 04.

NODE=M056310

NODE=M056R8  
NODE=M056R8

NODE=M056R8;LINKAGE=A

NODE=M056R8;LINKAGE=AD

$\Gamma(\gamma\rho^0)/\Gamma_{\text{total}}$  $\Gamma_{92}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                                                                                                                                                                                                                                                                                                                                                        | CL% | EVTS          | DOCUMENT ID          | TECN     | COMMENT                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------|----------------------|----------|-------------------------------------------|
| <b>&lt; 9</b>                                                                                                                                                                                                                                                                                                                                                                                                   | 90  | $1.2 \pm 4.5$ | <sup>1</sup> BENNETT | 08A CLEO | $\psi(2S) \rightarrow \gamma\gamma\rho^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                   |     |               |                      |          |                                           |
| <10                                                                                                                                                                                                                                                                                                                                                                                                             | 90  | $6 \pm 12$    | <sup>2</sup> ABLIKIM | 11E BES3 | $\psi(2S) \rightarrow \gamma\gamma\rho^0$ |
| <sup>1</sup> BENNETT 08A reports $< 9.6 \times 10^{-6}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \gamma\rho^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .    |     |               |                      |          |                                           |
| <sup>2</sup> ABLIKIM 11E reports $< 10.5 \times 10^{-6}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \gamma\rho^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . |     |               |                      |          |                                           |

NODE=M056R56  
 NODE=M056R56

NODE=M056R56;LINKAGE=BE

NODE=M056R56;LINKAGE=AB

 $\Gamma(\gamma\omega)/\Gamma_{\text{total}}$  $\Gamma_{93}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                                                                                                                                                                                                                                                                                                                                                        | CL% | EVTS          | DOCUMENT ID          | TECN     | COMMENT                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------|----------------------|----------|-------------------------------------------|
| <b>&lt; 8</b>                                                                                                                                                                                                                                                                                                                                                                                                   | 90  | $0.0 \pm 2.8$ | <sup>1</sup> BENNETT | 08A CLEO | $\psi(2S) \rightarrow \gamma\gamma\omega$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                   |     |               |                      |          |                                           |
| <13                                                                                                                                                                                                                                                                                                                                                                                                             | 90  | $5 \pm 11$    | <sup>2</sup> ABLIKIM | 11E BES3 | $\psi(2S) \rightarrow \gamma\gamma\omega$ |
| <sup>1</sup> BENNETT 08A reports $< 8.8 \times 10^{-6}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \gamma\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .    |     |               |                      |          |                                           |
| <sup>2</sup> ABLIKIM 11E reports $< 12.9 \times 10^{-6}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \gamma\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . |     |               |                      |          |                                           |

NODE=M056R57  
 NODE=M056R57

NODE=M056R57;LINKAGE=BE

NODE=M056R57;LINKAGE=AB

 $\Gamma(\gamma\phi)/\Gamma_{\text{total}}$  $\Gamma_{94}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                                                                                                                                                                                                                                                                                                                                                      | CL% | EVTS          | DOCUMENT ID          | TECN     | COMMENT                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------|----------------------|----------|-----------------------------------------|
| <b>&lt; 6</b>                                                                                                                                                                                                                                                                                                                                                                                                 | 90  | $0.1 \pm 1.6$ | <sup>1</sup> BENNETT | 08A CLEO | $\psi(2S) \rightarrow \gamma\gamma\phi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                 |     |               |                      |          |                                         |
| <16                                                                                                                                                                                                                                                                                                                                                                                                           | 90  | $15 \pm 7$    | <sup>2</sup> ABLIKIM | 11E BES3 | $\psi(2S) \rightarrow \gamma\gamma\phi$ |
| <sup>1</sup> BENNETT 08A reports $< 6.4 \times 10^{-6}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \gamma\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ .    |     |               |                      |          |                                         |
| <sup>2</sup> ABLIKIM 11E reports $< 16.2 \times 10^{-6}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow \gamma\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.62 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = 9.79 \times 10^{-2}$ . |     |               |                      |          |                                         |

NODE=M056R58  
 NODE=M056R58

NODE=M056R58;LINKAGE=BE

NODE=M056R58;LINKAGE=AB

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  $\Gamma_{95}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                            | CL% | DOCUMENT ID        | TECN    | COMMENT                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------|---------|----------------------------------------|
| <b><math>2.04 \pm 0.09</math> OUR FIT</b>                                                                                                                                                                                                                           |     |                    |         |                                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                       |     |                    |         |                                        |
| <7                                                                                                                                                                                                                                                                  | 90  | <sup>1</sup> WICHT | 08 BELL | $B^\pm \rightarrow K^\pm \gamma\gamma$ |
| <sup>1</sup> WICHT 08 reports $[\Gamma(\chi_{c0}(1P) \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c0} K^+)] < 0.11 \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c0} K^+) = 1.51 \times 10^{-4}$ . |     |                    |         |                                        |

NODE=M056R1  
 NODE=M056R1

NODE=M056R1;LINKAGE=WI

 $\Gamma(e^+e^- J/\psi(1S))/\Gamma_{\text{total}}$  $\Gamma_{96}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | EVTS | DOCUMENT ID            | TECN     | COMMENT                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------------------|----------|----------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |      |                        |          |                                              |
| $1.54 \pm 0.33 \pm 0.03$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 56   | <sup>1,2</sup> ABLIKIM | 17I BES3 | $\psi(2S) \rightarrow \gamma e^+ e^- J/\psi$ |
| <sup>1</sup> ABLIKIM 17I reports $(1.51 \pm 0.30 \pm 0.13) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c0}(1P) \rightarrow e^+ e^- J/\psi(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.99 \pm 0.27) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                        |          |                                              |
| <sup>2</sup> Not independent from other measurements reported by ABLIKIM 17I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |                        |          |                                              |

NODE=M056R93  
 NODE=M056R93

NODE=M056R93;LINKAGE=B

NODE=M056R93;LINKAGE=C

 $\Gamma(e^+e^- J/\psi(1S))/\Gamma(\gamma J/\psi(1S))$  $\Gamma_{96}/\Gamma_{91}$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                  | EVTS | DOCUMENT ID          | TECN     | COMMENT                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|----------------------------------------------|
| <b><math>9.5 \pm 1.9 \pm 0.7</math></b>                                                                                                                                                                                   | 56   | <sup>1</sup> ABLIKIM | 17I BES3 | $\psi(2S) \rightarrow e^+ e^- \gamma J/\psi$ |
| <sup>1</sup> Uses $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) \times B(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S)) = (15.8 \pm 0.3 \pm 0.6) \times 10^{-4}$ from ABLIKIM 17N and accounts for common systematic errors. |      |                      |          |                                              |

NODE=M056R94  
 NODE=M056R94

NODE=M056R94;LINKAGE=A

$$\Gamma(\mu^+ \mu^- J/\psi(1S))/\Gamma(e^+ e^- J/\psi(1S))$$

$$\Gamma_{97}/\Gamma_{96}$$

| VALUE           | CL% | EVTs | DOCUMENT ID | TECN     | COMMENT                                                                     |
|-----------------|-----|------|-------------|----------|-----------------------------------------------------------------------------|
| <b>&lt;0.14</b> | 90  | <9.5 | ABLIKIM     | 19Z BES3 | $\psi(2S) \rightarrow \gamma \chi_c \rightarrow \gamma(\mu^+ \mu^- J/\psi)$ |

NODE=M056R97  
NODE=M056R97

$$\Gamma(\gamma\gamma)/\Gamma(\gamma J/\psi(1S))$$

$$\Gamma_{95}/\Gamma_{91}$$

| VALUE (units $10^{-2}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**1.45±0.08 OUR FIT**

**2.0 ±0.4 OUR AVERAGE**

|                                          |                             |      |                                                                          |
|------------------------------------------|-----------------------------|------|--------------------------------------------------------------------------|
| 2.2 ±0.4 <sup>+0.1</sup> <sub>-0.2</sub> | <sup>1</sup> ANDREOTTI 04   | E835 | $p\bar{p} \rightarrow \chi_{c0} \rightarrow \gamma\gamma$                |
| 1.45±0.74                                | <sup>2</sup> AMBROGIANI 00B | E835 | $p\bar{p} \rightarrow \chi_{c2} \rightarrow \gamma\gamma, \gamma J/\psi$ |

<sup>1</sup> The values of  $B(p\bar{p})B(\gamma\gamma)$  and  $B(\gamma\gamma)B(\gamma J/\psi)$  measured by ANDREOTTI 04 are not independent. The latter is used in the fit because of smaller systematics.

<sup>2</sup> Calculated by us using  $B(J/\psi(1S) \rightarrow e^+ e^-) = 0.0593 \pm 0.0010$ .

NODE=M056R18  
NODE=M056R18

NODE=M056R;LINKAGE=AN

NODE=M056R;LINKAGE=7A

$$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}}$$

$$\Gamma_{58}/\Gamma \times \Gamma_{91}/\Gamma$$

| VALUE (units $10^{-7}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**31.1±1.5 OUR FIT**

**28.2±2.1 OUR AVERAGE**

|                                           |     |                               |      |                                                           |
|-------------------------------------------|-----|-------------------------------|------|-----------------------------------------------------------|
| 28.0±1.9±1.3                              | 392 | <sup>1,2,3</sup> BAGNASCO 02  | E835 | $p\bar{p} \rightarrow \chi_{c0} \rightarrow J/\psi\gamma$ |
| 29.3 <sup>+5.7</sup> <sub>-4.7</sub> ±1.5 | 89  | <sup>1,2</sup> AMBROGIANI 99B |      | $p\bar{p} \rightarrow \chi_{c0} \rightarrow J/\psi\gamma$ |

<sup>1</sup> Values in  $(\Gamma(p\bar{p}) \times \Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}})$  and  $(\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}})$  are not independent. The latter is used in the fit since it is less correlated to the total width.

<sup>2</sup> Calculated by us using  $B(J/\psi(1S) \rightarrow e^+ e^-) = 0.0593 \pm 0.0010$ .

<sup>3</sup> Recalculated by ANDREOTTI 05A.

NODE=M056R19  
NODE=M056R19

NODE=M056R;LINKAGE=KS

NODE=M056R19;LINKAGE=7A  
NODE=M056R19;LINKAGE=AN

$$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$$

$$\Gamma_{58}/\Gamma \times \Gamma_{95}/\Gamma$$

| VALUE (units $10^{-8}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**4.52±0.27 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                             |                           |      |                                                           |
|---------------------------------------------|---------------------------|------|-----------------------------------------------------------|
| 6.52±1.18 <sup>+0.48</sup> <sub>-0.72</sub> | <sup>1</sup> ANDREOTTI 04 | E835 | $p\bar{p} \rightarrow \chi_{c0} \rightarrow \gamma\gamma$ |
|---------------------------------------------|---------------------------|------|-----------------------------------------------------------|

<sup>1</sup> The values of  $B(p\bar{p})B(\gamma\gamma)$  and  $B(\gamma\gamma)B(\gamma J/\psi)$  measured by ANDREOTTI 04 are not independent. The latter is used in the fit because of smaller systematics.

NODE=M056R25  
NODE=M056R25

NODE=M056R25;LINKAGE=AN

## $\chi_{c0}(1P)$ CROSS-PARTICLE BRANCHING RATIOS

NODE=M056230

$$\Gamma(\chi_{c0}(1P) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{58}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-6}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**21.7±0.9 OUR FIT**

**23.7±1.0 OUR AVERAGE**

|                                           |                                    |                   |          |                                                                         |
|-------------------------------------------|------------------------------------|-------------------|----------|-------------------------------------------------------------------------|
| 23.7±0.8±0.9                              | 1222                               | ABLIKIM           | 13v BES3 | $\psi(2S) \rightarrow \gamma p\bar{p}$                                  |
| 23.7±1.4±1.4                              | 383 ± 22                           | <sup>1</sup> NAIK | 08 CLEO  | $\psi(2S) \rightarrow \gamma p\bar{p}$                                  |
| 23.6 <sup>+3.7</sup> <sub>-3.4</sub> ±3.4 | 89.5 <sup>+14</sup> <sub>-13</sub> | BAI               | 04F BES  | $\psi(2S) \rightarrow \gamma \chi_{c0}(1P) \rightarrow \gamma p\bar{p}$ |

<sup>1</sup> Calculated by us. NAIK 08 reports  $B(\chi_{c0} \rightarrow p\bar{p}) = (25.7 \pm 1.5 \pm 1.5 \pm 1.3) \times 10^{-5}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}) = (9.22 \pm 0.11 \pm 0.46)\%$ .

NODE=M056B6  
NODE=M056B6

NODE=M056B6;LINKAGE=NA

$$\Gamma(\chi_{c0}(1P) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$$

$$\Gamma_{58}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-5}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**6.25±0.26 OUR FIT**

**4.6 ±1.9**

|                  |     |     |                                                                     |
|------------------|-----|-----|---------------------------------------------------------------------|
| <sup>1</sup> BAI | 98I | BES | $\psi(2S) \rightarrow \gamma \chi_{c0} \rightarrow \gamma p\bar{p}$ |
|------------------|-----|-----|---------------------------------------------------------------------|

<sup>1</sup> Calculated by us. The value for  $B(\chi_{c0} \rightarrow p\bar{p})$  reported in BAI 98I is derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}) = (9.3 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.4 \pm 2.6)\%$  [BAI 98d].

NODE=M056B1  
NODE=M056B1

NODE=M056B;LINKAGE=B1



$$\Gamma(\chi_{c0}(1P) \rightarrow \Lambda \bar{\Lambda}) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{71} / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

VALUE (units  $10^{-6}$ ) EVTS DOCUMENT ID TECN COMMENT

**32.0±2.3 OUR FIT**

**31.7±2.3 OUR AVERAGE**

32.0±1.9±2.2 369 <sup>1</sup> ABLIKIM 13H BES3  $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda}$   
 31.2±3.3±2.0 131 ± 12 <sup>2</sup> NAIK 08 CLEO  $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda}$

<sup>1</sup> Calculated by us. ABLIKIM 13H reports  $B(\chi_{c0} \rightarrow \Lambda \bar{\Lambda}) = (33.3 \pm 2.0 \pm 2.6) \times 10^{-5}$  from a measurement of  $B(\chi_{c0} \rightarrow \Lambda \bar{\Lambda}) \times B(\psi(2S) \rightarrow \gamma \chi_{c0})$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c0}) = (9.62 \pm 0.31)\%$ .

<sup>2</sup> Calculated by us. NAIK 08 reports  $B(\chi_{c0} \rightarrow \Lambda \bar{\Lambda}) = (33.8 \pm 3.6 \pm 2.2 \pm 1.7) \times 10^{-5}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}) = (9.22 \pm 0.11 \pm 0.46)\%$ .

NODE=M056B20  
 NODE=M056B20

NODE=M056B20;LINKAGE=AB

NODE=M056B20;LINKAGE=NA

$$\Gamma(\chi_{c0}(1P) \rightarrow \Lambda \bar{\Lambda}) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_{71} / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

VALUE (units  $10^{-5}$ ) EVTS DOCUMENT ID TECN COMMENT

**9.2±0.7 OUR FIT**

**13.0<sup>+3.6</sup><sub>-3.5</sub>±2.5** 15.2<sup>+4.2</sup><sub>-4.0</sub> <sup>1</sup> BAI 03E BES  $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda}$

<sup>1</sup> BAI 03E reports  $[B(\chi_{c0} \rightarrow \Lambda \bar{\Lambda}) B(\psi(2S) \rightarrow \gamma \chi_{c0}) / B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-)] \times [B^2(\Lambda \rightarrow \pi^- p) / B(J/\psi \rightarrow p \bar{p})] = (2.45^{+0.68}_{-0.65} \pm 0.46)\%$ . We calculate from this measurement the presented value using  $B(\Lambda \rightarrow \pi^- p) = (63.9 \pm 0.5)\%$  and  $B(J/\psi \rightarrow p \bar{p}) = (2.17 \pm 0.07) \times 10^{-3}$ .

NODE=M056B21  
 NODE=M056B21

NODE=M056B21;LINKAGE=BA

$$\Gamma(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S)) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{91} / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

VALUE (units  $10^{-2}$ ) EVTS DOCUMENT ID TECN COMMENT

**0.138±0.005 OUR FIT**

**0.147±0.029 OUR AVERAGE**

Error includes scale factor of 4.6.

0.158±0.003±0.006 4.8k <sup>1</sup> ABLIKIM 17N BES3  $\psi(2S) \rightarrow \gamma \gamma J/\psi$   
 0.024±0.015±0.205 12k ABLIKIM 17U BES3  $e^+ e^- \rightarrow \gamma X$   
 0.069±0.018 <sup>2</sup> OREGLIA 82 CBAL  $\psi(2S) \rightarrow \gamma \chi_{c0}$   
 0.4 ±0.3 <sup>3</sup> BRANDELIK 79B DASP  $\psi(2S) \rightarrow \gamma \chi_{c0}$   
 0.16 ±0.11 <sup>3</sup> BARTEL 78B CNTR  $\psi(2S) \rightarrow \gamma \chi_{c0}$   
 3.3 ±1.7 <sup>4</sup> BIDDICK 77 CNTR  $e^+ e^- \rightarrow \gamma X$

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.151±0.003±0.010 4.3k <sup>5</sup> ABLIKIM 120 BES3  $\psi(2S) \rightarrow \gamma \chi_{c0}$   
 0.125±0.007±0.013 560 <sup>6</sup> MENDEZ 08 CLEO  $\psi(2S) \rightarrow \gamma \chi_{c0}$   
 0.18 ±0.01 ±0.02 172 <sup>7</sup> ADAM 05A CLEO Repl. by MENDEZ 08

<sup>1</sup> Uses  $B(J/\psi \rightarrow e^+ e^-) = (5.971 \pm 0.032)\%$  and  $B(J/\psi \rightarrow \mu^+ \mu^-) = (5.961 \pm 0.033)\%$ .

<sup>2</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \ell^+ \ell^-) = 0.1181 \pm 0.0020$ .

<sup>3</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \mu^+ \mu^-) = 0.0588 \pm 0.0010$ .

<sup>4</sup> Assumes isotropic gamma distribution.

<sup>5</sup> Superseded by ABLIKIM 17N.

<sup>6</sup> Not independent from other measurements of MENDEZ 08.

<sup>7</sup> Not independent from other values reported by ADAM 05A.

NODE=M056B2  
 NODE=M056B2

NODE=M056B2;LINKAGE=A

NODE=M056B;LINKAGE=3Q  
 NODE=M056B;LINKAGE=2Q  
 NODE=M056B;LINKAGE=EA  
 NODE=M056B2;LINKAGE=B  
 NODE=M056B2;LINKAGE=ME  
 NODE=M056B2;LINKAGE=AD

$$\Gamma(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S)) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \text{ anything})$$

$$\Gamma_{91} / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma_9^{\psi(2S)}$$

$$\Gamma_{91} / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma_9^{\psi(2S)} = \Gamma_{91} / \Gamma \times \Gamma_{151}^{\psi(2S)} / (\Gamma_{11}^{\psi(2S)} + \Gamma_{12}^{\psi(2S)} + \Gamma_{13}^{\psi(2S)} + 0.343 \Gamma_{152}^{\psi(2S)} + 0.190 \Gamma_{153}^{\psi(2S)})$$

VALUE (units  $10^{-2}$ ) EVTS DOCUMENT ID TECN COMMENT

**0.224±0.009 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.201±0.011±0.021 560 <sup>1</sup> MENDEZ 08 CLEO  $\psi(2S) \rightarrow \gamma \chi_{c0}$   
 0.31 ±0.02 ±0.03 172 ADAM 05A CLEO Repl. by MENDEZ 08

<sup>1</sup> Not independent from other measurements of MENDEZ 08.

NODE=M056B7

NODE=M056B7

NODE=M056B7

NODE=M056B7;LINKAGE=ME

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \quad \frac{\Gamma_{91}}{\Gamma} \times \frac{\Gamma_{151}^{\psi(2S)}}{\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.397±0.015 OUR FIT****0.358±0.020±0.037**

560

MENDEZ

08

CLEO

 $\psi(2S) \rightarrow \gamma \chi_{c0}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.55 ±0.04 ±0.06

172

<sup>1</sup> ADAM

05A

CLEO

Repl. by MENDEZ 08

<sup>1</sup> Not independent from other values reported by ADAM 05A.NODE=M056B8  
NODE=M056B8

NODE=M056B;LINKAGE=AD

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \gamma \gamma)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))}{\Gamma_{\text{total}}} \quad \frac{\Gamma_{95}}{\Gamma} \times \frac{\Gamma_{151}^{\psi(2S)}}{\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.00±0.08 OUR FIT****1.95±0.09 OUR AVERAGE**

1.93±0.08±0.05

3.5k

ABLIKIM

17AE

BES3

 $\psi(2S) \rightarrow \gamma \chi_{c0} \rightarrow 3\gamma$ 

2.17±0.32±0.10

0.2k

ECKLUND

08A

CLEO

 $\psi(2S) \rightarrow \gamma \chi_{c0} \rightarrow 3\gamma$ 

3.7 ±1.8 ±1.0

LEE

85

CBAL

 $\psi(2S) \rightarrow \gamma \chi_{c0}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.17±0.17±0.12

0.8k

<sup>1</sup> ABLIKIM

12A

BES3

 $\psi(2S) \rightarrow \gamma \chi_{c0} \rightarrow 3\gamma$ <sup>1</sup> Superseded by ABLIKIM 17AE.NODE=M056B3  
NODE=M056B3

NODE=M056B3;LINKAGE=A

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \pi \pi)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))}{\Gamma_{\text{total}}} \quad \frac{\Gamma_{32}}{\Gamma} \times \frac{\Gamma_{151}^{\psi(2S)}}{\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**8.34±0.29 OUR FIT****8.80±0.34 OUR AVERAGE**

9.11±0.08±0.65

17k

<sup>1</sup> ABLIKIM

10A

BES3

 $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$ 

8.81±0.11±0.43

8.9k

<sup>2</sup> ASNER

09

CLEO

 $\psi(2S) \rightarrow \gamma \pi^+ \pi^-$ 

8.13±0.19±0.89

2.8k

<sup>3</sup> ASNER

09

CLEO

 $\psi(2S) \rightarrow \gamma \pi^0 \pi^0$ <sup>1</sup> Calculated by us. ABLIKIM 10A reports  $B(\chi_{c0} \rightarrow \pi^0 \pi^0) = (3.23 \pm 0.03 \pm 0.23 \pm 0.14) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}) = (9.4 \pm 0.4)\%$ . We have multiplied the  $\pi^0 \pi^0$  measurement by 3 to obtain  $\pi \pi$ .<sup>2</sup> Calculated by us. ASNER 09 reports  $B(\chi_{c0} \rightarrow \pi^+ \pi^-) = (6.37 \pm 0.08 \pm 0.31 \pm 0.32) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}) = (9.22 \pm 0.11 \pm 0.46)\%$ . We have multiplied the  $\pi^+ \pi^-$  measurement by 3/2 to obtain  $\pi \pi$ .<sup>3</sup> Calculated by us. ASNER 09 reports  $B(\chi_{c0} \rightarrow \pi^0 \pi^0) = (2.94 \pm 0.07 \pm 0.32 \pm 0.15) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}) = (9.22 \pm 0.11 \pm 0.46)\%$ . We have multiplied the  $\pi^0 \pi^0$  measurement by 3 to obtain  $\pi \pi$ .NODE=M056B22  
NODE=M056B22

OCCUR=2

NODE=M056B22;LINKAGE=AB

NODE=M056B22;LINKAGE=AS

NODE=M056B22;LINKAGE=AN

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \pi \pi)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \quad \frac{\Gamma_{32}}{\Gamma} \times \frac{\Gamma_{151}^{\psi(2S)}}{\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**24.0±0.8 OUR FIT****20.7±1.7 OUR AVERAGE**

23.9±2.7±4.1

97 ± 11

<sup>1</sup> BAI

03C

BES

 $\psi(2S) \rightarrow \gamma \chi_{c0} \rightarrow \gamma \pi^0 \pi^0$ 

20.2±1.1±1.5

720 ± 32

<sup>2</sup> BAI

98I

BES

 $\psi(2S) \rightarrow \gamma \chi_{c0} \rightarrow \gamma \pi^+ \pi^-$ <sup>1</sup> We have multiplied  $\pi^0 \pi^0$  measurement by 3 to obtain  $\pi \pi$ .<sup>2</sup> Calculated by us. The value for  $B(\chi_{c0} \rightarrow \pi^+ \pi^-)$  reported in BAI 98I is derived using  $B(\psi' \rightarrow \gamma \chi_{c0}) = (9.3 \pm 0.8)\%$  and  $B(\psi' \rightarrow J/\psi \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D]. We have multiplied  $\pi^+ \pi^-$  measurement by 3/2 to obtain  $\pi \pi$ .NODE=M056B5  
NODE=M056B5

NODE=M056B;LINKAGE=D1

NODE=M056B;LINKAGE=D2

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \eta \eta)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))}{\Gamma_{\text{total}}} \quad \frac{\Gamma_{36}}{\Gamma} \times \frac{\Gamma_{151}^{\psi(2S)}}{\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.95±0.18 OUR FIT****3.12±0.19 OUR AVERAGE**

3.23±0.09±0.23

2132

<sup>1</sup> ABLIKIM

10A

BES3

 $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c0}$ 

2.93±0.12±0.29

0.9k

<sup>2</sup> ASNER

09

CLEO

 $\psi(2S) \rightarrow \gamma \eta \eta$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.86±0.46±0.37

48

<sup>3</sup> ADAMS

07

CLEO

 $\psi(2S) \rightarrow \gamma \chi_{c0}$ NODE=M056B11  
NODE=M056B11

- <sup>1</sup> Calculated by us. ABLIKIM 10A reports  $B(\chi_{c0} \rightarrow \eta\eta) = (3.44 \pm 0.10 \pm 0.24 \pm 0.13) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}) = (9.4 \pm 0.4)\%$ .
- <sup>2</sup> Calculated by us. ASNER 09 reports  $B(\chi_{c0} \rightarrow \eta\eta) = (3.18 \pm 0.13 \pm 0.31 \pm 0.16) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}) = (9.22 \pm 0.11 \pm 0.46)\%$ .
- <sup>3</sup> Superseded by ASNER 09. Calculated by us. The value of  $B(\chi_{c0}(1P) \rightarrow \eta\eta)$  reported by ADAMS 07 was derived using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.22 \pm 0.11 \pm 0.46)\%$  (ATHAR 04).

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \eta\eta)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)} \times \frac{\Gamma_{36}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{42}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-3}$ )     | DOCUMENT ID | TECN    | COMMENT                               |
|------------------------------|-------------|---------|---------------------------------------|
| <b>0.85 ± 0.05 OUR FIT</b>   |             |         |                                       |
| <b>0.578 ± 0.241 ± 0.158</b> | BAI         | 03C BES | $\psi(2S) \rightarrow \gamma\eta\eta$ |

NODE=M056B11;LINKAGE=AB  
NODE=M056B10  
NODE=M056B10

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow K^+K^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{42}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{42}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-4}$ )   | EVTS | DOCUMENT ID        | TECN    | COMMENT                              |
|----------------------------|------|--------------------|---------|--------------------------------------|
| <b>5.92 ± 0.28 OUR FIT</b> |      |                    |         |                                      |
| <b>5.97 ± 0.07 ± 0.32</b>  | 8.1k | <sup>1</sup> ASNER | 09 CLEO | $\psi(2S) \rightarrow \gamma K^+K^-$ |

- <sup>1</sup> Calculated by us. ASNER 09 reports  $B(\chi_{c0} \rightarrow K^+K^-) = (6.47 \pm 0.08 \pm 0.35 \pm 0.32) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}) = (9.22 \pm 0.11 \pm 0.46)\%$ .

NODE=M056B23  
NODE=M056B23

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow K^+K^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)} \times \frac{\Gamma_{42}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{42}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-3}$ )   | EVTS     | DOCUMENT ID      | TECN    | COMMENT                              |
|----------------------------|----------|------------------|---------|--------------------------------------|
| <b>1.71 ± 0.08 OUR FIT</b> |          |                  |         |                                      |
| <b>1.63 ± 0.10 ± 0.15</b>  | 774 ± 38 | <sup>1</sup> BAI | 98I BES | $\psi(2S) \rightarrow \gamma K^+K^-$ |

- <sup>1</sup> Calculated by us. The value for  $B(\chi_{c0} \rightarrow K^+K^-)$  reported by BAI 98I is derived using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}) = (9.3 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi\pi^+\pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D].

NODE=M056B9  
NODE=M056B9

NODE=M056B9;LINKAGE=BA

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow K_S^0 K_S^0)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{43}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{43}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-4}$ )       | EVTS | DOCUMENT ID        | TECN     | COMMENT                                   |
|--------------------------------|------|--------------------|----------|-------------------------------------------|
| <b>3.10 ± 0.16 OUR FIT</b>     |      |                    |          |                                           |
| <b>3.18 ± 0.17 OUR AVERAGE</b> |      |                    |          |                                           |
| 3.22 ± 0.07 ± 0.17             | 2.1k | <sup>1</sup> ASNER | 09 CLEO  | $\psi(2S) \rightarrow \gamma K_S^0 K_S^0$ |
| 3.02 ± 0.19 ± 0.33             | 322  | ABLIKIM            | 050 BES2 | $\psi(2S) \rightarrow \gamma K_S^0 K_S^0$ |

- <sup>1</sup> Calculated by us. ASNER 09 reports  $B(\chi_{c0} \rightarrow K_S^0 K_S^0) = (3.49 \pm 0.08 \pm 0.18 \pm 0.17) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}) = (9.22 \pm 0.11 \pm 0.46)\%$ .

NODE=M056B12  
NODE=M056B12

NODE=M056B12;LINKAGE=AS

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow K_S^0 K_S^0)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)} \times \frac{\Gamma_{43}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{43}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-4}$ ) | DOCUMENT ID      | TECN    | COMMENT                                   |
|--------------------------|------------------|---------|-------------------------------------------|
| <b>8.9 ± 0.5 OUR FIT</b> |                  |         |                                           |
| <b>5.6 ± 0.8 ± 1.3</b>   | <sup>1</sup> BAI | 99B BES | $\psi(2S) \rightarrow \gamma K_S^0 K_S^0$ |

- <sup>1</sup> Calculated by us. The value of  $B(\chi_{c0} \rightarrow K_S^0 K_S^0)$  reported by BAI 99B was derived using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.3 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi\pi^+\pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D].

NODE=M056B13  
NODE=M056B13

NODE=M056B13;LINKAGE=BA

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow 2(\pi^+\pi^-))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)} \times \frac{\Gamma_{11}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{11}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

| VALUE (units $10^{-3}$ )     | DOCUMENT ID            | TECN    | COMMENT                                |
|------------------------------|------------------------|---------|----------------------------------------|
| <b>6.6 ± 0.5 OUR FIT</b>     |                        |         |                                        |
| <b>6.9 ± 2.4 OUR AVERAGE</b> |                        |         | Error includes scale factor of 3.8.    |
| 4.4 ± 0.1 ± 0.9              | <sup>1</sup> BAI       | 99B BES | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |
| 9.3 ± 0.9                    | <sup>2</sup> TANENBAUM | 78 MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c0}$ |

- <sup>1</sup> Calculated by us. The value for  $B(\chi_{c0} \rightarrow 2\pi^+2\pi^-)$  reported in BAI 99B is derived using  $B(\psi(2S) \rightarrow \gamma\chi_{c0}) = (9.3 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D].
- <sup>2</sup> The value  $B(\psi(1S) \rightarrow \gamma\chi_{c0}) \times B(\chi_{c0} \rightarrow 2\pi^+2\pi^-)$  reported in TANENBAUM 78 is derived using  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) \times B(J/\psi(1S) \rightarrow \ell^+\ell^-) = (4.6 \pm 0.7)\%$ . Calculated by us using  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = 0.1181 \pm 0.0020$ .

NODE=M056B4  
NODE=M056B4

NODE=M056B;LINKAGE=B2

NODE=M056B;LINKAGE=J1

$$\Gamma(\chi_{c0}(1P) \rightarrow \pi^+ \pi^- K^+ K^-) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_8 / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

VALUE (units 10<sup>-3</sup>)

DOCUMENT ID

TECN

COMMENT

**1.78±0.14 OUR FIT****1.64±0.05±0.2**

ABLIKIM

05Q

BES2

 $\psi(2S) \rightarrow \gamma \chi_{c0}$ NODE=M056B18  
NODE=M056B18

$$\Gamma(\chi_{c0}(1P) \rightarrow \pi^+ \pi^- K^+ K^-) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_8 / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

VALUE (units 10<sup>-3</sup>)

DOCUMENT ID

TECN

COMMENT

**5.1 ±0.4 OUR FIT****5.8 ±1.6 OUR AVERAGE** Error includes scale factor of 2.3.

4.22±0.20±0.97

BAI

99B

BES

 $\psi(2S) \rightarrow \gamma \chi_{c0}$ 

7.4 ±1.0

<sup>1</sup> TANENBAUM

78

MRK1

 $\psi(2S) \rightarrow \gamma \chi_{c0}$ NODE=M056B19  
NODE=M056B19

<sup>1</sup> The reported value is derived using  $B(\psi(2S) \rightarrow \pi^+ \pi^- J/\psi) \times B(J/\psi \rightarrow \ell^+ \ell^-) = (4.6 \pm 0.7)\%$ . Calculated by us using  $B(J/\psi \rightarrow \ell^+ \ell^-) = 0.1181 \pm 0.0020$ .

NODE=M056B19;LINKAGE=TA

$$\Gamma(\chi_{c0}(1P) \rightarrow K^+ K^- K^+ K^-) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{51} / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

VALUE (units 10<sup>-4</sup>)

EVTS

DOCUMENT ID

TECN

COMMENT

**2.76±0.28 OUR FIT****3.20±0.11±0.41**

278

<sup>1</sup> ABLIKIM

06T

BES2

 $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ NODE=M056B14  
NODE=M056B14

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c0} \rightarrow 2K^+ 2K^-)$  reported by ABLIKIM 06T was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.2 \pm 0.4)\%$ .

NODE=M056B14;LINKAGE=AB

$$\Gamma(\chi_{c0}(1P) \rightarrow K^+ K^- K^+ K^-) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_{51} / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

VALUE (units 10<sup>-4</sup>)

DOCUMENT ID

TECN

COMMENT

**8.0±0.8 OUR FIT****6.1±0.8±0.9**<sup>1</sup> BAI

99B

BES

 $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ NODE=M056B15  
NODE=M056B15

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c0} \rightarrow 2K^+ 2K^-)$  reported by BAI 99B was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.3 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98d].

NODE=M056B15;LINKAGE=BA

$$\Gamma(\chi_{c0}(1P) \rightarrow \phi \phi) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{56} / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

VALUE (units 10<sup>-4</sup>)

EVTS

DOCUMENT ID

TECN

COMMENT

**0.78±0.07 OUR FIT****0.78±0.08 OUR AVERAGE**

0.77±0.03±0.08

612

<sup>1</sup> ABLIKIM

11K

BES3

 $\psi(2S) \rightarrow \gamma \text{ hadrons}$ 

0.86±0.19±0.12

26

<sup>2</sup> ABLIKIM

06T

BES2

 $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ NODE=M056B16  
NODE=M056B16

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c0} \rightarrow \phi \phi)$  reported by ABLIKIM 11K was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.62 \pm 0.31)\%$ .

NODE=M056B16;LINKAGE=AL

<sup>2</sup> Calculated by us. The value of  $B(\chi_{c0} \rightarrow \phi \phi)$  reported by ABLIKIM 06T was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.2 \pm 0.4)\%$ .

NODE=M056B16;LINKAGE=AB

$$\Gamma(\chi_{c0}(1P) \rightarrow \phi \phi) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_{56} / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

VALUE (units 10<sup>-4</sup>)

DOCUMENT ID

TECN

COMMENT

**2.25±0.21 OUR FIT****2.6 ±1.0 ±1.1**<sup>1</sup> BAI

99B

BES

 $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ NODE=M056B17  
NODE=M056B17

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c0} \rightarrow \phi \phi)$  reported by BAI 99B was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) = (9.3 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98d].

NODE=M056B17;LINKAGE=BA

$$\Gamma(\chi_{c0}(1P) \rightarrow \Sigma^+ \bar{p} K_S^0 + \text{c.c.}) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{81} / \Gamma \times \Gamma_{151}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

VALUE (units 10<sup>-5</sup>)

EVTS

DOCUMENT ID

TECN

COMMENT

**3.45±0.17±0.19**

493

<sup>1</sup> ABLIKIM

19BB

BES3

 $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{p} K_S^0 + \text{c.c.}$ NODE=M056B24  
NODE=M056B24

<sup>1</sup> Calculated by us. ABLIKIM 19BB reports  $B(\chi_c^0 \rightarrow \Sigma^+ \bar{p} K_S^0 + \text{c.c.}) = (3.52 \pm 0.19 \pm 0.21) \times 10^{-4}$  using  $B(\psi(2S) \rightarrow \gamma \chi_c^0) = (9.79 \pm 0.20)\%$  and other branching fractions from PDG 18.

NODE=M056B24;LINKAGE=A

$$\frac{\Gamma(\chi_{c0}(1P) \rightarrow \Sigma^0 \bar{p} K^+ + \text{c.c.})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c0}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{82}/\Gamma \times \Gamma_{151}^{\psi(2S)}/\Gamma_{\psi(2S)}}$$

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID          | TECN      | COMMENT                                                          |
|--------------------------|------|----------------------|-----------|------------------------------------------------------------------|
| <b>2.97±0.12±0.14</b>    | 871  | <sup>1</sup> ABLIKIM | 20AE BES3 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{p} K^+ + \text{c.c.}$ |

<sup>1</sup> Calculated by us. ABLIKIM 20AE reports  $B(\chi_c^0 \rightarrow \Sigma^0 \bar{p} K^+ + \text{c.c.}) = (3.03 \pm 0.12 \pm 0.15) \times 10^{-4}$  using  $B(\psi(2S) \rightarrow \gamma \chi_c^0) = (9.79 \pm 0.20)\%$  and other branching fractions from PDG 20.

NODE=M056P01  
NODE=M056P01

NODE=M056P01;LINKAGE=A

## $\chi_{c0}(1P)$ REFERENCES

NODE=M056

|               |      |                  |                                  |                        |             |
|---------------|------|------------------|----------------------------------|------------------------|-------------|
| ABLIKIM       | 20AE | PR D102 092006   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=60733 |
| ABLIKIM       | 20B  | PR D101 012012   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=60212 |
| ABLIKIM       | 20I  | PR D101 092002   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=60303 |
| PDG           | 20   | PTEP 2020 083C01 | P.A. Zyla <i>et al.</i>          | (PDG Collab.)          | REFID=60676 |
| ABLIKIM       | 19AA | PR D99 052008    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=59844 |
| ABLIKIM       | 19AU | PR D100 052010   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=59996 |
| ABLIKIM       | 19BB | PR D100 092006   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=60026 |
| ABLIKIM       | 19J  | PR D99 012015    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=59606 |
| ABLIKIM       | 19Z  | PR D99 051101    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=59837 |
| ABLIKIM       | 18V  | PR D97 052011    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=58990 |
| PDG           | 18   | PR D98 030001    | M. Tanabashi <i>et al.</i>       | (PDG Collab.)          | REFID=59304 |
| AAJ           | 17BB | EPJ C77 609      | R. Aaij <i>et al.</i>            | (LHCb Collab.)         | REFID=58191 |
| ABLIKIM       | 17AE | PR D96 092007    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=58310 |
| ABLIKIM       | 17AI | PR D96 112006    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=58321 |
| ABLIKIM       | 17I  | PRL 118 221802   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=57931 |
| ABLIKIM       | 17N  | PR D95 072004    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=57978 |
| ABLIKIM       | 17U  | PR D96 032001    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=58026 |
| PDG           | 16   | CP C40 100001    | C. Patrignani <i>et al.</i>      | (PDG Collab.)          | REFID=57140 |
| ABLIKIM       | 15I  | PR D91 092006    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=56774 |
| ABLIKIM       | 15M  | PR D91 112008    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=56778 |
| ABLIKIM       | 15N  | PR D91 112018    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=56779 |
| ABLIKIM       | 13B  | PR D87 012002    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=54877 |
| ABLIKIM       | 13D  | PR D87 012007    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=54879 |
| ABLIKIM       | 13H  | PR D87 032007    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=54953 |
| ABLIKIM       | 13V  | PR D88 112001    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=55583 |
| UEHARA        | 13   | PTEP 2013 123C01 | S. Uehara <i>et al.</i>          | (BELLE Collab.)        | REFID=55592 |
| ABLIKIM       | 12A  | PR D85 112008    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=54266 |
| ABLIKIM       | 12I  | PR D86 052004    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=54736 |
| ABLIKIM       | 12J  | PR D86 052011    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=54737 |
| ABLIKIM       | 12O  | PRL 109 172002   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=54742 |
| LIU           | 12B  | PRL 108 232001   | Z.Q. Liu <i>et al.</i>           | (BELLE Collab.)        | REFID=54303 |
| ABLIKIM       | 11A  | PR D83 012006    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=53647 |
| ABLIKIM       | 11E  | PR D83 112005    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=16717 |
| ABLIKIM       | 11F  | PR D83 112009    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=16719 |
| ABLIKIM       | 11K  | PRL 107 092001   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=53940 |
| DEL-AMO-SA... | 11M  | PR D84 012004    | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)        | REFID=16751 |
| ABLIKIM       | 10A  | PR D81 052005    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)       | REFID=53347 |
| ONYISI        | 10   | PR D82 011103    | P.U.E. Onyisi <i>et al.</i>      | (CLEO Collab.)         | REFID=53360 |
| UEHARA        | 10A  | PR D82 114031    | S. Uehara <i>et al.</i>          | (BELLE Collab.)        | REFID=53641 |
| ASNER         | 09   | PR D79 072007    | D.M. Asner <i>et al.</i>         | (CLEO Collab.)         | REFID=52721 |
| UEHARA        | 09   | PR D79 052009    | S. Uehara <i>et al.</i>          | (BELLE Collab.)        | REFID=52761 |
| BENNETT       | 08A  | PRL 101 151801   | J.V. Bennett <i>et al.</i>       | (CLEO Collab.)         | REFID=52575 |
| ECKLUND       | 08A  | PR D78 091501    | K.M. Ecklund <i>et al.</i>       | (CLEO Collab.)         | REFID=52583 |
| HE            | 08B  | PR D78 092004    | Q. He <i>et al.</i>              | (CLEO Collab.)         | REFID=52588 |
| MENDEZ        | 08   | PR D78 011102    | H. Mendez <i>et al.</i>          | (CLEO Collab.)         | REFID=52684 |
| NAIK          | 08   | PR D78 031101    | P. Naik <i>et al.</i>            | (CLEO Collab.)         | REFID=52301 |
| UEHARA        | 08   | EPJ C53 1        | S. Uehara <i>et al.</i>          | (BELLE Collab.)        | REFID=52064 |
| WICHT         | 08   | PL B662 323      | J. Wicht <i>et al.</i>           | (BELLE Collab.)        | REFID=52204 |
| ABE           | 07   | PRL 98 082001    | K. Abe <i>et al.</i>             | (BELLE Collab.)        | REFID=51627 |
| ADAMS         | 07   | PR D75 071101    | G.S. Adams <i>et al.</i>         | (CLEO Collab.)         | REFID=51651 |
| ATHAR         | 07   | PR D75 032002    | S.B. Athar <i>et al.</i>         | (CLEO Collab.)         | REFID=51618 |
| CHEN          | 07B  | PL B651 15       | W.T. Chen <i>et al.</i>          | (BELLE Collab.)        | REFID=51710 |
| ABLIKIM       | 06D  | PR D73 052006    | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=51049 |
| ABLIKIM       | 06I  | PR D74 012004    | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=51126 |
| ABLIKIM       | 06R  | PR D74 072001    | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=51447 |
| ABLIKIM       | 06T  | PL B642 197      | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=51453 |
| ABLIKIM       | 05G  | PR D71 092002    | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=50756 |
| ABLIKIM       | 05N  | PL B630 7        | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=50847 |
| ABLIKIM       | 05O  | PL B630 21       | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=50846 |
| ABLIKIM       | 05Q  | PR D72 092002    | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=50958 |
| ADAM          | 05A  | PRL 94 232002    | N.E. Adam <i>et al.</i>          | (CLEO Collab.)         | REFID=50763 |
| ANDREOTTI     | 05A  | NP B717 34       | M. Andreotti <i>et al.</i>       | (FNAL E835 Collab.)    | REFID=50769 |
| ANDREOTTI     | 05C  | PR D72 112002    | M. Andreotti <i>et al.</i>       | (FNAL E835 Collab.)    | REFID=50991 |
| NAKAZAWA      | 05   | PL B615 39       | H. Nakazawa <i>et al.</i>        | (BELLE Collab.)        | REFID=50807 |
| ABE           | 04G  | PR D70 071102    | K. Abe <i>et al.</i>             | (BELLE Collab.)        | REFID=50182 |
| ABLIKIM       | 04G  | PR D70 092002    | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=50187 |
| ABLIKIM       | 04H  | PR D70 092003    | M. Ablikim <i>et al.</i>         | (BES Collab.)          | REFID=50188 |
| ANDREOTTI     | 04   | PL B584 16       | M. Andreotti <i>et al.</i>       | (E835 Collab.)         | REFID=49744 |
| ATHAR         | 04   | PR D70 112002    | S.B. Athar <i>et al.</i>         | (CLEO Collab.)         | REFID=50331 |
| BAI           | 04F  | PR D69 092001    | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49752 |
| ANDREOTTI     | 03   | PRL 91 091801    | M. Andreotti <i>et al.</i>       | (FNAL E835 Collab.)    | REFID=49578 |
| AULCHENKO     | 03C  | PL B573 63       | V.M. Aulchenko <i>et al.</i>     | (KEDR Collab.)         | REFID=49579 |
| BAI           | 03C  | PR D67 032004    | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49190 |
| BAI           | 03E  | PR D67 112001    | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=49416 |
| ABE,K         | 02   | PRL 89 142001    | K. Abe <i>et al.</i>             | (BELLE Collab.)        | REFID=49188 |
| BAGNASCO      | 02   | PL B533 237      | S. Bagnasco <i>et al.</i>        | (FNAL E835 Collab.)    | REFID=48833 |
| EISENSTEIN    | 01   | PRL 87 061801    | B.I. Eisenstein <i>et al.</i>    | (CLEO Collab.)         | REFID=48344 |
| AMBROGIANI    | 00B  | PR D62 052002    | M. Ambrogiani <i>et al.</i>      | (FNAL E835 Collab.)    | REFID=47940 |
| AMBROGIANI    | 99B  | PRL 83 2902      | M. Ambrogiani <i>et al.</i>      | (FNAL E835 Collab.)    | REFID=47389 |
| BAI           | 99B  | PR D60 072001    | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=47385 |
| BAI           | 98D  | PR D58 092006    | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=46338 |
| BAI           | 98I  | PRL 81 3091      | J.Z. Bai <i>et al.</i>           | (BES Collab.)          | REFID=46343 |
| GAISER        | 86   | PR D34 711       | J. Gaiser <i>et al.</i>          | (Crystal Ball Collab.) | REFID=22012 |
| LEE           | 85   | SLAC 282         | R.A. Lee                         | (SLAC)                 | REFID=40589 |
| OREGLIA       | 82   | PR D25 2259      | M.J. Oreglia <i>et al.</i>       | (SLAC, CIT, HARV+)     | REFID=22120 |
| BRANDELIK     | 79B  | NP B160 426      | R. Brandelik <i>et al.</i>       | (DASP Collab.)         | REFID=22115 |
| BARTEL        | 78B  | PL 79B 492       | W. Bartel <i>et al.</i>          | (DESY, HEIDP)          | REFID=22111 |
| TANENBAUM     | 78   | PR D17 1731      | W.M. Tanenbaum <i>et al.</i>     | (SLAC, LBL)            | REFID=22112 |
| Also          |      | Private Comm.    | G. Trilling                      | (LBL, UCB)             | REFID=22113 |
| BIDDICK       | 77   | PRL 38 1324      | C.J. Biddick <i>et al.</i>       | (UCSD, UMD, PAVI+)     | REFID=22059 |

$\chi_{c1}(1P)$ 

$$I^G(J^{PC}) = 0^+(1^{++})$$

See the Review on " $\psi(2S)$  and  $\chi_c$  branching ratios" before the  $\chi_{c0}(1P)$  Listings.

NODE=M055

NODE=M055

NODE=M055M

NODE=M055M

 **$\chi_{c1}(1P)$  MASS**

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                         | TECN      | COMMENT                                                 |
|-------------------------------------------------------------------------------|------|-------------------------------------|-----------|---------------------------------------------------------|
| <b>3510.67 ± 0.05 OUR AVERAGE</b>                                             |      | Error includes scale factor of 1.2. |           |                                                         |
| 3508.4 ± 1.9 ± 0.7                                                            | 460  | <sup>1</sup> AAIJ                   | 17BB LHCB | $p\bar{p} \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$ |
| 3510.71 ± 0.04 ± 0.09                                                         | 4.8k | <sup>2</sup> AAIJ                   | 17BI LHCB | $\chi_{c1} \rightarrow J/\psi \mu^+ \mu^-$              |
| 3510.30 ± 0.14 ± 0.16                                                         |      | ABLIKIM                             | 05G BES2  | $\psi(2S) \rightarrow \gamma \chi_{c1}$                 |
| 3510.719 ± 0.051 ± 0.019                                                      |      | ANDREOTTI                           | 05A E835  | $p\bar{p} \rightarrow e^+ e^- \gamma$                   |
| 3509.4 ± 0.9                                                                  |      | BAI                                 | 99B BES   | $\psi(2S) \rightarrow \gamma X$                         |
| 3510.60 ± 0.087 ± 0.019                                                       | 513  | <sup>3</sup> ARMSTRONG              | 92 E760   | $\bar{p}p \rightarrow e^+ e^- \gamma$                   |
| 3511.3 ± 0.4 ± 0.4                                                            | 30   | BAGLIN                              | 86B SPEC  | $\bar{p}p \rightarrow e^+ e^- X$                        |
| 3512.3 ± 0.3 ± 4.0                                                            |      | <sup>4</sup> GAISER                 | 86 CBAL   | $\psi(2S) \rightarrow \gamma X$                         |
| 3507.4 ± 1.7                                                                  | 91   | <sup>5</sup> LEMOIGNE               | 82 GOLI   | $185 \pi^- \text{Be} \rightarrow \gamma \mu^+ \mu^- A$  |
| 3510.4 ± 0.6                                                                  |      | OREGLIA                             | 82 CBAL   | $e^+ e^- \rightarrow J/\psi 2\gamma$                    |
| 3510.1 ± 1.1                                                                  | 254  | <sup>6</sup> HIMEL                  | 80 MRK2   | $e^+ e^- \rightarrow J/\psi 2\gamma$                    |
| 3509 ± 11                                                                     | 21   | BRANDELIK                           | 79B DASP  | $e^+ e^- \rightarrow J/\psi 2\gamma$                    |
| 3507 ± 3                                                                      |      | <sup>6</sup> BARTEL                 | 78B CNTR  | $e^+ e^- \rightarrow J/\psi 2\gamma$                    |
| 3505.0 ± 4 ± 4                                                                |      | <sup>6,7</sup> TANENBAUM            | 78 MRK1   | $e^+ e^-$                                               |
| 3513 ± 7                                                                      | 367  | <sup>6</sup> BIDDICK                | 77 CNTR   | $\psi(2S) \rightarrow \gamma X$                         |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                                     |           |                                                         |
| 3500 ± 10                                                                     | 40   | TANENBAUM                           | 75 MRK1   | Hadrons $\gamma$                                        |

OCCUR=2

<sup>1</sup> From a fit of the  $\phi\phi$  invariant mass with the width of  $\chi_{c1}(1P)$  fixed to the PDG 16 value.

<sup>2</sup> AAIJ 17BI reports also  $m(\chi_{c2}) - m(\chi_{c1}) = 45.39 \pm 0.07 \pm 0.03$  MeV.

<sup>3</sup> Recalculated by ANDREOTTI 05A, using the value of  $\psi(2S)$  mass from AULCHENKO 03.

<sup>4</sup> Using mass of  $\psi(2S) = 3686.0$  MeV.

<sup>5</sup>  $J/\psi(1S)$  mass constrained to 3097 MeV.

<sup>6</sup> Mass value shifted by us by amount appropriate for  $\psi(2S)$  mass = 3686 MeV and  $J/\psi(1S)$  mass = 3097 MeV.

<sup>7</sup> From a simultaneous fit to radiative and hadronic decay channels.

NODE=M055M;LINKAGE=A

NODE=M055M;LINKAGE=B  
 NODE=M055M;LINKAGE=NW  
 NODE=M055M;LINKAGE=C  
 NODE=M055M;LINKAGE=P  
 NODE=M055M;LINKAGE=D

NODE=M055M;LINKAGE=M

 **$\chi_{c1}(1P)$  WIDTH**

| VALUE (MeV)                                                                   | CL% | EVTS | DOCUMENT ID            | TECN     | COMMENT                                 |
|-------------------------------------------------------------------------------|-----|------|------------------------|----------|-----------------------------------------|
| <b>0.84 ± 0.04 OUR FIT</b>                                                    |     |      |                        |          |                                         |
| <b>0.88 ± 0.05 OUR AVERAGE</b>                                                |     |      |                        |          |                                         |
| 1.39 <sup>+0.40</sup> <sub>-0.38</sub> <sup>+0.26</sup> <sub>-0.77</sub>      |     |      | ABLIKIM                | 05G BES2 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |
| 0.876 ± 0.045 ± 0.026                                                         |     |      | ANDREOTTI              | 05A E835 | $p\bar{p} \rightarrow e^+ e^- \gamma$   |
| 0.87 ± 0.11 ± 0.08                                                            |     | 513  | <sup>1</sup> ARMSTRONG | 92 E760  | $\bar{p}p \rightarrow e^+ e^- \gamma$   |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |     |      |                        |          |                                         |
| <1.3                                                                          | 95  |      | BAGLIN                 | 86B SPEC | $\bar{p}p \rightarrow e^+ e^- X$        |
| <3.8                                                                          | 90  |      | GAISER                 | 86 CBAL  | $\psi(2S) \rightarrow \gamma X$         |

<sup>1</sup> Recalculated by ANDREOTTI 05A.

NODE=M055W

NODE=M055W

NODE=M055W;LINKAGE=AN

 **$\chi_{c1}(1P)$  DECAY MODES**

| Mode | Fraction ( $\Gamma_i/\Gamma$ ) | Scale factor/<br>Confidence level |
|------|--------------------------------|-----------------------------------|
|------|--------------------------------|-----------------------------------|

NODE=M055215;NODE=M055

## Hadronic decays

|                 |                                                                                |                                          |                   |           |
|-----------------|--------------------------------------------------------------------------------|------------------------------------------|-------------------|-----------|
|                 |                                                                                |                                          | NODE=M055;CLUMP=A |           |
| Г <sub>1</sub>  | $3(\pi^+\pi^-)$                                                                | $(5.8 \pm 1.4) \times 10^{-3}$           | S=1.2             | DESIG=6   |
| Г <sub>2</sub>  | $2(\pi^+\pi^-)$                                                                | $(7.6 \pm 2.6) \times 10^{-3}$           |                   | DESIG=5   |
| Г <sub>3</sub>  | $\pi^+\pi^-\pi^0\pi^0$                                                         | $(1.19 \pm 0.15) \%$                     |                   | DESIG=51  |
| Г <sub>4</sub>  | $\rho^+\pi^-\pi^0 + \text{c.c.}$                                               | $(1.45 \pm 0.24) \%$                     |                   | DESIG=52  |
| Г <sub>5</sub>  | $\rho^0\pi^+\pi^-$                                                             | $(3.9 \pm 3.5) \times 10^{-3}$           |                   | DESIG=9   |
| Г <sub>6</sub>  | $4\pi^0$                                                                       | $(5.4 \pm 0.8) \times 10^{-4}$           |                   | DESIG=60  |
| Г <sub>7</sub>  | $\pi^+\pi^-K^+K^-$                                                             | $(4.5 \pm 1.0) \times 10^{-3}$           |                   | DESIG=7   |
| Г <sub>8</sub>  | $K^+K^-\pi^0\pi^0$                                                             | $(1.12 \pm 0.27) \times 10^{-3}$         |                   | DESIG=53  |
| Г <sub>9</sub>  | $K^+K^-\pi^+\pi^-\pi^0$                                                        | $(1.15 \pm 0.13) \%$                     |                   | DESIG=79  |
| Г <sub>10</sub> | $K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$                                              | $(7.5 \pm 0.8) \times 10^{-3}$           |                   | DESIG=84  |
| Г <sub>11</sub> | $K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$                                         | $(8.6 \pm 1.4) \times 10^{-3}$           |                   | DESIG=55  |
| Г <sub>12</sub> | $\rho^-K^+\bar{K}^0 + \text{c.c.}$                                             | $(5.0 \pm 1.2) \times 10^{-3}$           |                   | DESIG=56  |
| Г <sub>13</sub> | $K^*(892)^0\bar{K}^0\pi^0 \rightarrow K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.}$    | $(2.3 \pm 0.6) \times 10^{-3}$           |                   | DESIG=57  |
| Г <sub>14</sub> | $K^+K^-\eta\pi^0$                                                              | $(1.12 \pm 0.34) \times 10^{-3}$         |                   | DESIG=58  |
| Г <sub>15</sub> | $\pi^+\pi^-K_S^0K_S^0$                                                         | $(6.9 \pm 2.9) \times 10^{-4}$           |                   | DESIG=28  |
| Г <sub>16</sub> | $K^+K^-\eta$                                                                   | $(3.2 \pm 1.0) \times 10^{-4}$           |                   | DESIG=42  |
| Г <sub>17</sub> | $\bar{K}^0K^+\pi^- + \text{c.c.}$                                              | $(7.0 \pm 0.6) \times 10^{-3}$           |                   | DESIG=17  |
| Г <sub>18</sub> | $K^*(892)^0\bar{K}^0 + \text{c.c.}$                                            | $(10 \pm 4) \times 10^{-4}$              |                   | DESIG=32  |
| Г <sub>19</sub> | $K^*(892)^+K^- + \text{c.c.}$                                                  | $(1.4 \pm 0.6) \times 10^{-3}$           |                   | DESIG=33  |
| Г <sub>20</sub> | $K_J^*(1430)^0\bar{K}^0 + \text{c.c.} \rightarrow K_S^0K^+\pi^- + \text{c.c.}$ | $< 8 \times 10^{-4}$                     | CL=90%            | DESIG=34  |
| Г <sub>21</sub> | $K_J^*(1430)^+K^- + \text{c.c.} \rightarrow K_S^0K^+\pi^- + \text{c.c.}$       | $< 2.1 \times 10^{-3}$                   | CL=90%            | DESIG=35  |
| Г <sub>22</sub> | $K^+K^-\pi^0$                                                                  | $(1.81 \pm 0.24) \times 10^{-3}$         |                   | DESIG=38  |
| Г <sub>23</sub> | $\eta\pi^+\pi^-$                                                               | $(4.62 \pm 0.23) \times 10^{-3}$         |                   | DESIG=31  |
| Г <sub>24</sub> | $a_0(980)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                     | $(3.2 \pm 0.4) \times 10^{-3}$           | S=2.2             | DESIG=36  |
| Г <sub>25</sub> | $a_2(1320)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                    | $(1.76 \pm 0.24) \times 10^{-4}$         |                   | DESIG=93  |
| Г <sub>26</sub> | $a_2(1700)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                    | $(4.6 \pm 0.7) \times 10^{-5}$           |                   | DESIG=96  |
| Г <sub>27</sub> | $f_2(1270)\eta \rightarrow \eta\pi^+\pi^-$                                     | $(3.5 \pm 0.6) \times 10^{-4}$           |                   | DESIG=94  |
| Г <sub>28</sub> | $f_4(2050)\eta \rightarrow \eta\pi^+\pi^-$                                     | $(2.5 \pm 0.9) \times 10^{-5}$           |                   | DESIG=95  |
| Г <sub>29</sub> | $\pi_1(1400)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                  | $< 5 \times 10^{-5}$                     | CL=90%            | DESIG=97  |
| Г <sub>30</sub> | $\pi_1(1600)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                  | $< 1.5 \times 10^{-5}$                   | CL=90%            | DESIG=98  |
| Г <sub>31</sub> | $\pi_1(2015)^+\pi^- + \text{c.c.} \rightarrow \eta\pi^+\pi^-$                  | $< 8 \times 10^{-6}$                     | CL=90%            | DESIG=99  |
| Г <sub>32</sub> | $f_2(1270)\eta$                                                                | $(6.7 \pm 1.1) \times 10^{-4}$           |                   | DESIG=37  |
| Г <sub>33</sub> | $\pi^+\pi^-\eta'$                                                              | $(2.2 \pm 0.4) \times 10^{-3}$           |                   | DESIG=44  |
| Г <sub>34</sub> | $K^+K^-\eta'(958)$                                                             | $(8.8 \pm 0.9) \times 10^{-4}$           |                   | DESIG=85  |
| Г <sub>35</sub> | $K_0^*(1430)^+K^- + \text{c.c.}$                                               | $(6.4 \pm_{-2.8}^{+2.2}) \times 10^{-4}$ |                   | DESIG=86  |
| Г <sub>36</sub> | $f_0(980)\eta'(958)$                                                           | $(1.6 \pm_{-0.7}^{+1.4}) \times 10^{-4}$ |                   | DESIG=87  |
| Г <sub>37</sub> | $f_0(1710)\eta'(958)$                                                          | $(7 \pm_{-5}^{+7}) \times 10^{-5}$       |                   | DESIG=88  |
| Г <sub>38</sub> | $f_2'(1525)\eta'(958)$                                                         | $(9 \pm 6) \times 10^{-5}$               |                   | DESIG=89  |
| Г <sub>39</sub> | $\pi^0 f_0(980) \rightarrow \pi^0\pi^+\pi^-$                                   | $(3.5 \pm 0.9) \times 10^{-7}$           |                   | DESIG=61  |
| Г <sub>40</sub> | $K^+\bar{K}^*(892)^0\pi^- + \text{c.c.}$                                       | $(3.2 \pm 2.1) \times 10^{-3}$           |                   | DESIG=10  |
| Г <sub>41</sub> | $K^*(892)^0\bar{K}^*(892)^0$                                                   | $(1.4 \pm 0.4) \times 10^{-3}$           |                   | DESIG=21  |
| Г <sub>42</sub> | $K^+K^-K_S^0K_S^0$                                                             | $< 4 \times 10^{-4}$                     | CL=90%            | DESIG=29  |
| Г <sub>43</sub> | $K_S^0K_S^0K_S^0K_S^0$                                                         | $(3.5 \pm 1.0) \times 10^{-5}$           |                   | DESIG=102 |
| Г <sub>44</sub> | $K^+K^-K^+K^-$                                                                 | $(5.4 \pm 1.1) \times 10^{-4}$           |                   | DESIG=14  |
| Г <sub>45</sub> | $K^+K^-\phi$                                                                   | $(4.1 \pm 1.5) \times 10^{-4}$           |                   | DESIG=30  |
| Г <sub>46</sub> | $\bar{K}^0K^+\pi^-\phi + \text{c.c.}$                                          | $(3.3 \pm 0.5) \times 10^{-3}$           |                   | DESIG=90  |
| Г <sub>47</sub> | $K^+K^-\pi^0\phi$                                                              | $(1.62 \pm 0.30) \times 10^{-3}$         |                   | DESIG=91  |
| Г <sub>48</sub> | $\phi\pi^+\pi^-\pi^0$                                                          | $(7.5 \pm 1.0) \times 10^{-4}$           |                   | DESIG=82  |
| Г <sub>49</sub> | $\omega\omega$                                                                 | $(5.7 \pm 0.7) \times 10^{-4}$           |                   | DESIG=66  |
| Г <sub>50</sub> | $\omega K^+K^-$                                                                | $(7.8 \pm 0.9) \times 10^{-4}$           |                   | DESIG=81  |
| Г <sub>51</sub> | $\omega\phi$                                                                   | $(2.7 \pm 0.4) \times 10^{-5}$           |                   | DESIG=67  |
| Г <sub>52</sub> | $\phi\phi$                                                                     | $(4.2 \pm 0.5) \times 10^{-4}$           |                   | DESIG=68  |

|                 |                                                  |                                  |        |           |
|-----------------|--------------------------------------------------|----------------------------------|--------|-----------|
| Γ <sub>53</sub> | $\phi\phi\eta$                                   | $(3.0 \pm 0.5) \times 10^{-4}$   |        | DESIG=104 |
| Γ <sub>54</sub> | $p\bar{p}$                                       | $(7.60 \pm 0.34) \times 10^{-5}$ |        | DESIG=11  |
| Γ <sub>55</sub> | $p\bar{p}\pi^0$                                  | $(1.55 \pm 0.18) \times 10^{-4}$ |        | DESIG=39  |
| Γ <sub>56</sub> | $p\bar{p}\eta$                                   | $(1.45 \pm 0.25) \times 10^{-4}$ |        | DESIG=43  |
| Γ <sub>57</sub> | $p\bar{p}\omega$                                 | $(2.12 \pm 0.31) \times 10^{-4}$ |        | DESIG=59  |
| Γ <sub>58</sub> | $p\bar{p}\phi$                                   | $< 1.7 \times 10^{-5}$           | CL=90% | DESIG=65  |
| Γ <sub>59</sub> | $p\bar{p}\pi^+\pi^-$                             | $(5.0 \pm 1.9) \times 10^{-4}$   |        | DESIG=8   |
| Γ <sub>60</sub> | $p\bar{p}\pi^0\pi^0$                             | $< 5 \times 10^{-4}$             | CL=90% | DESIG=54  |
| Γ <sub>61</sub> | $p\bar{p}K^+K^-$ (non-resonant)                  | $(1.27 \pm 0.22) \times 10^{-4}$ |        | DESIG=62  |
| Γ <sub>62</sub> | $p\bar{p}K_S^0 K_S^0$                            | $< 4.5 \times 10^{-4}$           | CL=90% | DESIG=25  |
| Γ <sub>63</sub> | $p\bar{n}\pi^-$                                  | $(3.8 \pm 0.5) \times 10^{-4}$   |        | DESIG=74  |
| Γ <sub>64</sub> | $\bar{p}n\pi^+$                                  | $(3.9 \pm 0.5) \times 10^{-4}$   |        | DESIG=75  |
| Γ <sub>65</sub> | $p\bar{n}\pi^-\pi^0$                             | $(1.03 \pm 0.12) \times 10^{-3}$ |        | DESIG=76  |
| Γ <sub>66</sub> | $\bar{p}n\pi^+\pi^0$                             | $(1.01 \pm 0.12) \times 10^{-3}$ |        | DESIG=77  |
| Γ <sub>67</sub> | $\Lambda\bar{\Lambda}$                           | $(1.14 \pm 0.11) \times 10^{-4}$ |        | DESIG=19  |
| Γ <sub>68</sub> | $\Lambda\bar{\Lambda}\pi^+\pi^-$                 | $(2.9 \pm 0.5) \times 10^{-4}$   |        | DESIG=24  |
| Γ <sub>69</sub> | $\Lambda\bar{\Lambda}\pi^+\pi^-$ (non-resonant)  | $(2.5 \pm 0.6) \times 10^{-4}$   |        | DESIG=69  |
| Γ <sub>70</sub> | $\Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.}$ | $< 1.3 \times 10^{-4}$           | CL=90% | DESIG=70  |
| Γ <sub>71</sub> | $\Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.}$ | $< 1.3 \times 10^{-4}$           | CL=90% | DESIG=71  |
| Γ <sub>72</sub> | $K^+\bar{p}\Lambda + \text{c.c.}$                | $(4.2 \pm 0.4) \times 10^{-4}$   | S=1.2  | DESIG=40  |
| Γ <sub>73</sub> | $K^*(892)^+\bar{p}\Lambda + \text{c.c.}$         | $(4.9 \pm 0.7) \times 10^{-4}$   |        | DESIG=106 |
| Γ <sub>74</sub> | $K^+\bar{p}\Lambda(1520) + \text{c.c.}$          | $(1.7 \pm 0.4) \times 10^{-4}$   |        | DESIG=63  |
| Γ <sub>75</sub> | $\Lambda(1520)\bar{\Lambda}(1520)$               | $< 9 \times 10^{-5}$             | CL=90% | DESIG=64  |
| Γ <sub>76</sub> | $\Sigma^0\bar{\Sigma}^0$                         | $(4.2 \pm 0.6) \times 10^{-5}$   |        | DESIG=48  |
| Γ <sub>77</sub> | $\Sigma^+\bar{p}K_S^0 + \text{c.c.}$             | $(1.53 \pm 0.12) \times 10^{-4}$ |        | DESIG=105 |
| Γ <sub>78</sub> | $\Sigma^0\bar{p}K^+ + \text{c.c.}$               | $(1.46 \pm 0.10) \times 10^{-4}$ |        | DESIG=108 |
| Γ <sub>79</sub> | $\Sigma^+\bar{\Sigma}^-$                         | $(3.6 \pm 0.7) \times 10^{-5}$   |        | DESIG=49  |
| Γ <sub>80</sub> | $\Sigma^-\bar{\Sigma}^+$                         | $(5.7 \pm 1.5) \times 10^{-5}$   |        | DESIG=107 |
| Γ <sub>81</sub> | $\Sigma(1385)^+\bar{\Sigma}(1385)^-$             | $< 9 \times 10^{-5}$             | CL=90% | DESIG=72  |
| Γ <sub>82</sub> | $\Sigma(1385)^-\bar{\Sigma}(1385)^+$             | $< 5 \times 10^{-5}$             | CL=90% | DESIG=73  |
| Γ <sub>83</sub> | $K^-\Lambda\bar{\Xi}^+ + \text{c.c.}$            | $(1.35 \pm 0.24) \times 10^{-4}$ |        | DESIG=92  |
| Γ <sub>84</sub> | $\Xi^0\bar{\Xi}^0$                               | $< 6 \times 10^{-5}$             | CL=90% | DESIG=50  |
| Γ <sub>85</sub> | $\Xi^-\bar{\Xi}^+$                               | $(8.0 \pm 2.1) \times 10^{-5}$   |        | DESIG=26  |
| Γ <sub>86</sub> | $\pi^+\pi^-\pi^+ + K^+K^-$                       | $< 2.1 \times 10^{-3}$           |        | DESIG=23  |
| Γ <sub>87</sub> | $K_S^0 K_S^0$                                    | $< 6 \times 10^{-5}$             | CL=90% | DESIG=27  |
| Γ <sub>88</sub> | $\eta_c\pi^+\pi^-$                               | $< 3.2 \times 10^{-3}$           | CL=90% | DESIG=83  |

### Radiative decays

|                 |                         |                                  |        |                              |
|-----------------|-------------------------|----------------------------------|--------|------------------------------|
| Γ <sub>89</sub> | $\gamma J/\psi(1S)$     | $(34.3 \pm 1.0) \%$              |        | NODE=M055;CLUMP=B<br>DESIG=1 |
| Γ <sub>90</sub> | $\gamma\rho^0$          | $(2.16 \pm 0.17) \times 10^{-4}$ |        | DESIG=45                     |
| Γ <sub>91</sub> | $\gamma\omega$          | $(6.8 \pm 0.8) \times 10^{-5}$   |        | DESIG=46                     |
| Γ <sub>92</sub> | $\gamma\phi$            | $(2.4 \pm 0.5) \times 10^{-5}$   |        | DESIG=47                     |
| Γ <sub>93</sub> | $\gamma\gamma$          | $< 6.3 \times 10^{-6}$           | CL=90% | DESIG=4                      |
| Γ <sub>94</sub> | $e^+e^- J/\psi(1S)$     | $(3.46 \pm 0.22) \times 10^{-3}$ |        | DESIG=100                    |
| Γ <sub>95</sub> | $\mu^+\mu^- J/\psi(1S)$ | $(2.33 \pm 0.29) \times 10^{-4}$ |        | DESIG=103                    |

### CONSTRAINED FIT INFORMATION

A multiparticle fit to  $\chi_{c1}(1P)$ ,  $\chi_{c0}(1P)$ ,  $\chi_{c2}(1P)$ , and  $\psi(2S)$  with 4 total widths, a partial width, 25 combinations of partial widths obtained from integrated cross section, and 84 branching ratios uses 248 measurements to determine 49 parameters. The overall fit has a  $\chi^2 = 378.1$  for 199 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ .

|          |          |          |          |          |          |
|----------|----------|----------|----------|----------|----------|
| $x_{44}$ | 3        |          |          |          |          |
| $x_{54}$ | 4        | 2        |          |          |          |
| $x_{67}$ | 7        | 3        | 4        |          |          |
| $x_{89}$ | 23       | 9        | 2        | 20       |          |
| Γ        | -12      | -5       | -63      | -10      | -41      |
|          | $x_{17}$ | $x_{44}$ | $x_{54}$ | $x_{67}$ | $x_{89}$ |



$\chi_{c1}(1P)$  PARTIAL WIDTHS

$$\chi_{c1}(1P) \Gamma(i) \Gamma(\gamma J/\psi(1S)) / \Gamma(\text{total})$$

$$\Gamma(p\bar{p}) \times \Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}} \quad \Gamma_{54} \Gamma_{89} / \Gamma$$

| VALUE (eV) | DOCUMENT ID | TECN | COMMENT |
|------------|-------------|------|---------|
|------------|-------------|------|---------|

**21.9±0.8 OUR FIT****21.4±0.9 OUR AVERAGE**21.5±0.5±0.8 <sup>1</sup> ANDREOTTI 05A E835  $p\bar{p} \rightarrow e^+ e^- \gamma$ 21.4±1.5±2.2 <sup>1,2</sup> ARMSTRONG 92 E760  $\bar{p}p \rightarrow e^+ e^- \gamma$ 19.9<sup>+4.4</sup><sub>-4.0</sub> <sup>1</sup> BAGLIN 86B SPEC  $\bar{p}p \rightarrow e^+ e^- X$ <sup>1</sup> Calculated by us using  $B(J/\psi(1S) \rightarrow e^+ e^-) = 0.0593 \pm 0.0010$ .<sup>2</sup> Recalculated by ANDREOTTI 05A.

NODE=M055220

NODE=M055223

NODE=M055G1  
NODE=M055G1NODE=M055G;LINKAGE=7A  
NODE=M055G;LINKAGE=AN $\chi_{c1}(1P)$  BRANCHING RATIOS

## HADRONIC DECAYS

$$\Gamma(3(\pi^+ \pi^-)) / \Gamma_{\text{total}} \quad \Gamma_1 / \Gamma$$

| VALUE (units 10 <sup>-3</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

**5.8±1.4 OUR EVALUATION** Error includes scale factor of 1.2. Treating systematic error as correlated.**5.8±1.1 OUR AVERAGE**5.4±0.7±0.9 <sup>1</sup> BAI 99B BES  $\psi(2S) \rightarrow \gamma \chi_{c1}$ 16.0±5.9±0.8 <sup>1</sup> TANENBAUM 78 MRK1  $\psi(2S) \rightarrow \gamma \chi_{c1}$ <sup>1</sup> Rescaled by us using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}) = (8.8 \pm 0.4)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (32.6 \pm 0.5)\%$ .

NODE=M055225

NODE=M055305

NODE=M055R6  
NODE=M055R6

→ UNCHECKED ←

NODE=M055R;LINKAGE=X2

$$\Gamma(2(\pi^+ \pi^-)) / \Gamma_{\text{total}} \quad \Gamma_2 / \Gamma$$

| VALUE (units 10 <sup>-3</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

**7.6±2.6 OUR EVALUATION** Treating systematic error as correlated.**8 ±4 OUR AVERAGE** Error includes scale factor of 1.5.4.6±2.1±2.6 <sup>1</sup> BAI 99B BES  $\psi(2S) \rightarrow \gamma \chi_{c1}$ 12.5±4.2±0.6 <sup>1</sup> TANENBAUM 78 MRK1  $\psi(2S) \rightarrow \gamma \chi_{c1}$ <sup>1</sup> Rescaled by us using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}) = (8.8 \pm 0.4)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (32.6 \pm 0.5)\%$ .NODE=M055R4  
NODE=M055R4

→ UNCHECKED ←

NODE=M055R4;LINKAGE=X2

$$\Gamma(\pi^+ \pi^- \pi^0 \pi^0) / \Gamma_{\text{total}} \quad \Gamma_3 / \Gamma$$

| VALUE (%) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-----------|------|-------------|------|---------|
|-----------|------|-------------|------|---------|

**1.19±0.15±0.03** 604.7 <sup>1</sup> HE 08B CLEO  $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ <sup>1</sup> HE 08B reports  $1.28 \pm 0.06 \pm 0.15 \pm 0.08\%$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \pi^+ \pi^- \pi^0 \pi^0) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.NODE=M055R35  
NODE=M055R35

NODE=M055R35;LINKAGE=HE

$$\Gamma(\rho^+ \pi^- \pi^0 + \text{c.c.}) / \Gamma_{\text{total}} \quad \Gamma_4 / \Gamma$$

| VALUE (%) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-----------|------|-------------|------|---------|
|-----------|------|-------------|------|---------|

**1.45±0.24±0.04** 712.3 <sup>1,2</sup> HE 08B CLEO  $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ <sup>1</sup> HE 08B reports  $1.56 \pm 0.13 \pm 0.22 \pm 0.10\%$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \rho^+ \pi^- \pi^0 + \text{c.c.}) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.<sup>2</sup> Calculated by us. We have added the values from HE 08B for  $\rho^+ \pi^- \pi^0$  and  $\rho^- \pi^+ \pi^0$  decays assuming uncorrelated statistical and fully correlated systematic uncertainties.NODE=M055R36  
NODE=M055R36

NODE=M055R36;LINKAGE=HE

NODE=M055R36;LINKAGE=OC

$$\Gamma(\rho^0 \pi^+ \pi^-) / \Gamma_{\text{total}} \quad \Gamma_5 / \Gamma$$

| VALUE (units 10 <sup>-3</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

**3.9±3.5** <sup>1</sup> TANENBAUM 78 MRK1  $\psi(2S) \rightarrow \gamma \chi_{c1}$ <sup>1</sup> Estimated using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 0.087$ . The errors do not contain the uncertainty in the  $\psi(2S)$  decay.NODE=M055R8  
NODE=M055R8

NODE=M055R;LINKAGE=T

$\Gamma(4\pi^0)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|-----------------------------------------------------------|
| <b><math>5.4 \pm 0.8 \pm 0.1</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 608  | <sup>1</sup> ABLIKIM | 11A BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c1}$ |
| <sup>1</sup> ABLIKIM 11A reports $(0.57 \pm 0.03 \pm 0.08) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow 4\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                                           |

NODE=M055R44  
 NODE=M055R44

NODE=M055R44;LINKAGE=AB

 $\Gamma(\pi^+\pi^-K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                                                              | DOCUMENT ID                              | TECN    | COMMENT                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------|----------------------------------------|
| <b><math>4.5 \pm 1.0</math> OUR EVALUATION</b>                                                                                                                        | Treating systematic error as correlated. |         |                                        |
| <b><math>4.5 \pm 0.9</math> OUR AVERAGE</b>                                                                                                                           |                                          |         |                                        |
| $4.2 \pm 0.4 \pm 0.9$                                                                                                                                                 | <sup>1</sup> BAI                         | 99B BES | $\psi(2S) \rightarrow \gamma\chi_{c1}$ |
| $7.3 \pm 3.0 \pm 0.4$                                                                                                                                                 | <sup>1</sup> TANENBAUM                   | 78 MRK1 | $\psi(2S) \rightarrow \gamma\chi_{c1}$ |
| <sup>1</sup> Rescaled by us using $B(\psi(2S) \rightarrow \gamma\chi_{c1}) = (8.8 \pm 0.4)\%$ and $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$ . |                                          |         |                                        |

NODE=M055R5  
 NODE=M055R5

→ UNCHECKED ←

NODE=M055R5;LINKAGE=X2

 $\Gamma(K^+K^-\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | EVTS | DOCUMENT ID     | TECN     | COMMENT                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------|----------|---------------------------------------------|
| <b><math>1.12 \pm 0.27 \pm 0.03</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 45.1 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |
| <sup>1</sup> HE 08B reports $(0.12 \pm 0.02 \pm 0.02 \pm 0.01) \times 10^{-2}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow K^+K^-\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                 |          |                                             |

NODE=M055R37  
 NODE=M055R37

NODE=M055R37;LINKAGE=HE

 $\Gamma(K^+K^-\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|-------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|-----------------------------------------------------------|
| <b><math>11.46 \pm 0.12 \pm 1.29</math></b>                                                                             | 12k  | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c1}$ |
| <sup>1</sup> Using $1.06 \times 10^8 \psi(2S)$ mesons and $B(\psi(2S) \rightarrow \chi_{c1}\gamma) = (9.2 \pm 0.4)\%$ . |      |                      |          |                                                           |

NODE=M055R00  
 NODE=M055R00

NODE=M055R00;LINKAGE=A

 $\Gamma(K_S^0 K^\pm \pi^\mp \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|-------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|-----------------------------------------------------------|
| <b><math>7.52 \pm 0.11 \pm 0.79</math></b>                                                                              | 5.1k | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c1}$ |
| <sup>1</sup> Using $1.06 \times 10^8 \psi(2S)$ mesons and $B(\psi(2S) \rightarrow \chi_{c1}\gamma) = (9.2 \pm 0.4)\%$ . |      |                      |          |                                                           |

NODE=M055R60  
 NODE=M055R60

NODE=M055R60;LINKAGE=A

 $\Gamma(K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | EVTS  | DOCUMENT ID     | TECN     | COMMENT                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------|----------|---------------------------------------------|
| <b><math>0.86 \pm 0.13 \pm 0.02</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 141.3 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |
| <sup>1</sup> HE 08B reports $0.92 \pm 0.09 \pm 0.11 \pm 0.06\%$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |       |                 |          |                                             |

NODE=M055R39  
 NODE=M055R39

NODE=M055R39;LINKAGE=HE

 $\Gamma(\rho^- K^+ \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | EVTS  | DOCUMENT ID     | TECN     | COMMENT                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------|----------|---------------------------------------------|
| <b><math>0.50 \pm 0.12 \pm 0.01</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 141.3 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |
| <sup>1</sup> HE 08B reports $0.54 \pm 0.11 \pm 0.07 \pm 0.03\%$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow \rho^- K^+ \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |       |                 |          |                                             |

NODE=M055R40  
 NODE=M055R40

NODE=M055R40;LINKAGE=HE

 $\Gamma(K^*(892)^0 \bar{K}^0 \pi^0 \rightarrow K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE (%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EVTS  | DOCUMENT ID     | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------|----------|---------------------------------------------|
| <b><math>0.23 \pm 0.06 \pm 0.01</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 141.3 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |
| <sup>1</sup> HE 08B reports $0.25 \pm 0.06 \pm 0.03 \pm 0.02\%$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow K^*(892)^0 \bar{K}^0 \pi^0 \rightarrow K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |       |                 |          |                                             |

NODE=M055R41  
 NODE=M055R41

NODE=M055R41;LINKAGE=HE

$\Gamma(K^+ K^- \eta \pi^0)/\Gamma_{\text{total}}$   $\Gamma_{14}/\Gamma$ 

| VALUE (%)                | EVTs  | DOCUMENT ID     | TECN     | COMMENT                                      |
|--------------------------|-------|-----------------|----------|----------------------------------------------|
| <b>0.112±0.034±0.003</b> | 141.3 | <sup>1</sup> HE | 08B CLEO | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M055R42  
NODE=M055R42

<sup>1</sup> HE 08B reports  $0.12 \pm 0.03 \pm 0.02 \pm 0.01$  % from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K^+ K^- \eta \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R42;LINKAGE=HE

 $\Gamma(\pi^+ \pi^- K_S^0 K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTs     | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------|----------|----------------------|----------|-----------------------------------------|
| <b>6.9±2.9±0.2</b>       | 19.8±7.7 | <sup>1</sup> ABLIKIM | 050 BES2 | $\psi(2S) \rightarrow \chi_{c1} \gamma$ |

NODE=M055R05  
NODE=M055R05

<sup>1</sup> ABLIKIM 050 reports  $[\Gamma(\chi_{c1}(1P) \rightarrow \pi^+ \pi^- K_S^0 K_S^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$   $= (0.67 \pm 0.26 \pm 0.11) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R05;LINKAGE=AB

 $\Gamma(K^+ K^- \eta)/\Gamma_{\text{total}}$   $\Gamma_{16}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID           | TECN | COMMENT                                   |
|--------------------------|-----------------------|------|-------------------------------------------|
| <b>3.2±1.0±0.1</b>       | <sup>1</sup> ATHAR 07 | CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |

NODE=M055R25  
NODE=M055R25

<sup>1</sup> ATHAR 07 reports  $(0.34 \pm 0.10 \pm 0.04) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K^+ K^- \eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R25;LINKAGE=AT

 $\Gamma(\bar{K}^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{17}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>7.0±0.6 OUR FIT</b>   |             |

NODE=M055R17  
NODE=M055R17

 $\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{18}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------|------|----------------------|----------|-----------------------------------------|
| <b>0.98±0.37±0.02</b>    | 22   | <sup>1</sup> ABLIKIM | 06R BES2 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |

NODE=M055R09  
NODE=M055R09

<sup>1</sup> ABLIKIM 06R reports  $(1.1 \pm 0.4 \pm 0.1) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R09;LINKAGE=AB

 $\Gamma(K^*(892)^+ K^- + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{19}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------|------|----------------------|----------|-----------------------------------------|
| <b>1.43±0.65±0.03</b>    | 27   | <sup>1</sup> ABLIKIM | 06R BES2 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |

NODE=M055R10  
NODE=M055R10

<sup>1</sup> ABLIKIM 06R reports  $(1.6 \pm 0.7 \pm 0.2) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K^*(892)^+ K^- + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R10;LINKAGE=AB

 $\Gamma(K_J^*(1430)^0 \bar{K}^0 + \text{c.c.} \rightarrow K_S^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{20}/\Gamma$ 

| VALUE                                     | CL% | DOCUMENT ID          | TECN     | COMMENT                                 |
|-------------------------------------------|-----|----------------------|----------|-----------------------------------------|
| <b><math>&lt; 8 \times 10^{-4}</math></b> | 90  | <sup>1</sup> ABLIKIM | 06R BES2 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |

NODE=M055R12  
NODE=M055R12

<sup>1</sup> ABLIKIM 06R reports  $< 0.9 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K_J^*(1430)^0 \bar{K}^0 + \text{c.c.} \rightarrow K_S^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R12;LINKAGE=AB

 $\Gamma(K_J^*(1430)^+ K^- + \text{c.c.} \rightarrow K_S^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{21}/\Gamma$ 

| VALUE                                       | CL% | DOCUMENT ID          | TECN     | COMMENT                                 |
|---------------------------------------------|-----|----------------------|----------|-----------------------------------------|
| <b><math>&lt; 2.1 \times 10^{-3}</math></b> | 90  | <sup>1</sup> ABLIKIM | 06R BES2 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |

NODE=M055R13  
NODE=M055R13

<sup>1</sup> ABLIKIM 06R reports  $< 2.4 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K_J^*(1430)^+ K^- + \text{c.c.} \rightarrow K_S^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R13;LINKAGE=AB

$\Gamma(K^+ K^- \pi^0)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{22}/\Gamma$ NODE=M055R20  
NODE=M055R20**1.81±0.24±0.04**<sup>1</sup> ATHAR

07

CLEO

 $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ 

<sup>1</sup> ATHAR 07 reports  $(1.95 \pm 0.16 \pm 0.23) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R20;LINKAGE=AT

 $\Gamma(\eta \pi^+ \pi^-)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{23}/\Gamma$ NODE=M055R08  
NODE=M055R08**4.62±0.23 OUR AVERAGE**

4.58±0.23±0.11

<sup>1,2</sup> ABLIKIM

17K

BES3

 $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$ 

4.7 ±0.5 ±0.1

<sup>3</sup> ATHAR

07

CLEO

 $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ 

5.3 ±0.9 ±0.1

222

<sup>4</sup> ABLIKIM

06R

BES2

 $\psi(2S) \rightarrow \gamma \chi_{c1}$ 

<sup>1</sup> From an amplitude analysis using an isobar model.

<sup>2</sup> ABLIKIM 17K reports  $(4.67 \pm 0.03 \pm 0.23 \pm 0.16) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R08;LINKAGE=A  
NODE=M055R08;LINKAGE=B

<sup>3</sup> ATHAR 07 reports  $(5.0 \pm 0.3 \pm 0.5) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R08;LINKAGE=AT

<sup>4</sup> ABLIKIM 06R reports  $(5.9 \pm 0.7 \pm 0.8) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R08;LINKAGE=AB

 $\Gamma(a_0(980)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{24}/\Gamma$ NODE=M055R15  
NODE=M055R15**3.2 ±0.4 OUR AVERAGE** Error includes scale factor of 2.2.

3.33±0.19±0.08

<sup>1,2</sup> ABLIKIM

17K

BES3

 $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$ 

1.79±0.63±0.04

58

<sup>3</sup> ABLIKIM

06R

BES2

 $\psi(2S) \rightarrow \gamma \chi_{c1}$ 

<sup>1</sup> From an amplitude analysis using an isobar model.

<sup>2</sup> ABLIKIM 17K reports  $(3.40 \pm 0.03 \pm 0.19 \pm 0.11) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow a_0(980)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R15;LINKAGE=A  
NODE=M055R15;LINKAGE=B

<sup>3</sup> ABLIKIM 06R reports  $(2.0 \pm 0.5 \pm 0.5) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow a_0(980)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R15;LINKAGE=AB

 $\Gamma(a_2(1320)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{25}/\Gamma$ NODE=M055R72  
NODE=M055R72**0.176±0.023±0.004**<sup>1,2</sup> ABLIKIM

17K

BES3

 $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$ 

<sup>1</sup> From an amplitude analysis using an isobar model.

<sup>2</sup> ABLIKIM 17K reports  $(0.18 \pm 0.01 \pm 0.02 \pm 0.01) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow a_2(1320)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R72;LINKAGE=A  
NODE=M055R72;LINKAGE=B $\Gamma(a_2(1700)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-)/\Gamma_{\text{total}}$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{26}/\Gamma$ NODE=M055R75  
NODE=M055R75**4.6±0.7±0.1**<sup>1,2</sup> ABLIKIM

17K

BES3

 $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

<sup>1</sup> From an amplitude analysis using an isobar model.

<sup>2</sup> ABLIKIM 17K reports  $(4.7 \pm 0.4 \pm 0.6 \pm 0.2) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow a_2(1700)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R75;LINKAGE=A  
NODE=M055R75;LINKAGE=B

### $\Gamma(f_2(1270)\eta \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**3.5±0.6±0.1**

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

<sup>1</sup> From an amplitude analysis using an isobar model.

<sup>2</sup> ABLIKIM 17K reports  $(0.36 \pm 0.01 \pm 0.06 \pm 0.01) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow f_2(1270)\eta \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R73  
NODE=M055R73

OCCUR=2

NODE=M055R73;LINKAGE=A  
NODE=M055R73;LINKAGE=D

### $\Gamma(f_4(2050)\eta \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

**2.5±0.9±0.1**

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

<sup>1</sup> From an amplitude analysis using an isobar model.

<sup>2</sup> ABLIKIM 17K reports  $(2.6 \pm 0.4 \pm 0.8 \pm 0.1) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow f_4(2050)\eta \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R74  
NODE=M055R74

NODE=M055R74;LINKAGE=A  
NODE=M055R74;LINKAGE=B

### $\Gamma(\pi_1(1400)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<5 × 10<sup>-5</sup>**

90

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

<sup>1</sup> From an amplitude analysis using an isobar model.

<sup>2</sup> ABLIKIM 17K reports  $< 4.6 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \pi_1(1400)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R76  
NODE=M055R76

NODE=M055R76;LINKAGE=A  
NODE=M055R76;LINKAGE=B

### $\Gamma(\pi_1(1600)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<1.5 × 10<sup>-5</sup>**

90

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

<sup>1</sup> From an amplitude analysis using an isobar model.

<sup>2</sup> ABLIKIM 17K reports  $< 1.5 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \pi_1(1600)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R77  
NODE=M055R77

NODE=M055R77;LINKAGE=A  
NODE=M055R77;LINKAGE=B

### $\Gamma(\pi_1(2015)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}$

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<8 × 10<sup>-6</sup>**

90

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

<sup>1</sup> From an amplitude analysis using an isobar model.

<sup>2</sup> ABLIKIM 17K reports  $< 8 \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \pi_1(2015)^+ \pi^- + \text{c.c.} \rightarrow \eta \pi^+ \pi^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R78  
NODE=M055R78

NODE=M055R78;LINKAGE=A  
NODE=M055R78;LINKAGE=B

### $\Gamma(f_2(1270)\eta) / \Gamma_{\text{total}}$

VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**0.67±0.11 OUR AVERAGE**

0.63±0.11±0.02

1,2 ABLIKIM 17K BES3  $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$

2.7 ±0.8 ±0.1

53

<sup>3</sup> ABLIKIM 06R BES2  $\psi(2S) \rightarrow \gamma \chi_{c1}$

NODE=M055R16  
NODE=M055R16

<sup>1</sup>ABLIKIM 17K reports  $(6.4 \pm 1.1) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow f_2(1270)\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup>From an amplitude analysis using an isobar model.

<sup>3</sup>ABLIKIM 06R reports  $(3.0 \pm 0.7 \pm 0.5) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow f_2(1270)\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R16;LINKAGE=B

NODE=M055R16;LINKAGE=D  
NODE=M055R16;LINKAGE=C

### $\Gamma(\pi^+\pi^-\eta')/\Gamma_{\text{total}}$

VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**$2.2 \pm 0.4 \pm 0.1$**

<sup>1</sup>ATHAR

07

CLEO

$\psi(2S) \rightarrow \gamma h^+ h^- h^0$

<sup>1</sup>ATHAR 07 reports  $(2.4 \pm 0.4 \pm 0.3) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \pi^+\pi^-\eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = 0.0907 \pm 0.0011 \pm 0.0054$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R28  
NODE=M055R28

NODE=M055R28;LINKAGE=AT

### $\Gamma(K^+K^-\eta'(958))/\Gamma_{\text{total}}$

VALUE (units  $10^{-4}$ )

EVTs

DOCUMENT ID

TECN

COMMENT

**$8.75 \pm 0.87$**

310

<sup>1</sup>ABLIKIM

14J

BES3

$\psi(2S) \rightarrow \gamma K^+ K^- \eta'(958)$

<sup>1</sup>Derived using  $B(\psi(2S) \rightarrow \gamma\chi_{c1}) = (9.2 \pm 0.4)\%$ . Uncertainty includes both statistical and systematic contributions combined in quadrature.

NODE=M055R64  
NODE=M055R64

NODE=M055R64;LINKAGE=A

### $\Gamma(K^*(1430)^+ K^- + \text{c.c.})/\Gamma_{\text{total}}$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**$6.41 \pm 0.57^{+2.09}_{-2.71}$**

<sup>1</sup>ABLIKIM

14J

BES3

$\psi(2S) \rightarrow \gamma K^+ K^- \eta'(958)$

<sup>1</sup>Normalized to  $B(\chi_{c1} \rightarrow K^+ K^- \eta'(958))$  branching fraction.

NODE=M055R65  
NODE=M055R65

NODE=M055R65;LINKAGE=A

### $\Gamma(f_0(980)\eta'(958))/\Gamma_{\text{total}}$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**$1.65 \pm 0.47^{+1.32}_{-0.56}$**

<sup>1</sup>ABLIKIM

14J

BES3

$\psi(2S) \rightarrow \gamma K^+ K^- \eta'(958)$

<sup>1</sup>Normalized to  $B(\chi_{c1} \rightarrow K^+ K^- \eta'(958))$  branching fraction.

NODE=M055R66  
NODE=M055R66

NODE=M055R66;LINKAGE=A

### $\Gamma(f_0(1710)\eta'(958))/\Gamma_{\text{total}}$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**$0.71 \pm 0.22^{+0.68}_{-0.48}$**

<sup>1</sup>ABLIKIM

14J

BES3

$\psi(2S) \rightarrow \gamma K^+ K^- \eta'(958)$

<sup>1</sup>Normalized to  $B(\chi_{c1} \rightarrow K^+ K^- \eta'(958))$  branching fraction.

NODE=M055R67  
NODE=M055R67

NODE=M055R67;LINKAGE=A

### $\Gamma(f'_2(1525)\eta'(958))/\Gamma_{\text{total}}$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**$0.92 \pm 0.23^{+0.55}_{-0.51}$**

<sup>1</sup>ABLIKIM

14J

BES3

$\psi(2S) \rightarrow \gamma K^+ K^- \eta'(958)$

<sup>1</sup>Normalized to  $B(\chi_{c1} \rightarrow K^+ K^- \eta'(958))$  branching fraction.

NODE=M055R68  
NODE=M055R68

NODE=M055R68;LINKAGE=A

### $\Gamma(\pi^0 f_0(980) \rightarrow \pi^0 \pi^+ \pi^-)/\Gamma_{\text{total}}$

VALUE (units  $10^{-6}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**$0.35 \pm 0.09$**

ABLIKIM

18D

BES3

$\psi(2S) \rightarrow \gamma \pi^0 \pi^+ \pi^-$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<6

90

<sup>1</sup>ABLIKIM

11D

BES3

$\psi(2S) \rightarrow \gamma \pi^0 \pi^+ \pi^-$

<sup>1</sup>ABLIKIM 11D reports  $[\Gamma(\chi_{c1}(1P) \rightarrow \pi^0 f_0(980) \rightarrow \pi^0 \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))] < 6.0 \times 10^{-7}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R18  
NODE=M055R18

NODE=M055R18;LINKAGE=BR

### $\Gamma(K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.})/\Gamma_{\text{total}}$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**$32 \pm 21$**

<sup>1</sup>TANENBAUM

78

MRK1

$\psi(2S) \rightarrow \gamma\chi_{c1}$

<sup>1</sup>Estimated using  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = 0.087$ . The errors do not contain the uncertainty in the  $\psi(2S)$  decay.

NODE=M055R9  
NODE=M055R9

NODE=M055R9;LINKAGE=T

$\Gamma(K^*(892)^0 \bar{K}^*(892)^0)/\Gamma_{\text{total}}$  $\Gamma_{41}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS       | DOCUMENT ID            | TECN    | COMMENT                                           |
|--------------------------|------------|------------------------|---------|---------------------------------------------------|
| <b>1.44±0.36±0.03</b>    | 28.4 ± 5.5 | <sup>1,2</sup> ABLIKIM | 04H BES | $\psi(2S) \rightarrow \gamma K^+ K^- \pi^+ \pi^-$ |

NODE=M055R26  
 NODE=M055R26

<sup>1</sup> ABLIKIM 04H reports  $[\Gamma(\chi_{c1}(1P) \rightarrow K^*(892)^0 \bar{K}^*(892)^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))] = (1.40 \pm 0.27 \pm 0.22) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R26;LINKAGE=AB

<sup>2</sup> Assumes  $B(K^*(892)^0 \rightarrow K^- \pi^+) = 2/3$ .

NODE=M055R26;LINKAGE=AL

 $\Gamma(K^+ K^- K_S^0 \bar{K}_S^0)/\Gamma_{\text{total}}$  $\Gamma_{42}/\Gamma$ 

| VALUE                          | CL% | EVTS      | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------------|-----|-----------|----------------------|----------|-----------------------------------------|
| <b>&lt;4 × 10<sup>-4</sup></b> | 90  | 3.2 ± 2.4 | <sup>1</sup> ABLIKIM | 050 BES2 | $\psi(2S) \rightarrow \chi_{c1} \gamma$ |

NODE=M055R06  
 NODE=M055R06

<sup>1</sup> ABLIKIM 050 reports  $[\Gamma(\chi_{c1}(1P) \rightarrow K^+ K^- K_S^0 \bar{K}_S^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))] < 4.2 \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R06;LINKAGE=AB

 $\Gamma(K_S^0 \bar{K}_S^0 K_S^0 \bar{K}_S^0)/\Gamma_{\text{total}}$  $\Gamma_{43}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN      | COMMENT                              |
|--------------------------|------|----------------------|-----------|--------------------------------------|
| <b>0.35±0.10±0.01</b>    | 22   | <sup>1</sup> ABLIKIM | 19AA BES3 | $\psi(2S) \rightarrow \gamma 4K_S^0$ |

NODE=M055R82  
 NODE=M055R82

<sup>1</sup> Using  $B(K_S^0 \rightarrow \pi^+ \pi^-) = (69.20 \pm 0.05)\%$ . ABLIKIM 19AA reports  $[\Gamma(\chi_{c1}(1P) \rightarrow K_S^0 \bar{K}_S^0 K_S^0 \bar{K}_S^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))] = (3.4 \pm 0.9 \pm 0.3) \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value..

NODE=M055R82;LINKAGE=A

 $\Gamma(K^+ K^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{44}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>0.54±0.11 OUR FIT</b> |             |

NODE=M055R14  
 NODE=M055R14

 $\Gamma(K^+ K^- \phi)/\Gamma_{\text{total}}$  $\Gamma_{45}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------|------|----------------------|----------|-----------------------------------------|
| <b>0.41±0.15±0.01</b>    | 17   | <sup>1</sup> ABLIKIM | 06T BES2 | $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ |

NODE=M055R07  
 NODE=M055R07

<sup>1</sup> ABLIKIM 06T reports  $(0.46 \pm 0.16 \pm 0.06) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K^+ K^- \phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R07;LINKAGE=AB

 $\Gamma(\bar{K}^0 K^+ \pi^- \phi + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{46}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID | TECN     | COMMENT                                 |
|--------------------------|-------------|----------|-----------------------------------------|
| <b>3.27±0.28±0.46</b>    | ABLIKIM     | 15M BES3 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |

NODE=M055R69  
 NODE=M055R69

 $\Gamma(K^+ K^- \pi^0 \phi)/\Gamma_{\text{total}}$  $\Gamma_{47}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID | TECN     | COMMENT                                 |
|--------------------------|-------------|----------|-----------------------------------------|
| <b>1.62±0.12±0.28</b>    | ABLIKIM     | 15M BES3 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |

NODE=M055R70  
 NODE=M055R70

 $\Gamma(\phi \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{48}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                     |
|--------------------------|------|----------------------|----------|-------------------------------------------------------------|
| <b>0.75±0.06±0.08</b>    | 373  | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c1}$ |

NODE=M055R62  
 NODE=M055R62

<sup>1</sup> Using  $1.06 \times 10^8 \psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c1} \gamma) = (9.2 \pm 0.4)\%$ .

NODE=M055R62;LINKAGE=A

 $\Gamma(\omega \omega)/\Gamma_{\text{total}}$  $\Gamma_{49}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                       |
|--------------------------|------|----------------------|----------|-----------------------------------------------|
| <b>5.7±0.7±0.1</b>       | 597  | <sup>1</sup> ABLIKIM | 11K BES3 | $\psi(2S) \rightarrow \gamma \text{ hadrons}$ |

NODE=M055R49  
 NODE=M055R49

<sup>1</sup> ABLIKIM 11K reports  $(6.0 \pm 0.3 \pm 0.7) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \omega \omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R49;LINKAGE=AL

$\Gamma(\omega K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{50}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|--------------------------|------|----------------------|----------|-----------------------------------------------------------|
| <b>0.78±0.04±0.08</b>    | 628  | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c1}$ |

<sup>1</sup> Using  $1.06 \times 10^8$   $\psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c1}\gamma) = (9.2 \pm 0.4)\%$ .

NODE=M055R61  
NODE=M055R61

NODE=M055R61;LINKAGE=A

 $\Gamma(\omega\phi)/\Gamma_{\text{total}}$  $\Gamma_{51}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                               |
|--------------------------|------|----------------------|----------|---------------------------------------|
| <b>0.27±0.04±0.01</b>    | 105  | <sup>1</sup> ABLIKIM | 19J BES3 | $\psi(2S) \rightarrow \gamma$ hadrons |

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.21±0.06±0.01      15      <sup>2,3</sup> ABLIKIM      11K BES3       $\psi(2S) \rightarrow \gamma$  hadrons

<sup>1</sup> ABLIKIM 19J reports  $[\Gamma(\chi_{c1}(1P) \rightarrow \omega\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  =  $(2.67 \pm 0.31 \pm 0.27) \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ABLIKIM 11K reports  $(0.22 \pm 0.06 \pm 0.02) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \omega\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> Superseded by ABLIKIM 19J.

NODE=M055R50  
NODE=M055R50

NODE=M055R50;LINKAGE=A

NODE=M055R50;LINKAGE=AL

NODE=M055R50;LINKAGE=B

 $\Gamma(\phi\phi)/\Gamma_{\text{total}}$  $\Gamma_{52}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                               |
|--------------------------|------|----------------------|----------|---------------------------------------|
| <b>4.2±0.5±0.1</b>       | 366  | <sup>1</sup> ABLIKIM | 11K BES3 | $\psi(2S) \rightarrow \gamma$ hadrons |

<sup>1</sup> ABLIKIM 11K reports  $(4.4 \pm 0.3 \pm 0.5) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \phi\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R51  
NODE=M055R51

NODE=M055R51;LINKAGE=AL

 $\Gamma(\phi\phi\eta)/\Gamma_{\text{total}}$  $\Gamma_{53}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                   |
|--------------------------|------|----------------------|----------|-------------------------------------------|
| <b>3.0±0.4±0.2</b>       | 83.6 | <sup>1</sup> ABLIKIM | 20B BES3 | $\psi(2S) \rightarrow \gamma\phi\phi\eta$ |

<sup>1</sup> ABLIKIM 20B reports  $(2.96 \pm 0.43 \pm 0.22) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \phi\phi\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ .

NODE=M055R85  
NODE=M055R85

NODE=M055R85;LINKAGE=A

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{54}/\Gamma$ 

| VALUE (units $10^{-4}$ )   | DOCUMENT ID |
|----------------------------|-------------|
| <b>0.760±0.034 OUR FIT</b> |             |

NODE=M055R11  
NODE=M055R11

 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{55}/\Gamma$ 

| VALUE (units $10^{-3}$ )       | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|-------------|------|---------|
| <b>0.155±0.018 OUR AVERAGE</b> |             |      |         |

0.163±0.019±0.004      <sup>1</sup> ONYISI      10      CLE3       $\psi(2S) \rightarrow \gamma p\bar{p}X$

0.112±0.047±0.003      <sup>2</sup> ATHAR      07      CLEO       $\psi(2S) \rightarrow \gamma h^+ h^- h^0$

<sup>1</sup> ONYISI 10 reports  $(1.75 \pm 0.16 \pm 0.13 \pm 0.11) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{p}\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ATHAR 07 reports  $(1.2 \pm 0.5 \pm 0.1) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{p}\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R21  
NODE=M055R21

NODE=M055R21;LINKAGE=ON

NODE=M055R21;LINKAGE=AT

 $\Gamma(p\bar{p}\eta)/\Gamma_{\text{total}}$  $\Gamma_{56}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID         | TECN    | COMMENT                                 |
|--------------------------|-----|---------------------|---------|-----------------------------------------|
| <b>0.145±0.024±0.004</b> |     | <sup>1</sup> ONYISI | 10 CLE3 | $\psi(2S) \rightarrow \gamma p\bar{p}X$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.15      90      <sup>2</sup> ATHAR      07      CLEO       $\psi(2S) \rightarrow \gamma h^+ h^- h^0$

NODE=M055R27  
NODE=M055R27



- <sup>1</sup> ONYISI 10 reports  $(1.56 \pm 0.22 \pm 0.14 \pm 0.10) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{p}\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.
- <sup>2</sup> ATHAR 07 reports  $< 0.16 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{p}\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R27;LINKAGE=ON

NODE=M055R27;LINKAGE=AT

 **$\Gamma(p\bar{p}\omega)/\Gamma_{\text{total}}$**  **$\Gamma_{57}/\Gamma$** VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**0.212±0.030±0.005**<sup>1</sup> ONYISI

10

CLE3

 $\psi(2S) \rightarrow \gamma p\bar{p}X$ 

- <sup>1</sup> ONYISI 10 reports  $(2.28 \pm 0.28 \pm 0.16 \pm 0.14) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{p}\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R43  
NODE=M055R43

NODE=M055R43;LINKAGE=ON

 **$\Gamma(p\bar{p}\phi)/\Gamma_{\text{total}}$**  **$\Gamma_{58}/\Gamma$** 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<1.7 × 10<sup>-5</sup>**

90

<sup>1</sup> ABLIKIM

11F

BES3

 $\psi(2S) \rightarrow \gamma p\bar{p}K^+K^-$ 

- <sup>1</sup> ABLIKIM 11F reports  $< 1.82 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{p}\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R48  
NODE=M055R48

NODE=M055R48;LINKAGE=AB

 **$\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$**  **$\Gamma_{59}/\Gamma$** VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**0.50±0.19 OUR EVALUATION**

Treating systematic error as correlated.

**0.50±0.19 OUR AVERAGE**

0.46±0.12±0.15

<sup>1</sup> BAI

99B

BES

 $\psi(2S) \rightarrow \gamma\chi_{c1}$ 

1.08±0.77±0.05

<sup>1</sup> TANENBAUM

78

MRK1

 $\psi(2S) \rightarrow \gamma\chi_{c1}$ 

- <sup>1</sup> Rescaled by us using  $B(\psi(2S) \rightarrow \gamma\chi_{c1}) = (8.8 \pm 0.4)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$ .

NODE=M055R7  
NODE=M055R7

→ UNCHECKED ←

NODE=M055R7;LINKAGE=X2

 **$\Gamma(p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}$**  **$\Gamma_{60}/\Gamma$** 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<5 × 10<sup>-4</sup>**

90

<sup>1</sup> HE

08B

CLEO

 $e^+e^- \rightarrow \gamma h^+h^-h^0h^0$ 

- <sup>1</sup> HE 08B reports  $< 0.05 \times 10^{-2}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R38  
NODE=M055R38

NODE=M055R38;LINKAGE=HE

 **$\Gamma(p\bar{p}K^+K^- \text{ (non-resonant)})/\Gamma_{\text{total}}$**  **$\Gamma_{61}/\Gamma$** VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.27±0.22±0.03**

82 ± 9

<sup>1</sup> ABLIKIM

11F

BES3

 $\psi(2S) \rightarrow \gamma p\bar{p}K^+K^-$ 

- <sup>1</sup> ABLIKIM 11F reports  $(1.35 \pm 0.15 \pm 0.19) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{p}K^+K^- \text{ (non-resonant)})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R45  
NODE=M055R45

NODE=M055R45;LINKAGE=AB

 **$\Gamma(p\bar{p}K_S^0K_S^0)/\Gamma_{\text{total}}$**  **$\Gamma_{62}/\Gamma$** VALUE (units  $10^{-4}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**<4.5**

90

<sup>1</sup> ABLIKIM

06D

BES2

 $\psi(2S) \rightarrow \gamma\chi_{c1}$ 

- <sup>1</sup> Using  $B(\psi(2S) \rightarrow \chi_{c1}\gamma) = (9.1 \pm 0.6)\%$ .

NODE=M055R02  
NODE=M055R02

NODE=M055R;LINKAGE=AB

 **$\Gamma(p\bar{n}\pi^-)/\Gamma_{\text{total}}$**  **$\Gamma_{63}/\Gamma$** VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**3.8±0.5±0.1**

1412

<sup>1</sup> ABLIKIM

12J

BES3

 $\psi(2S) \rightarrow \gamma p\bar{n}\pi^-$ 

- <sup>1</sup> ABLIKIM 12J reports  $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{n}\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))] = (0.37 \pm 0.02 \pm 0.04) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R56  
NODE=M055R56

NODE=M055R56;LINKAGE=AL

$\Gamma(\bar{p}n\pi^+)/\Gamma_{\text{total}}$  $\Gamma_{64}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                           | EVTS | DOCUMENT ID          | TECN     | COMMENT                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b><math>3.9 \pm 0.5 \pm 0.1</math></b>                                                                                                                                                                                                                                                                                                                                                                                                            | 1625 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma \bar{p}n\pi^+$ |
| <sup>1</sup> ABLIKIM 12J reports $[\Gamma(\chi_{c1}(1P) \rightarrow \bar{p}n\pi^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))] = (0.38 \pm 0.02 \pm 0.04) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                             |

NODE=M055R57  
 NODE=M055R57

NODE=M055R57;LINKAGE=AL

 $\Gamma(p\bar{n}\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{65}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                | EVTS | DOCUMENT ID          | TECN     | COMMENT                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------------|
| <b><math>10.3 \pm 1.1 \pm 0.2</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                | 1082 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma p\bar{n}\pi^-\pi^0$ |
| <sup>1</sup> ABLIKIM 12J reports $[\Gamma(\chi_{c1}(1P) \rightarrow p\bar{n}\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))] = (1.00 \pm 0.05 \pm 0.10) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                                  |

NODE=M055R58  
 NODE=M055R58

NODE=M055R58;LINKAGE=AL

 $\Gamma(\bar{p}n\pi^+\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{66}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                | EVTS | DOCUMENT ID          | TECN     | COMMENT                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------------|
| <b><math>10.1 \pm 1.1 \pm 0.2</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                | 1261 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma \bar{p}n\pi^+\pi^0$ |
| <sup>1</sup> ABLIKIM 12J reports $[\Gamma(\chi_{c1}(1P) \rightarrow \bar{p}n\pi^+\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))] = (0.98 \pm 0.05 \pm 0.10) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                                  |

NODE=M055R59  
 NODE=M055R59

NODE=M055R59;LINKAGE=AL

 $\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$  $\Gamma_{67}/\Gamma$ 

| VALUE (units $10^{-4}$ )                  | DOCUMENT ID |
|-------------------------------------------|-------------|
| <b><math>1.14 \pm 0.11</math> OUR FIT</b> |             |

NODE=M055R23  
 NODE=M055R23

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{68}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|----------------------|----------|--------------------------------------------------------------|
| <b><math>29 \pm 5 \pm 1</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     | 105  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda\bar{\Lambda}\pi^+\pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |     |      |                      |          |                                                              |
| <150                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 90  |      | <sup>2</sup> ABLIKIM | 06D BES2 | $\psi(2S) \rightarrow \gamma \chi_{c1}$                      |
| <sup>1</sup> ABLIKIM 12I reports $(31.1 \pm 3.4 \pm 3.9) \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow \Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |     |      |                      |          |                                                              |
| <sup>2</sup> Using $B(\psi(2S) \rightarrow \chi_{c1}\gamma) (9.1 \pm 0.6)\%$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     |      |                      |          |                                                              |

NODE=M055R01  
 NODE=M055R01

NODE=M055R01;LINKAGE=AL

NODE=M055R01;LINKAGE=AB

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^- (\text{non-resonant}))/\Gamma_{\text{total}}$  $\Gamma_{69}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------------------------|
| <b><math>25 \pm 6 \pm 1</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 13   | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda\bar{\Lambda}\pi^+\pi^-$ |
| <sup>1</sup> ABLIKIM 12I reports $(26.2 \pm 5.5 \pm 3.3) \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow \Lambda\bar{\Lambda}\pi^+\pi^- (\text{non-resonant}))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                                              |

NODE=M055R19  
 NODE=M055R19

NODE=M055R19;LINKAGE=AL

 $\Gamma(\Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{70}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                                            | CL% | DOCUMENT ID          | TECN     | COMMENT                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|----------|----------------------------------------------------------------|
| <b><math>&lt;1.3 \times 10^{-4}</math></b>                                                                                                                                                                                                                                                                                                                                                                                                       | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^+\bar{\Lambda}\pi^-$ |
| <sup>1</sup> ABLIKIM 12I reports $< 14 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma(1385)^+\bar{\Lambda}\pi^- + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ . |     |                      |          |                                                                |

NODE=M055R52  
 NODE=M055R52

NODE=M055R52;LINKAGE=AL

 $\Gamma(\Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{71}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                         | CL% | DOCUMENT ID          | TECN     | COMMENT                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|----------|----------------------------------------------------------------|
| <b>&lt;13</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^-\bar{\Lambda}\pi^+$ |
| <sup>1</sup> ABLIKIM 12I reports $< 14 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma(1385)^-\bar{\Lambda}\pi^+ + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ . |     |                      |          |                                                                |

NODE=M055R53  
 NODE=M055R53

NODE=M055R53;LINKAGE=AL

$\Gamma(K^+ \bar{p} \Lambda + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{72}/\Gamma$ 

| VALUE (units $10^{-4}$ )                    | EVTS                                | DOCUMENT ID            | TECN     | COMMENT                                           |
|---------------------------------------------|-------------------------------------|------------------------|----------|---------------------------------------------------|
| <b><math>4.2 \pm 0.4</math> OUR AVERAGE</b> | Error includes scale factor of 1.2. |                        |          |                                                   |
| $9.2^{+2.8}_{-2.4} \pm 0.4$                 | 24                                  | <sup>1</sup> LU        | 19 BELL  | $B^+ \rightarrow \bar{p} \Lambda K^+ K^+$         |
| $4.2 \pm 0.4 \pm 0.1$                       | 3k                                  | <sup>2,3</sup> ABLIKIM | 13D BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{p} K^+$ |
| $3.1 \pm 0.9 \pm 0.1$                       |                                     | <sup>4</sup> ATHAR     | 07 CLEO  | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$         |

<sup>1</sup> LU 19 reports  $(9.15^{+2.63}_{-2.25} \pm 0.86) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K^+ \bar{p} \Lambda + \text{c.c.})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(1P) K^+)]$  assuming  $B(B^+ \rightarrow \chi_{c1}(1P) K^+) = (4.79 \pm 0.23) \times 10^{-4}$ , which we rescale to our best value  $B(B^+ \rightarrow \chi_{c1}(1P) K^+) = (4.74 \pm 0.22) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ABLIKIM 13D reports  $(4.5 \pm 0.2 \pm 0.4) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K^+ \bar{p} \Lambda + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> Using  $B(\Lambda \rightarrow p \pi^-) = 63.9\%$ .

<sup>4</sup> ATHAR 07 reports  $(3.3 \pm 0.9 \pm 0.4) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K^+ \bar{p} \Lambda + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R22  
NODE=M055R22

NODE=M055R22;LINKAGE=A

NODE=M055R22;LINKAGE=AB

NODE=M055R22;LINKAGE=LB  
NODE=M055R22;LINKAGE=AT

 $\Gamma(K^*(892)^+ \bar{p} \Lambda + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{73}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID          | TECN      | COMMENT                                              |
|-----------------------------------------|------|----------------------|-----------|------------------------------------------------------|
| <b><math>4.9 \pm 0.7 \pm 0.1</math></b> | 328  | <sup>1</sup> ABLIKIM | 19AU BES3 | $\psi(2S) \rightarrow \gamma K^{*+} \bar{p} \Lambda$ |

<sup>1</sup> ABLIKIM 19AU reports  $[\Gamma(\chi_{c1}(1P) \rightarrow K^*(892)^+ \bar{p} \Lambda + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))] = (4.8 \pm 0.5 \pm 0.4) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R86  
NODE=M055R86

NODE=M055R86;LINKAGE=F

 $\Gamma(K^+ \bar{p} \Lambda(1520) + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{74}/\Gamma$ 

| VALUE (units $10^{-4}$ )                   | EVTS        | DOCUMENT ID          | TECN     | COMMENT                                         |
|--------------------------------------------|-------------|----------------------|----------|-------------------------------------------------|
| <b><math>1.71 \pm 0.44 \pm 0.04</math></b> | $48 \pm 10$ | <sup>1</sup> ABLIKIM | 11F BES3 | $\psi(2S) \rightarrow \gamma p \bar{p} K^+ K^-$ |

<sup>1</sup> ABLIKIM 11F reports  $(1.81 \pm 0.38 \pm 0.28) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow K^+ \bar{p} \Lambda(1520) + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R46  
NODE=M055R46

NODE=M055R46;LINKAGE=AB

 $\Gamma(\Lambda(1520) \bar{\Lambda}(1520))/\Gamma_{\text{total}}$  $\Gamma_{75}/\Gamma$ 

| VALUE                                     | CL% | DOCUMENT ID          | TECN     | COMMENT                                         |
|-------------------------------------------|-----|----------------------|----------|-------------------------------------------------|
| <b><math>&lt; 9 \times 10^{-5}</math></b> | 90  | <sup>1</sup> ABLIKIM | 11F BES3 | $\psi(2S) \rightarrow \gamma p \bar{p} K^+ K^-$ |

<sup>1</sup> ABLIKIM 11F reports  $< 1.00 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Lambda(1520) \bar{\Lambda}(1520))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R47  
NODE=M055R47

NODE=M055R47;LINKAGE=AB

 $\Gamma(\Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{76}/\Gamma$ 

| VALUE (units $10^{-5}$ )                | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                               |
|-----------------------------------------|-----|------|----------------------|----------|-------------------------------------------------------|
| <b><math>4.2 \pm 0.6 \pm 0.1</math></b> |     | 103  | <sup>1</sup> ABLIKIM | 18V BES3 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|    |    |               |                      |     |      |                                                       |
|----|----|---------------|----------------------|-----|------|-------------------------------------------------------|
| <6 | 90 |               | <sup>2</sup> ABLIKIM | 13H | BES3 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |
| <4 | 90 | $3.8 \pm 2.5$ | <sup>3</sup> NAIK    | 08  | CLEO | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |

<sup>1</sup> ABLIKIM 18V reports  $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))] = (0.41 \pm 0.05 \pm 0.03) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ABLIKIM 13H reports  $< 0.62 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

<sup>3</sup> NAIK 08 reports  $< 0.44 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R32  
NODE=M055R32

NODE=M055R32;LINKAGE=B

NODE=M055R32;LINKAGE=AB

NODE=M055R32;LINKAGE=NA

$\Gamma(\Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}$  $\Gamma_{79}/\Gamma$ 

| VALUE (units $10^{-5}$ )                | CL% | EVTs | DOCUMENT ID          | TECN     | COMMENT                                               |
|-----------------------------------------|-----|------|----------------------|----------|-------------------------------------------------------|
| <b><math>3.6 \pm 0.6 \pm 0.1</math></b> |     | 59   | <sup>1</sup> ABLIKIM | 18V BES3 | $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{\Sigma}^-$ |

NODE=M055R33  
 NODE=M055R33

• • • We do not use the following data for averages, fits, limits, etc. • • •

|    |    |               |                      |          |                                                       |
|----|----|---------------|----------------------|----------|-------------------------------------------------------|
| <8 | 90 |               | <sup>2</sup> ABLIKIM | 13H BES3 | $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{\Sigma}^-$ |
| <6 | 90 | $4.3 \pm 2.3$ | <sup>3</sup> NAIK    | 08 CLEO  | $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{\Sigma}^-$ |

<sup>1</sup> ABLIKIM 18V reports  $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))] = (0.35 \pm 0.06 \pm 0.02) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R33;LINKAGE=B

<sup>2</sup> ABLIKIM 13H reports  $< 0.87 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R33;LINKAGE=AB

<sup>3</sup> NAIK 08 reports  $< 0.65 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R33;LINKAGE=NA

 $\Gamma(\Sigma^- \bar{\Sigma}^+)/\Gamma_{\text{total}}$  $\Gamma_{80}/\Gamma$ 

| VALUE (units $10^{-5}$ )                | CL% | EVTs | DOCUMENT ID          | TECN     | COMMENT                                               |
|-----------------------------------------|-----|------|----------------------|----------|-------------------------------------------------------|
| <b><math>5.7 \pm 1.4 \pm 0.6</math></b> |     | 214  | <sup>1</sup> ABLIKIM | 20I BES3 | $\psi(2S) \rightarrow \gamma \Sigma^- \bar{\Sigma}^+$ |

NODE=M055R87  
 NODE=M055R87

<sup>1</sup> ABLIKIM 20I reports  $(5.7 \pm 1.4 \pm 0.6) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma^- \bar{\Sigma}^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ .

NODE=M055R87;LINKAGE=A

 $\Gamma(\Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}}$  $\Gamma_{81}/\Gamma$ 

| VALUE                                     | CL% | DOCUMENT ID          | TECN     | COMMENT                                                         |
|-------------------------------------------|-----|----------------------|----------|-----------------------------------------------------------------|
| <b><math>&lt; 9 \times 10^{-5}</math></b> | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda} \pi^+ \pi^-$ |

NODE=M055R54  
 NODE=M055R54

<sup>1</sup> ABLIKIM 12I reports  $< 10 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R54;LINKAGE=AL

 $\Gamma(\Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}}$  $\Gamma_{82}/\Gamma$ 

| VALUE                                     | CL% | DOCUMENT ID          | TECN     | COMMENT                                                         |
|-------------------------------------------|-----|----------------------|----------|-----------------------------------------------------------------|
| <b><math>&lt; 5 \times 10^{-5}</math></b> | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda} \pi^+ \pi^-$ |

NODE=M055R55  
 NODE=M055R55

<sup>1</sup> ABLIKIM 12I reports  $< 5.7 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R55;LINKAGE=AL

 $\Gamma(K^- \Lambda \bar{\Xi}^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{83}/\Gamma$ 

| VALUE (units $10^{-4}$ )                   | EVTs | DOCUMENT ID          | TECN     | COMMENT                                                             |
|--------------------------------------------|------|----------------------|----------|---------------------------------------------------------------------|
| <b><math>1.35 \pm 0.24 \pm 0.03</math></b> | 49   | <sup>1</sup> ABLIKIM | 15I BES3 | $\psi(2S) \rightarrow \gamma K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$ |

NODE=M055R71  
 NODE=M055R71

<sup>1</sup> ABLIKIM 15I reports  $[\Gamma(\chi_{c1}(1P) \rightarrow K^- \Lambda \bar{\Xi}^+ + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))] = (1.32 \pm 0.20 \pm 0.12) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R71;LINKAGE=A

 $\Gamma(\Xi^0 \Xi^0)/\Gamma_{\text{total}}$  $\Gamma_{84}/\Gamma$ 

| VALUE                                     | CL% | EVTs          | DOCUMENT ID       | TECN    | COMMENT                                   |
|-------------------------------------------|-----|---------------|-------------------|---------|-------------------------------------------|
| <b><math>&lt; 6 \times 10^{-5}</math></b> | 90  | $1.7 \pm 2.4$ | <sup>1</sup> NAIK | 08 CLEO | $\psi(2S) \rightarrow \gamma \Xi^0 \Xi^0$ |

NODE=M055R34  
 NODE=M055R34

<sup>1</sup> NAIK 08 reports  $< 0.60 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Xi^0 \Xi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R34;LINKAGE=NA

 $\Gamma(\Xi^- \Xi^+)/\Gamma_{\text{total}}$  $\Gamma_{85}/\Gamma$ 

| VALUE (units $10^{-4}$ )                   | CL%            | EVTs | DOCUMENT ID       | TECN    | COMMENT                                   |
|--------------------------------------------|----------------|------|-------------------|---------|-------------------------------------------|
| <b><math>0.80 \pm 0.21 \pm 0.02</math></b> | $16.4 \pm 4.3$ |      | <sup>1</sup> NAIK | 08 CLEO | $\psi(2S) \rightarrow \gamma \Xi^+ \Xi^-$ |

NODE=M055R03  
 NODE=M055R03

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |  |                      |          |                                         |
|-------|----|--|----------------------|----------|-----------------------------------------|
| < 3.4 | 90 |  | <sup>2</sup> ABLIKIM | 06D BES2 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |
|-------|----|--|----------------------|----------|-----------------------------------------|

<sup>1</sup> NAIK 08 reports  $(0.86 \pm 0.22 \pm 0.08) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \Xi^- \Xi^+) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Using  $B(\psi(2S) \rightarrow \chi_{c1} \gamma) (9.1 \pm 0.6)\%$ .

NODE=M055R03;LINKAGE=NA

$[\Gamma(\pi^+ \pi^-) + \Gamma(K^+ K^-)] / \Gamma_{\text{total}} \quad \Gamma_{86} / \Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                       |  |                      |         |                                         |
|-----------------------|--|----------------------|---------|-----------------------------------------|
| $< 21 \times 10^{-4}$ |  | <sup>1</sup> FELDMAN | 77 MRK1 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |
|-----------------------|--|----------------------|---------|-----------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |    |                        |          |                                         |
|-----------------------|----|------------------------|----------|-----------------------------------------|
| $< 38 \times 10^{-4}$ | 90 | <sup>1</sup> BRANDELIK | 79B DASP | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |
|-----------------------|----|------------------------|----------|-----------------------------------------|

<sup>1</sup> Estimated using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 0.087$ . The errors do not contain the uncertainty in the  $\psi(2S)$  decay.

NODE=M055R03;LINKAGE=AB

NODE=M055R2  
NODE=M055R2

NODE=M055R2;LINKAGE=T

$\Gamma(K_S^0 K_S^0) / \Gamma_{\text{total}} \quad \Gamma_{87} / \Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                      |    |                      |          |                                         |
|----------------------|----|----------------------|----------|-----------------------------------------|
| $< 6 \times 10^{-5}$ | 90 | <sup>1</sup> ABLIKIM | 050 BES2 | $\psi(2S) \rightarrow \chi_{c1} \gamma$ |
|----------------------|----|----------------------|----------|-----------------------------------------|

<sup>1</sup> ABLIKIM 050 reports  $[\Gamma(\chi_{c1}(1P) \rightarrow K_S^0 K_S^0) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$   $< 0.6 \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R04  
NODE=M055R04

NODE=M055R04;LINKAGE=AB

$\Gamma(\eta_c \pi^+ \pi^-) / \Gamma_{\text{total}} \quad \Gamma_{88} / \Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                        |    |                        |          |                                                             |
|------------------------|----|------------------------|----------|-------------------------------------------------------------|
| $< 3.2 \times 10^{-3}$ | 90 | <sup>1,2</sup> ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c1}$ |
|------------------------|----|------------------------|----------|-------------------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                        |    |                        |          |                                                             |
|------------------------|----|------------------------|----------|-------------------------------------------------------------|
| $< 4.4 \times 10^{-3}$ | 90 | <sup>1,3</sup> ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c1}$ |
|------------------------|----|------------------------|----------|-------------------------------------------------------------|

<sup>1</sup> Using  $1.06 \times 10^8$   $\psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c1} \gamma) = (9.2 \pm 0.4)\%$ .

<sup>2</sup> Using the  $\eta_c \rightarrow K_S^0 K^\pm \pi^\mp$  decays.

<sup>3</sup> Using the  $\eta_c \rightarrow K^+ K^- \pi^0$  decays.

NODE=M055R63  
NODE=M055R63

OCCUR=2

NODE=M055R63;LINKAGE=A

NODE=M055R63;LINKAGE=B

NODE=M055R63;LINKAGE=C

## ————— RADIATIVE DECAYS —————

$\Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}} \quad \Gamma_{89} / \Gamma$

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**34.3 ± 1.0 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                           |      |                      |          |                                |
|---------------------------|------|----------------------|----------|--------------------------------|
| $34.75 \pm 0.11 \pm 1.70$ | 1.9M | <sup>1</sup> ABLIKIM | 17U BES3 | $e^+ e^- \rightarrow \gamma X$ |
|---------------------------|------|----------------------|----------|--------------------------------|

|                        |  |                   |          |                                                             |
|------------------------|--|-------------------|----------|-------------------------------------------------------------|
| $37.9 \pm 0.8 \pm 2.1$ |  | <sup>2</sup> ADAM | 05A CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c1}$ |
|------------------------|--|-------------------|----------|-------------------------------------------------------------|

<sup>1</sup> Not independent from  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))$  and the product  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) \times B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))$  also measured in ABLIKIM 17U.

<sup>2</sup> Uses  $B(\psi(2S) \rightarrow \gamma \chi_{c1} \rightarrow \gamma \gamma J/\psi)$  from ADAM 05A and  $B(\psi(2S) \rightarrow \gamma \chi_{c1})$  from ATHAR 04.

NODE=M055R1  
NODE=M055R1

NODE=M055R1;LINKAGE=A

NODE=M055R1;LINKAGE=AD

$\Gamma(\gamma \rho^0) / \Gamma_{\text{total}} \quad \Gamma_{90} / \Gamma$

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**216 ± 17 OUR AVERAGE**

|                    |              |                      |          |                                             |
|--------------------|--------------|----------------------|----------|---------------------------------------------|
| $215 \pm 22 \pm 5$ | $432 \pm 25$ | <sup>1</sup> ABLIKIM | 11E BES3 | $\psi(2S) \rightarrow \gamma \gamma \rho^0$ |
|--------------------|--------------|----------------------|----------|---------------------------------------------|

|                    |              |                      |          |                                             |
|--------------------|--------------|----------------------|----------|---------------------------------------------|
| $217 \pm 24 \pm 5$ | $186 \pm 15$ | <sup>2</sup> BENNETT | 08A CLEO | $\psi(2S) \rightarrow \gamma \gamma \rho^0$ |
|--------------------|--------------|----------------------|----------|---------------------------------------------|

<sup>1</sup> ABLIKIM 11E reports  $(228 \pm 13 \pm 22) \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \gamma \rho^0) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> BENNETT 08A reports  $(243 \pm 19 \pm 22) \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \gamma \rho^0) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R29  
NODE=M055R29

NODE=M055R29;LINKAGE=AB

NODE=M055R29;LINKAGE=BE

$\Gamma(\gamma\omega)/\Gamma_{\text{total}}$ 
 $\Gamma_{91}/\Gamma$ 

VALUE (units  $10^{-6}$ ) EVTS DOCUMENT ID TECN COMMENT

**68 ± 8 OUR AVERAGE**

66 ± 9 ± 2 136 ± 14 <sup>1</sup> ABLIKIM 11E BES3  $\psi(2S) \rightarrow \gamma\gamma\omega$   
 74 ± 17 ± 2 39 ± 7 <sup>2</sup> BENNETT 08A CLEO  $\psi(2S) \rightarrow \gamma\gamma\omega$

<sup>1</sup> ABLIKIM 11E reports  $(69.7 \pm 7.2 \pm 6.6) \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \gamma\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> BENNETT 08A reports  $(83 \pm 15 \pm 12) \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \gamma\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M055R30  
 NODE=M055R30

NODE=M055R30;LINKAGE=AB

NODE=M055R30;LINKAGE=BE

 $\Gamma(\gamma\phi)/\Gamma_{\text{total}}$ 
 $\Gamma_{92}/\Gamma$ 

VALUE (units  $10^{-6}$ ) CL% EVTS DOCUMENT ID TECN COMMENT

**24 ± 5 ± 1** 43 ± 9 <sup>1</sup> ABLIKIM 11E BES3  $\psi(2S) \rightarrow \gamma\gamma\phi$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<23 90 5.2 ± 3.1 <sup>2</sup> BENNETT 08A CLEO  $\psi(2S) \rightarrow \gamma\gamma\phi$

<sup>1</sup> ABLIKIM 11E reports  $(25.8 \pm 5.2 \pm 2.3) \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \gamma\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.2 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> BENNETT 08A reports  $< 26 \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow \gamma\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (8.7 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = 9.75 \times 10^{-2}$ .

NODE=M055R31  
 NODE=M055R31

NODE=M055R31;LINKAGE=AB

NODE=M055R31;LINKAGE=BE

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ 
 $\Gamma_{93}/\Gamma$ 

VALUE CL% DOCUMENT ID TECN COMMENT

< **6.3 × 10<sup>-6</sup>** 90 ABLIKIM 17AE BES3  $\psi(2S) \rightarrow \gamma\chi_{c1} \rightarrow 3\gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 3.5 × 10<sup>-5</sup> 90 ECKLUND 08A CLEO  $\psi(2S) \rightarrow \gamma\chi_{c1} \rightarrow 3\gamma$

<150 × 10<sup>-5</sup> 90 <sup>1</sup> YAMADA 77 DASP  $e^+e^- \rightarrow 3\gamma$

<sup>1</sup> Estimated using  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = 0.087$ . The errors do not contain the uncertainty in the  $\psi(2S)$  decay.

NODE=M055R3  
 NODE=M055R3

NODE=M055R;LINKAGE=T1

 $\Gamma(e^+e^- J/\psi(1S))/\Gamma_{\text{total}}$ 
 $\Gamma_{94}/\Gamma$ 

VALUE (units  $10^{-3}$ ) EVTS DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

3.65 ± 0.23 ± 0.09 1.9k <sup>1,2</sup> ABLIKIM 17I BES3  $\psi(2S) \rightarrow \gamma e^+e^- J/\psi$

<sup>1</sup> ABLIKIM 17I reports  $(3.73 \pm 0.09 \pm 0.25) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c1}(1P) \rightarrow e^+e^- J/\psi(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Not independent from other measurements reported by ABLIKIM 17I

NODE=M055R79  
 NODE=M055R79

NODE=M055R79;LINKAGE=B

NODE=M055R79;LINKAGE=C

 $\Gamma(e^+e^- J/\psi(1S))/\Gamma(\gamma J/\psi(1S))$ 
 $\Gamma_{94}/\Gamma_{89}$ 

VALUE (units  $10^{-3}$ ) EVTS DOCUMENT ID TECN COMMENT

**10.1 ± 0.3 ± 0.5** 1.9k <sup>1</sup> ABLIKIM 17I BES3  $\psi(2S) \rightarrow e^+e^- \gamma J/\psi$

<sup>1</sup> Uses  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) \times B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)) = (351.8 \pm 1.0 \pm 12.0) \times 10^{-4}$  from ABLIKIM 17N and accounts for common systematic errors.

NODE=M055R80  
 NODE=M055R80

NODE=M055R80;LINKAGE=A

 $\Gamma(\mu^+\mu^- J/\psi(1S))/\Gamma(e^+e^- J/\psi(1S))$ 
 $\Gamma_{95}/\Gamma_{94}$ 

VALUE (units  $10^{-2}$ ) EVTS DOCUMENT ID TECN COMMENT

**6.73 ± 0.51 ± 0.50** 222 ABLIKIM 19Z BES3  $\psi(2S) \rightarrow \gamma\chi_c \rightarrow \gamma(\mu^+\mu^- J/\psi)$

NODE=M055R84  
 NODE=M055R84

$\chi_{c1}(1P)$  CROSS-PARTICLE BRANCHING RATIOS

NODE=M055230

$$\Gamma(\chi_{c1}(1P) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$$

$$\Gamma_{54}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

NODE=M055B1  
NODE=M055B1VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

**2.14±0.10 OUR FIT****1.1 ±1.0**<sup>1</sup> BAI

98I

BES

 $\psi(2S) \rightarrow \gamma\chi_{c1} \rightarrow \gamma\bar{p}p$ 

<sup>1</sup> Calculated by us. The value for  $B(\chi_{c1} \rightarrow p\bar{p})$  reported in BAI 98I is derived using  $B(\psi(2S) \rightarrow \gamma\chi_{c1}) = (8.7 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D].

NODE=M055B;LINKAGE=J2

$$\Gamma(\chi_{c1}(1P) \rightarrow \Lambda\bar{\Lambda})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{67}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

NODE=M055B10  
NODE=M055B10VALUE (units  $10^{-6}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**11.1±1.1 OUR FIT****10.9±1.1 OUR AVERAGE**

11.2±1.0±0.9

136

<sup>1</sup> ABLIKIM

13H

BES3

 $\psi(2S) \rightarrow \gamma\Lambda\bar{\Lambda}$ 

10.5±1.6±0.6

46 ± 7

<sup>2</sup> NAIK

08

CLEO

 $\psi(2S) \rightarrow \gamma\Lambda\bar{\Lambda}$ 

<sup>1</sup> Calculated by us. ABLIKIM 13H reports  $B(\chi_{c1} \rightarrow \Lambda\bar{\Lambda}) = (12.2 \pm 1.1 \pm 1.1) \times 10^{-5}$  from a measurement of  $B(\chi_{c1} \rightarrow \Lambda\bar{\Lambda}) \times B(\psi(2S) \rightarrow \gamma\chi_{c1})$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}) = (9.2 \pm 0.4)\%$ .

NODE=M055B10;LINKAGE=AB

<sup>2</sup> Calculated by us. NAIK 08 reports  $B(\chi_{c1} \rightarrow \Lambda\bar{\Lambda}) = (11.6 \pm 1.8 \pm 0.7 \pm 0.7) \times 10^{-5}$  using  $B(\psi(2S) \rightarrow \gamma\chi_{c1}) = (9.07 \pm 0.11 \pm 0.54)\%$ .

NODE=M055B10;LINKAGE=NA

$$\Gamma(\chi_{c1}(1P) \rightarrow \Lambda\bar{\Lambda})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$$

$$\Gamma_{67}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

NODE=M055B11  
NODE=M055B11VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**3.20±0.30 OUR FIT****7.1  $^{+2.8}_{-2.4}$  ±1.3**9.0  $^{+3.5}_{-3.1}$ <sup>1</sup> BAI

03E

BES

 $\psi(2S) \rightarrow \gamma\Lambda\bar{\Lambda}$ 

<sup>1</sup> BAI 03E reports  $[B(\chi_{c1} \rightarrow \Lambda\bar{\Lambda}) B(\psi(2S) \rightarrow \gamma\chi_{c1}) / B(\psi(2S) \rightarrow J/\psi\pi^+\pi^-)] \times [B^2(\Lambda \rightarrow \pi^-p) / B(J/\psi \rightarrow p\bar{p})] = (1.33^{+0.52}_{-0.46} \pm 0.25)\%$ . We calculate from this measurement the presented value using  $B(\Lambda \rightarrow \pi^-p) = (63.9 \pm 0.5)\%$  and  $B(J/\psi \rightarrow p\bar{p}) = (2.17 \pm 0.07) \times 10^{-3}$ .

NODE=M055B11;LINKAGE=BA

$$\Gamma(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{89}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

NODE=M055B2  
NODE=M055B2VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**3.34 ±0.06 OUR FIT****3.24 ±0.16 OUR AVERAGE**

Error includes scale factor of 2.1. See the ideogram below.

3.518±0.010±0.120

143k

<sup>1</sup> ABLIKIM

17N

BES3

 $\psi(2S) \rightarrow \gamma\gamma J/\psi$ 

3.442±0.010±0.132

1.9M

ABLIKIM

17U

BES3

 $e^+e^- \rightarrow \gamma X$ 

2.81 ±0.05 ±0.23

13k

BAI

04I

BES2

 $\psi(2S) \rightarrow J/\psi\gamma\gamma$ 

2.56 ±0.12 ±0.20

GAISER

86

CBAL

 $\psi(2S) \rightarrow \gamma X$ 

2.78 ±0.30

<sup>2</sup> OREGLIA

82

CBAL

 $\psi(2S) \rightarrow \gamma\chi_{c1}$ 

2.2 ±0.5

<sup>3</sup> BRANDELIK

79B

DASP

 $\psi(2S) \rightarrow \gamma\chi_{c1}$ 

2.9 ±0.5

<sup>3</sup> BARTEL

78B

CNTR

 $\psi(2S) \rightarrow \gamma\chi_{c1}$ 

5.0 ±1.5

<sup>4</sup> BIDDICK

77

CNTR

 $e^+e^- \rightarrow \gamma X$ 

2.8 ±0.9

<sup>2</sup> WHITAKER

76

MRK1

 $e^+e^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

3.377±0.009±0.183

142k

<sup>5</sup> ABLIKIM

12O

BES3

 $\psi(2S) \rightarrow \gamma\chi_{c1}$ 

3.56 ±0.03 ±0.12

24.9k

<sup>6</sup> MENDEZ

08

CLEO

 $\psi(2S) \rightarrow \gamma\chi_{c1}$ 

3.44 ±0.06 ±0.13

3.7k

<sup>7</sup> ADAM

05A

CLEO

Repl. by MENDEZ 08

<sup>1</sup> Uses  $B(J/\psi \rightarrow e^+e^-) = (5.971 \pm 0.032)\%$  and  $B(J/\psi \rightarrow \mu^+\mu^-) = (5.961 \pm 0.033)\%$ .

NODE=M055B2;LINKAGE=A

<sup>2</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = 0.1181 \pm 0.0020$ .

NODE=M055B;LINKAGE=3Q

<sup>3</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = 0.0588 \pm 0.0010$ .

NODE=M055B;LINKAGE=2Q

<sup>4</sup> Assumes isotropic gamma distribution.

NODE=M055B;LINKAGE=EA

<sup>5</sup> Superseded by ABLIKIM 17N.

NODE=M055B2;LINKAGE=B

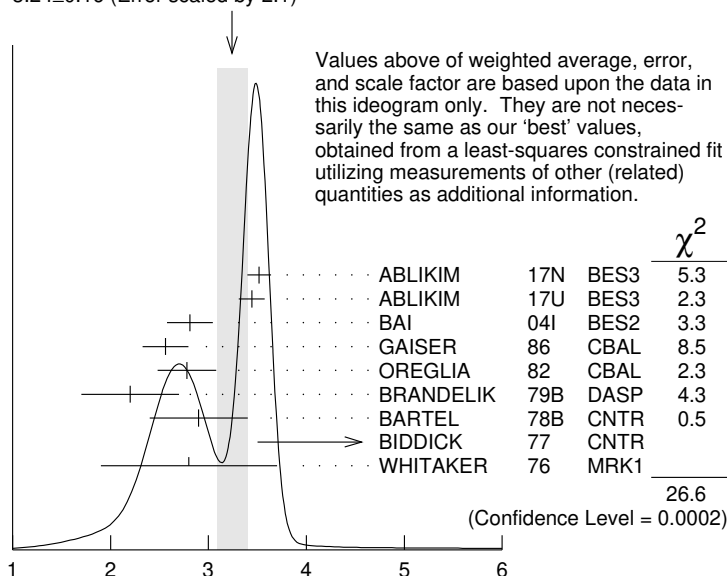
<sup>6</sup> Not independent from other measurements of MENDEZ 08.

NODE=M055B2;LINKAGE=ME

<sup>7</sup> Not independent from other values reported by ADAM 05A.

NODE=M055B;LINKAGE=AD

WEIGHTED AVERAGE  
3.24±0.16 (Error scaled by 2.1)



$$\Gamma(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))/\Gamma_{\text{total}} \text{ (units } 10^{-2})$$

$$\Gamma(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S) \text{ anything})$$

$$\Gamma_{89}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_9^{\psi(2S)} = \Gamma_{89}/\Gamma \times \Gamma_{152}^{\psi(2S)}/(\Gamma_{11}^{\psi(2S)} + \Gamma_{12}^{\psi(2S)} + \Gamma_{13}^{\psi(2S)} + 0.343\Gamma_{152}^{\psi(2S)} + 0.190\Gamma_{153}^{\psi(2S)})$$

NODE=M055B7

NODE=M055B7

NODE=M055B7

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**5.43±0.10 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |       |                     |     |      |                                         |
|----------------|-------|---------------------|-----|------|-----------------------------------------|
| 5.70±0.04±0.15 | 24.9k | <sup>1</sup> MENDEZ | 08  | CLEO | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |
| 5.77±0.10±0.12 | 3.7k  | ADAM                | 05A | CLEO | Repl. by MENDEZ 08                      |

<sup>1</sup> Not independent from other measurements of MENDEZ 08.

NODE=M055B7;LINKAGE=ME

$$\Gamma(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_{89}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**9.63±0.17 OUR FIT**

**10.15±0.28 OUR AVERAGE**

|                 |       |                      |     |      |                                         |
|-----------------|-------|----------------------|-----|------|-----------------------------------------|
| 10.17±0.07±0.27 | 24.9k | MENDEZ               | 08  | CLEO | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |
| 12.6 ±0.3 ±3.8  | 3k    | <sup>1</sup> ABLIKIM | 04B | BES  | $\psi(2S) \rightarrow J/\psi X$         |
| 8.5 ±2.1        |       | <sup>2</sup> HIMEL   | 80  | MRK2 | $\psi(2S) \rightarrow \gamma \chi_{c1}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |      |                   |     |      |                    |
|-----------------|------|-------------------|-----|------|--------------------|
| 10.24±0.17±0.23 | 3.7k | <sup>3</sup> ADAM | 05A | CLEO | Repl. by MENDEZ 08 |
|-----------------|------|-------------------|-----|------|--------------------|

<sup>1</sup> From a fit to the  $J/\psi$  recoil mass spectra.

<sup>2</sup> The value for  $B(\psi(2S) \rightarrow \gamma \chi_{c1}) \times B(\chi_{c1} \rightarrow \gamma J/\psi(1S))$  quoted in HIMEL 80 is derived using  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (33 \pm 3)\%$  and  $B(J/\psi(1S) \rightarrow \ell^+ \ell^-) = 0.138 \pm 0.018$ . Calculated by us using  $B(J/\psi(1S) \rightarrow \ell^+ \ell^-) = 0.1181 \pm 0.0020$ .

<sup>3</sup> Not independent from other values reported by ADAM 05A.

NODE=M055B;LINKAGE=AB

NODE=M055B;LINKAGE=J3

NODE=M055B3;LINKAGE=AD

$$\Gamma(\chi_{c1}(1P) \rightarrow \bar{K}^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{17}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-4}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**6.8±0.5 OUR FIT**

**7.2±0.6 OUR AVERAGE**

|             |                      |     |      |                                               |
|-------------|----------------------|-----|------|-----------------------------------------------|
| 7.3±0.5±0.5 | <sup>1</sup> ATHAR   | 07  | CLEO | $\psi(2S) \rightarrow \gamma K_S^0 K^+ \pi^-$ |
| 7.0±0.5±0.9 | <sup>2</sup> ABLIKIM | 06R | BES2 | $\psi(2S) \rightarrow \gamma \chi_{c1}$       |

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c1} \rightarrow K^0 K^+ \pi^- + \text{c.c.})$  reported by ATHAR 07 was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (9.07 \pm 0.11 \pm 0.54)\%$ .

<sup>2</sup> Calculated by us. ABLIKIM 06R reports  $B(\chi_{c1} \rightarrow K_S^0 K^+ \pi^-) = (4.0 \pm 0.3 \pm 0.5) \times 10^{-3}$ . We use  $B(\psi(2S) \rightarrow \gamma \chi_{c1}) = (8.7 \pm 0.4) \times 10^{-2}$ .

NODE=M055B16

NODE=M055B16

NODE=M055B16;LINKAGE=AT

NODE=M055B16;LINKAGE=AB



$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow \bar{K}^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))/\Gamma_{\text{total}}}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \quad \frac{\Gamma_{17}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**19.6 ± 1.6 OUR FIT****13.2 ± 2.4 ± 3.2**<sup>1</sup> BAI

99B

BES

 $\psi(2S) \rightarrow \gamma K_S^0 K^+ \pi^-$ 

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c1} \rightarrow K_S^0 K^+ \pi^-)$  reported by BAI 99B was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D].

NODE=M055B17  
NODE=M055B17

NODE=M055B17;LINKAGE=BA

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow K^+ K^- K^+ K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))/\Gamma_{\text{total}}}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \quad \frac{\Gamma_{44}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**0.53 ± 0.11 OUR FIT****0.61 ± 0.11 ± 0.08**

54

<sup>1</sup> ABLIKIM

06T

BES2

 $\psi(2S) \rightarrow \gamma K^+ K^+ K^- K^-$ 

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c1} \rightarrow 2K^+ 2K^-)$  reported by ABLIKIM 06T was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.8)\%$ .

NODE=M055B14  
NODE=M055B14

NODE=M055B14;LINKAGE=AB

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow K^+ K^- K^+ K^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))/\Gamma_{\text{total}}}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \quad \frac{\Gamma_{44}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**1.52 ± 0.31 OUR FIT****1.13 ± 0.40 ± 0.29**<sup>1</sup> BAI

99B

BES

 $\psi(2S) \rightarrow \gamma K^+ K^+ K^- K^-$ 

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c1} \rightarrow 2K^+ 2K^-)$  reported by BAI 99B was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) = (8.7 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D].

NODE=M055B15  
NODE=M055B15

NODE=M055B15;LINKAGE=BA

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow p \bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))/\Gamma_{\text{total}}}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \quad \frac{\Gamma_{54}/\Gamma \times \Gamma_{152}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-6}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**7.41 ± 0.35 OUR FIT****7.8 ± 0.6 OUR AVERAGE**

Error includes scale factor of 1.4. See the ideogram below.

7.9 ± 0.4 ± 0.3

453

ABLIKIM

13v

BES3

 $\psi(2S) \rightarrow \gamma p \bar{p}$ 

8.2 ± 0.7 ± 0.4

141 ± 13

<sup>1</sup> NAIK

08

CLEO

 $\psi(2S) \rightarrow \gamma p \bar{p}$ 4.8  $^{+1.4}_{-1.3}$  ± 0.618.2  $^{+5.5}_{-4.9}$ 

BAI

04F

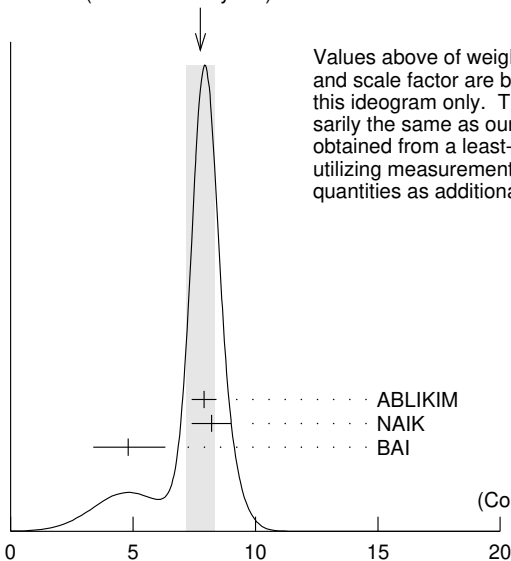
BES

 $\psi(2S) \rightarrow \gamma \chi_{c1}(1P) \rightarrow \gamma p \bar{p}$ 

<sup>1</sup> Calculated by us. NAIK 08 reports  $B(\chi_{c1} \rightarrow p \bar{p}) = (9.0 \pm 0.8 \pm 0.4 \pm 0.5) \times 10^{-5}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}) = (9.07 \pm 0.11 \pm 0.54)\%$ .

NODE=M055B6  
NODE=M055B6

NODE=M055B6;LINKAGE=NA

WEIGHTED AVERAGE  
7.8 ± 0.6 (Error scaled by 1.4)

Values above of weighted average, error, and scale factor are based upon the data in this ideogram only. They are not necessarily the same as our 'best' values, obtained from a least-squares constrained fit utilizing measurements of other (related) quantities as additional information.

$$\Gamma(\chi_{c1}(1P) \rightarrow p \bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))/\Gamma_{\text{total}} \quad (\text{units } 10^{-6})$$

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow \Sigma^+ \bar{p} K_S^0 + \text{c.c.})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{77}}{\Gamma} \times \frac{\Gamma_{152}^{\psi(2S)}}{\Gamma \psi(2S)}$$

| VALUE (units $10^{-5}$ )  | EVTS | DOCUMENT ID          | TECN      | COMMENT                                                            |
|---------------------------|------|----------------------|-----------|--------------------------------------------------------------------|
| <b>1.49 ± 0.09 ± 0.07</b> | 258  | <sup>1</sup> ABLIKIM | 19BB BES3 | $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{p} K_S^0 + \text{c.c.}$ |

<sup>1</sup> Calculated by us. ABLIKIM 19BB reports  $B(\chi_{c1} \rightarrow \Sigma^+ \bar{p} K_S^0 + \text{c.c.}) = (1.53 \pm 0.10 \pm 0.08) \times 10^{-4}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}) = (9.75 \pm 0.24)\%$  and other branching fractions from PDG 18.

NODE=M055B01  
NODE=M055B01

NODE=M055B01;LINKAGE=A

$$\frac{\Gamma(\chi_{c1}(1P) \rightarrow \Sigma^0 \bar{p} K^+ + \text{c.c.})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c1}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{78}}{\Gamma} \times \frac{\Gamma_{152}^{\psi(2S)}}{\Gamma \psi(2S)}$$

| VALUE (units $10^{-5}$ )  | EVTS | DOCUMENT ID          | TECN      | COMMENT                                                          |
|---------------------------|------|----------------------|-----------|------------------------------------------------------------------|
| <b>1.42 ± 0.07 ± 0.06</b> | 493  | <sup>1</sup> ABLIKIM | 20AE BES3 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{p} K^+ + \text{c.c.}$ |

<sup>1</sup> Calculated by us. ABLIKIM 20AE reports  $B(\chi_{c1} \rightarrow \Sigma^0 \bar{p} K^+ + \text{c.c.}) = (1.46 \pm 0.07 \pm 0.07) \times 10^{-4}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c1}) = (9.75 \pm 0.24)\%$  and other branching fractions from PDG 20.

NODE=M055R88  
NODE=M055R88

NODE=M055R88;LINKAGE=A

### MULTIPOLE AMPLITUDES IN $\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)$

**$a_2 = M2/\sqrt{E1^2 + M2^2}$  Magnetic quadrupole fractional transition amplitude**

| VALUE (units $10^{-2}$ )             | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                                                  |
|--------------------------------------|------|-------------------------------------------------------------|----------|--------------------------------------------------------------------------|
| <b>-6.7 ± 0.9 OUR AVERAGE</b>        |      | Error includes scale factor of 2.6. See the ideogram below. |          |                                                                          |
| -7.40 ± 0.33 ± 0.34                  | 164k | <sup>1</sup> ABLIKIM                                        | 17N BES3 | $\psi(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$                       |
| -6.26 ± 0.63 ± 0.24                  | 39k  | ARTUSO                                                      | 09 CLEO  | $\psi(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$                       |
| 0.2 ± 3.2 ± 0.4                      | 2090 | AMBROGIANI                                                  | 02 E835  | $\rho \bar{\rho} \rightarrow \chi_{c1} \rightarrow J/\psi \gamma$        |
| -0.2 <sup>+0.8</sup> <sub>-2.0</sub> | 921  | OREGLIA                                                     | 82 CBAL  | $\psi(2S) \rightarrow \chi_{c1} \gamma \rightarrow J/\psi \gamma \gamma$ |

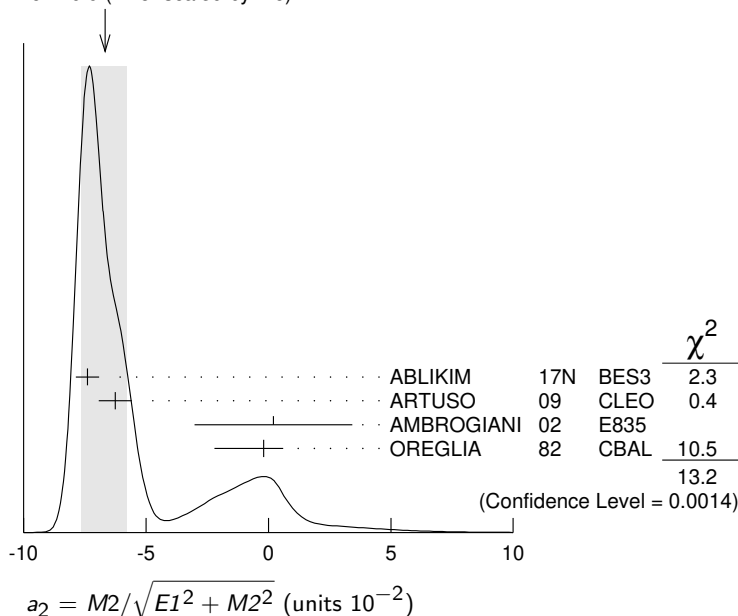
<sup>1</sup> Correlated with  $b_2$  with correlation coefficient  $\rho_{a_2 b_2} = 0.133$ .

NODE=M055240

NODE=M055A1  
NODE=M055A1

NODE=M055A1;LINKAGE=A

WEIGHTED AVERAGE  
-6.7 ± 0.9 (Error scaled by 2.6)



### MULTIPOLE AMPLITUDES IN $\psi(2S) \rightarrow \gamma \chi_{c1}(1S)$ RADIATIVE DECAY

**$b_2 = M2/\sqrt{E1^2 + M2^2}$  Magnetic quadrupole fractional transition amplitude**

| VALUE (units $10^{-2}$ )            | EVTS | DOCUMENT ID          | TECN     | COMMENT                                            |
|-------------------------------------|------|----------------------|----------|----------------------------------------------------|
| <b>2.5 ± 0.4 OUR AVERAGE</b>        |      |                      |          |                                                    |
| 2.29 ± 0.39 ± 0.27                  | 164k | <sup>1</sup> ABLIKIM | 17N BES3 | $\psi(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| 2.76 ± 0.73 ± 0.23                  | 39k  | ARTUSO               | 09 CLEO  | $\psi(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| 7.7 <sup>+5.0</sup> <sub>-4.5</sub> | 921  | OREGLIA              | 82 CBAL  | $\psi(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

<sup>1</sup> Correlated with  $a_2$  with correlation coefficient  $\rho_{a_2 b_2} = 0.133$ .

NODE=M055250

NODE=M055QB2  
NODE=M055QB2

NODE=M055QB2;LINKAGE=A

# MULTIPOLE AMPLITUDE RATIOS IN RADIATIVE DECAYS

$$\psi(2S) \rightarrow \gamma \chi_{c1}(1S) \text{ and } \chi_{c1} \rightarrow \gamma J/\psi(1S)$$

## $a_2/b_2$ Magnetic quadrupole transition amplitude ratio

| VALUE                   | EVTS | DOCUMENT ID         | TECN | COMMENT                                                 |
|-------------------------|------|---------------------|------|---------------------------------------------------------|
| $-2.27^{+0.57}_{-0.99}$ | 39k  | <sup>1</sup> ARTUSO | 09   | CLEO $\psi(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

<sup>1</sup> Statistical and systematic errors combined. Not independent of  $a_2(\chi_{c1})$  and  $b_2(\chi_{c1})$  values from ARTUSO 09.

NODE=M055260

NODE=M055QAR  
NODE=M055QAR

NODE=M055QAR;LINKAGE=AR

## $\chi_{c1}(1P)$ REFERENCES

NODE=M055

|            |      |                  |                              |                                 |             |
|------------|------|------------------|------------------------------|---------------------------------|-------------|
| ABLIKIM    | 20AE | PR D102 092006   | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=60733 |
| ABLIKIM    | 20B  | PR D101 012012   | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=60212 |
| ABLIKIM    | 20I  | PR D101 092002   | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=60303 |
| PDG        | 20   | PTEP 2020 083C01 | P.A. Zyla <i>et al.</i>      | (PDG Collab.)                   | REFID=60676 |
| ABLIKIM    | 19AA | PR D99 052008    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=59844 |
| ABLIKIM    | 19AU | PR D100 052010   | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=59996 |
| ABLIKIM    | 19BB | PR D100 092006   | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=60026 |
| ABLIKIM    | 19J  | PR D99 012015    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=59606 |
| ABLIKIM    | 19Z  | PR D99 051101    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=59837 |
| LU         | 19   | PR D99 032003    | P.-C. Lu <i>et al.</i>       | (BELLE Collab.)                 | REFID=59614 |
| ABLIKIM    | 18D  | PRL 121 022001   | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=58849 |
| ABLIKIM    | 18V  | PR D97 052011    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=58990 |
| PDG        | 18   | PR D98 030001    | M. Tanabashi <i>et al.</i>   | (PDG Collab.)                   | REFID=59304 |
| AAIJ       | 17BB | EPJ C77 609      | R. Aaij <i>et al.</i>        | (LHCb Collab.)                  | REFID=58191 |
| AAIJ       | 17BI | PRL 119 221801   | R. Aaij <i>et al.</i>        | (LHCb Collab.)                  | REFID=58278 |
| ABLIKIM    | 17AE | PR D96 092007    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=58310 |
| ABLIKIM    | 17I  | PRL 118 221802   | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=57931 |
| ABLIKIM    | 17K  | PR D95 032002    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=57953 |
| ABLIKIM    | 17N  | PR D95 072004    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=57978 |
| ABLIKIM    | 17U  | PR D96 032001    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=58026 |
| PDG        | 16   | CP C40 100001    | C. Patrignani <i>et al.</i>  | (PDG Collab.)                   | REFID=57140 |
| ABLIKIM    | 15I  | PR D91 092006    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=56774 |
| ABLIKIM    | 15M  | PR D91 112008    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=56778 |
| ABLIKIM    | 14J  | PR D89 074030    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=55901 |
| ABLIKIM    | 13B  | PR D87 012002    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=54877 |
| ABLIKIM    | 13D  | PR D87 012007    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=54879 |
| ABLIKIM    | 13H  | PR D87 032007    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=54953 |
| ABLIKIM    | 13V  | PR D88 112001    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=55583 |
| ABLIKIM    | 12I  | PR D86 052004    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=54736 |
| ABLIKIM    | 12J  | PR D86 052011    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=54737 |
| ABLIKIM    | 12O  | PRL 109 172002   | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=54742 |
| ABLIKIM    | 11A  | PR D83 012006    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=53647 |
| ABLIKIM    | 11D  | PR D83 032003    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=16715 |
| ABLIKIM    | 11E  | PR D83 112005    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=16717 |
| ABLIKIM    | 11F  | PR D83 112009    | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=16719 |
| ABLIKIM    | 11K  | PRL 107 092001   | M. Ablikim <i>et al.</i>     | (BESIII Collab.)                | REFID=53940 |
| ONYISI     | 10   | PR D82 011103    | P.U.E. Onyisi <i>et al.</i>  | (CLEO Collab.)                  | REFID=53360 |
| ARTUSO     | 09   | PR D80 112003    | M. Artuso <i>et al.</i>      | (CLEO Collab.)                  | REFID=53206 |
| BENNETT    | 08A  | PRL 101 151801   | J.V. Bennett <i>et al.</i>   | (CLEO Collab.)                  | REFID=52575 |
| ECKLUND    | 08A  | PR D78 091501    | K.M. Ecklund <i>et al.</i>   | (CLEO Collab.)                  | REFID=52583 |
| HE         | 08B  | PR D78 092004    | Q. He <i>et al.</i>          | (CLEO Collab.)                  | REFID=52588 |
| MENDEZ     | 08   | PR D78 011102    | H. Mendez <i>et al.</i>      | (CLEO Collab.)                  | REFID=52684 |
| NAIK       | 08   | PR D78 031101    | P. Naik <i>et al.</i>        | (CLEO Collab.)                  | REFID=52301 |
| ATHAR      | 07   | PR D75 032002    | S.B. Athar <i>et al.</i>     | (CLEO Collab.)                  | REFID=51618 |
| ABLIKIM    | 06D  | PR D73 052006    | M. Ablikim <i>et al.</i>     | (BES Collab.)                   | REFID=51049 |
| ABLIKIM    | 06R  | PR D74 072001    | M. Ablikim <i>et al.</i>     | (BES Collab.)                   | REFID=51447 |
| ABLIKIM    | 06T  | PL B642 197      | M. Ablikim <i>et al.</i>     | (BES Collab.)                   | REFID=51453 |
| ABLIKIM    | 05G  | PR D71 092002    | M. Ablikim <i>et al.</i>     | (BES Collab.)                   | REFID=50756 |
| ABLIKIM    | 05O  | PL B630 21       | M. Ablikim <i>et al.</i>     | (BES Collab.)                   | REFID=50846 |
| ADAM       | 05A  | PRL 94 232002    | N.E. Adam <i>et al.</i>      | (CLEO Collab.)                  | REFID=50763 |
| ANDREOTTI  | 05A  | NP B717 34       | M. Andreotti <i>et al.</i>   | (FNAL E835 Collab.)             | REFID=50769 |
| ABLIKIM    | 04B  | PR D70 012003    | M. Ablikim <i>et al.</i>     | (BES Collab.)                   | REFID=49741 |
| ABLIKIM    | 04H  | PR D70 092003    | M. Ablikim <i>et al.</i>     | (BES Collab.)                   | REFID=50188 |
| ATHAR      | 04   | PR D70 112002    | S.B. Athar <i>et al.</i>     | (CLEO Collab.)                  | REFID=50331 |
| BAI        | 04F  | PR D69 092001    | J.Z. Bai <i>et al.</i>       | (BES Collab.)                   | REFID=49752 |
| BAI        | 04I  | PR D70 012006    | J.Z. Bai <i>et al.</i>       | (BES Collab.)                   | REFID=49755 |
| AULCHENKO  | 03   | PL B573 63       | V.M. Aulchenko <i>et al.</i> | (KEDR Collab.)                  | REFID=49579 |
| BAI        | 03E  | PR D67 112001    | J.Z. Bai <i>et al.</i>       | (BES Collab.)                   | REFID=49416 |
| AMBROGIANI | 02   | PR D65 052002    | M. Ambrogiani <i>et al.</i>  | (FNAL E835 Collab.)             | REFID=48552 |
| BAI        | 99B  | PR D60 072001    | J.Z. Bai <i>et al.</i>       | (BES Collab.)                   | REFID=47385 |
| BAI        | 98D  | PR D58 092006    | J.Z. Bai <i>et al.</i>       | (BES Collab.)                   | REFID=46338 |
| BAI        | 98I  | PRL 81 3091      | J.Z. Bai <i>et al.</i>       | (BES Collab.)                   | REFID=46343 |
| ARMSTRONG  | 92   | NP B373 35       | T.A. Armstrong <i>et al.</i> | (FNAL, FERR, GENO+)             | REFID=41865 |
| Also       |      | PRL 68 1468      | T.A. Armstrong <i>et al.</i> | (FNAL, FERR, GENO+)             | REFID=41907 |
| BAGLIN     | 86B  | PL B172 455      | C. Baglin                    | (LAPP, CERN, GENO, LYON, OSLO+) | REFID=22145 |
| GAISER     | 86   | PR D34 711       | J. Gaiser <i>et al.</i>      | (Crystal Ball Collab.)          | REFID=22012 |
| LEMOIGNE   | 82   | PL 113B 509      | Y. Lemoigne <i>et al.</i>    | (SACL, LOIC, SHMP+)             | REFID=22084 |
| OREGLIA    | 82   | PR D25 2259      | M.J. Oreglia <i>et al.</i>   | (SLAC, CIT, HARV+)              | REFID=22120 |
| Also       |      | Private Comm.    | M.J. Oreglia                 | (EFI)                           | REFID=22143 |
| HIMEL      | 80   | PRL 44 920       | T. Himel <i>et al.</i>       | (LBL, SLAC)                     | REFID=22119 |
| Also       |      | Private Comm.    | G. Trilling                  | (LBL, UCB)                      | REFID=22113 |
| BRANDELIK  | 79B  | NP B160 426      | R. Brandelik <i>et al.</i>   | (DASP Collab.)                  | REFID=22115 |
| BARTEL     | 78B  | PL 79B 492       | W. Bartel <i>et al.</i>      | (DESY, HEIDP)                   | REFID=22111 |
| TANENBAUM  | 78   | PR D17 1731      | W.M. Tanenbaum <i>et al.</i> | (SLAC, LBL)                     | REFID=22112 |
| Also       |      | Private Comm.    | G. Trilling                  | (LBL, UCB)                      | REFID=22113 |
| BIDDICK    | 77   | PRL 38 1324      | C.J. Biddick <i>et al.</i>   | (UCSD, UMD, PAVI+)              | REFID=22059 |
| FELDMAN    | 77   | PRPL 33C 285     | G.J. Feldman, M.L. Perl      | (LBL, SLAC)                     | REFID=22062 |
| YAMADA     | 77   | Hamburg Conf. 69 | S. Yamada                    | (DASP Collab.)                  | REFID=22064 |
| WHITAKER   | 76   | PRL 37 1596      | J.S. Whitaker <i>et al.</i>  | (SLAC, LBL)                     | REFID=22151 |
| TANENBAUM  | 75   | PRL 35 1323      | W.M. Tanenbaum <i>et al.</i> | (LBL, SLAC)                     | REFID=22106 |

# $h_c(1P)$

$$I^G(J^{PC}) = 0^-(1^{+-})$$

Quantum numbers are quark model prediction,  $C = -$  established by  $\eta_c \gamma$  decay.

NODE=M144

NODE=M144

NODE=M144M

NODE=M144M

## $h_c(1P)$ MASS

| VALUE (MeV)                                                                   | EVTS                             | DOCUMENT ID            | TECN     | COMMENT                                                 |
|-------------------------------------------------------------------------------|----------------------------------|------------------------|----------|---------------------------------------------------------|
| <b>3525.38±0.11 OUR AVERAGE</b>                                               |                                  |                        |          |                                                         |
| 3525.31±0.11±0.14                                                             | 832                              | <sup>1</sup> ABLIKIM   | 12N BES3 | $\psi(2S) \rightarrow \pi^0 \gamma$ hadrons             |
| 3525.40±0.13±0.18                                                             | 3679                             | ABLIKIM                | 10B BES3 | $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$              |
| 3525.20±0.18±0.12                                                             | 1282                             | <sup>2</sup> DOBBS     | 08A CLEO | $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$              |
| 3525.8 ±0.2 ±0.2                                                              | 13                               | ANDREOTTI              | 05B E835 | $\bar{p} p \rightarrow \eta_c \gamma$                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                  |                        |          |                                                         |
| 3525.6 ±0.5                                                                   | 92 <sup>+23</sup> <sub>-22</sub> | ADAMS                  | 09 CLEO  | $\psi(2S) \rightarrow 2(\pi^+ \pi^- \pi^0)$             |
| 3524.4 ±0.6 ±0.4                                                              | 168 ± 40                         | <sup>3</sup> ROSNER    | 05 CLEO  | $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$              |
| 3527 ±8                                                                       | 42                               | ANTONIAZZI             | 94 E705  | 300 $\pi^\pm$ , $p\text{Li} \rightarrow J/\psi \pi^0 X$ |
| 3526.28±0.18±0.19                                                             | 59                               | <sup>4</sup> ARMSTRONG | 92D E760 | $\bar{p} p \rightarrow J/\psi \pi^0$                    |
| 3525.4 ±0.8 ±0.4                                                              | 5                                | BAGLIN                 | 86 SPEC  | $\bar{p} p \rightarrow J/\psi X$                        |

<sup>1</sup>With floating width.

<sup>2</sup>Combination of exclusive and inclusive analyses for the reaction  $\psi(2S) \rightarrow \pi^0 h_c \rightarrow \pi^0 \eta_c \gamma$ . This result is the average of DOBBS 08A and ROSNER 05.

<sup>3</sup>Superseded by DOBBS 08A.

<sup>4</sup>Mass central value and systematic error recalculated by us according to Eq.(16) in ARMSTRONG 93B, using the value for the  $\psi(2S)$  mass from AULCHENKO 03.

NODE=M144M;LINKAGE=AB

NODE=M144M;LINKAGE=DO

NODE=M144M;LINKAGE=RO

NODE=M144M;LINKAGE=NW

## $h_c(1P)$ WIDTH

| VALUE (MeV)                                                                   | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                    |
|-------------------------------------------------------------------------------|-----|------|----------------------|----------|--------------------------------------------|
| <b>0.70±0.28±0.22</b>                                                         |     |      |                      |          |                                            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                      |          |                                            |
| < 1.44                                                                        | 90  | 3679 | <sup>2</sup> ABLIKIM | 10B BES3 | $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$ |
| < 1                                                                           |     | 13   | ANDREOTTI            | 05B E835 | $\bar{p} p \rightarrow \eta_c \gamma$      |
| < 1.1                                                                         | 90  | 59   | ARMSTRONG            | 92D E760 | $\bar{p} p \rightarrow J/\psi \pi^0$       |

<sup>1</sup>With floating mass.

<sup>2</sup>The central value is  $\Gamma = 0.73 \pm 0.45 \pm 0.28$  MeV.

NODE=M144W

NODE=M144W

NODE=M144W;LINKAGE=AL

NODE=M144W;LINKAGE=AB

## $h_c(1P)$ DECAY MODES

NODE=M144215;NODE=M144

| Mode                                          | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|-----------------------------------------------|--------------------------------|------------------|
| $\Gamma_1 J/\psi(1S)\pi^0$                    |                                |                  |
| $\Gamma_2 J/\psi(1S)\pi\pi$                   | not seen                       |                  |
| $\Gamma_3 J/\psi(1S)\pi^+\pi^-$               | < 2.3 $\times 10^{-3}$         | 90%              |
| $\Gamma_4 p\bar{p}$                           | < 1.5 $\times 10^{-4}$         | 90%              |
| $\Gamma_5 p\bar{p}\pi^+\pi^-$                 | ( 2.9±0.6 ) $\times 10^{-3}$   |                  |
| $\Gamma_6 p\bar{p}\pi^0\pi^0$                 | < 5 $\times 10^{-4}$           | 90%              |
| $\Gamma_7 \pi^+\pi^-\pi^0$                    | ( 1.6±0.5 ) $\times 10^{-3}$   |                  |
| $\Gamma_8 \pi^+\pi^-\pi^0\eta$                | ( 7.2±2.3 ) $\times 10^{-3}$   |                  |
| $\Gamma_9 2\pi^+2\pi^-\pi^0$                  | ( 8.1±1.8 ) $\times 10^{-3}$   |                  |
| $\Gamma_{10} 3\pi^+3\pi^-\pi^0$               | < 9 $\times 10^{-3}$           | 90%              |
| $\Gamma_{11} K^+K^-\pi^+\pi^-$                | < 6 $\times 10^{-4}$           | 90%              |
| $\Gamma_{12} K^+K^-\pi^+\pi^-\pi^0$           | ( 3.2±0.8 ) $\times 10^{-3}$   |                  |
| $\Gamma_{13} K^+K^-\pi^+\pi^-\eta$            | < 2.3 $\times 10^{-3}$         | 90%              |
| $\Gamma_{14} K^+K^-\pi^0$                     | < 6 $\times 10^{-4}$           | 90%              |
| $\Gamma_{15} K^+K^-\pi^0\eta$                 | < 2.1 $\times 10^{-3}$         | 90%              |
| $\Gamma_{16} K^+K^-\eta$                      | < 9 $\times 10^{-4}$           | 90%              |
| $\Gamma_{17} 2K^+2K^-\pi^0$                   | < 2.4 $\times 10^{-4}$         | 90%              |
| $\Gamma_{18} K_S^0 K^\pm \pi^\mp$             | < 6 $\times 10^{-4}$           | 90%              |
| $\Gamma_{19} K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$ | ( 2.8±1.0 ) $\times 10^{-3}$   |                  |

DESIG=1

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=10

DESIG=3

DESIG=11

DESIG=13

DESIG=5

DESIG=14

DESIG=6

DESIG=7

DESIG=12

DESIG=15

DESIG=16

DESIG=17

DESIG=18

DESIG=19

DESIG=20

DESIG=21

DESIG=22

**Radiative decays**

|               |                    |                                |
|---------------|--------------------|--------------------------------|
| $\Gamma_{20}$ | $\gamma\eta$       | $(4.7 \pm 2.1) \times 10^{-4}$ |
| $\Gamma_{21}$ | $\gamma\eta'(958)$ | $(1.5 \pm 0.4) \times 10^{-3}$ |
| $\Gamma_{22}$ | $\gamma\eta_c(1S)$ | $(50 \pm 9) \%$                |

NODE=M144;CLUMP=R  
DESIG=9  
DESIG=8  
DESIG=4

 **$h_c(1P)$  PARTIAL WIDTHS**

NODE=M144220

 **$h_c(1P) \Gamma(i)\Gamma(\bar{p}p)/\Gamma(\text{total})$** 

NODE=M144223

| $\Gamma(\gamma\eta_c(1S)) \times \Gamma(\bar{p}p)/\Gamma_{\text{total}}$ | $\Gamma_{22}\Gamma_4/\Gamma$ |
|--------------------------------------------------------------------------|------------------------------|
| VALUE (eV)                                                               | EVTS                         |

NODE=M144G1  
NODE=M144G1

• • • We do not use the following data for averages, fits, limits, etc. • • •

12.0 $\pm$ 4.5      13      <sup>1</sup> ANDREOTTI    05B    E835     $\bar{p}p \rightarrow \eta_c \gamma$

<sup>1</sup> Assuming  $\Gamma = 1$  MeV.

NODE=M144G1;LINKAGE=AN

 **$h_c(1P)$  BRANCHING RATIOS**

NODE=M144225

| $\Gamma(J/\psi(1S)\pi\pi)/\Gamma(J/\psi(1S)\pi^0)$ | $\Gamma_2/\Gamma_1$ |
|----------------------------------------------------|---------------------|
| VALUE                                              | CL%                 |

NODE=M144R1  
NODE=M144R1

**<0.18**      90      ARMSTRONG    92D    E760     $\bar{p}p \rightarrow J/\psi \pi^0$

| $\Gamma(J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$ | $\Gamma_3/\Gamma$ |
|------------------------------------------------------|-------------------|
| VALUE                                                | CL%               |

NODE=M144R07  
NODE=M144R07

**<2.3  $\times 10^{-3}$**       90      <sup>1</sup> ABLIKIM      18M    BES3     $\psi(2S) \rightarrow \pi^0 \pi^+ \pi^- J/\psi$

OCCUR=2

<sup>1</sup> ABLIKIM 18M reports  $[\Gamma(h_c(1P) \rightarrow J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] < 2.0 \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ .

NODE=M144R07;LINKAGE=B

| $\Gamma(\bar{p}p)/\Gamma_{\text{total}}$ | $\Gamma_4/\Gamma$ |
|------------------------------------------|-------------------|
| VALUE                                    | CL%               |

NODE=M144R20  
NODE=M144R20

**<1.5  $\times 10^{-4}$**       90      <sup>1</sup> ABLIKIM      13V    BES3     $\psi(2S) \rightarrow \gamma \bar{p}p$

<sup>1</sup> ABLIKIM 13V reports  $[\Gamma(h_c(1P) \rightarrow \bar{p}p)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] < 1.3 \times 10^{-7}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ .

NODE=M144R20;LINKAGE=A

| $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ | $\Gamma_7/\Gamma$ |
|-------------------------------------------------|-------------------|
| VALUE (units $10^{-3}$ )                        | CL%               |

NODE=M144R01  
NODE=M144R01

**1.6 $\pm$ 0.5 $\pm$ 0.2**      101      <sup>1</sup> ABLIKIM      19AG    BES3     $\psi(2S) \rightarrow \pi^0 h_c(1P)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<2.2      90      <sup>2</sup> ADAMS      09    CLEO     $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$

<sup>1</sup> ABLIKIM 19AG reports  $[\Gamma(h_c(1P) \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] = (1.38 \pm 0.35 \pm 0.17) \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M144R01;LINKAGE=A

<sup>2</sup> ADAMS 09 reports  $[\Gamma(h_c(1P) \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] < 0.19 \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ .

NODE=M144R01;LINKAGE=AD

| $\Gamma(\pi^+\pi^-\pi^0\eta)/\Gamma_{\text{total}}$ | $\Gamma_8/\Gamma$ |
|-----------------------------------------------------|-------------------|
| VALUE (units $10^{-3}$ )                            | EVTS              |

NODE=M144R11  
NODE=M144R11

**7.2 $\pm$ 2.0 $\pm$ 1.0**      35      <sup>1</sup> ABLIKIM      20AH    BES3     $\psi(2S) \rightarrow \pi^0 h_c(1P)$

<sup>1</sup> ABLIKIM 20AH reports  $[\Gamma(h_c(1P) \rightarrow \pi^+\pi^-\pi^0\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] = (6.2 \pm 1.6 \pm 0.7) \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M144R11;LINKAGE=A

| $\Gamma(2\pi^+2\pi^-\pi^0)/\Gamma_{\text{total}}$ | $\Gamma_9/\Gamma$ |
|---------------------------------------------------|-------------------|
| VALUE (units $10^{-2}$ )                          | EVTS              |

NODE=M144R02  
NODE=M144R02

**0.81 $\pm$ 0.18 OUR AVERAGE**

0.74 $\pm$ 0.14 $\pm$ 0.11      254      <sup>1</sup> ABLIKIM      19AG    BES3     $\psi(2S) \rightarrow \pi^0 h_c(1P)$

2.2  $\begin{smallmatrix} +0.8 \\ -0.6 \end{smallmatrix}$   $\pm$ 0.3      92      <sup>2</sup> ADAMS      09    CLEO     $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$

<sup>1</sup> ABLIKIM 19AG reports  $[\Gamma(h_c(1P) \rightarrow 2\pi^+ 2\pi^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $= (6.40 \pm 0.81 \pm 0.87) \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$   
 $= (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is  
the systematic error from using our best value.

NODE=M144R02;LINKAGE=A

<sup>2</sup> ADAMS 09 reports  $[\Gamma(h_c(1P) \rightarrow 2\pi^+ 2\pi^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $= (1.88_{-0.45}^{+0.48+0.47}) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$   
 $= (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is  
the systematic error from using our best value.

NODE=M144R02;LINKAGE=AD

| $\Gamma(3\pi^+ 3\pi^- \pi^0)/\Gamma_{\text{total}}$ |     |                      | $\Gamma_{10}/\Gamma$ |                                      |  |
|-----------------------------------------------------|-----|----------------------|----------------------|--------------------------------------|--|
| VALUE                                               | CL% | DOCUMENT ID          | TECN                 | COMMENT                              |  |
| <b>&lt;9 × 10<sup>-3</sup></b>                      | 90  | <sup>1</sup> ABLIKIM | 19AG BES3            | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |  |

NODE=M144R03  
NODE=M144R03

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.029 90 <sup>2</sup> ADAMS 09 CLEO  $\psi(2S) \rightarrow \pi^0 \gamma \eta_c$

<sup>1</sup> ABLIKIM 19AG reports  $[\Gamma(h_c(1P) \rightarrow 3\pi^+ 3\pi^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $< 7.5 \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ .

NODE=M144R03;LINKAGE=A

<sup>2</sup> ADAMS 09 reports  $[\Gamma(h_c(1P) \rightarrow 3\pi^+ 3\pi^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $< 2.5 \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ .

NODE=M144R03;LINKAGE=AD

| $\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$ |      |                      | $\Gamma_5/\Gamma$ |                                      |  |
|----------------------------------------------------|------|----------------------|-------------------|--------------------------------------|--|
| VALUE (units 10 <sup>-3</sup> )                    | EVTS | DOCUMENT ID          | TECN              | COMMENT                              |  |
| <b>2.9±0.5±0.4</b>                                 | 230  | <sup>1</sup> ABLIKIM | 19AG BES3         | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |  |

NODE=M144R08  
NODE=M144R08

<sup>1</sup> ABLIKIM 19AG reports  $[\Gamma(h_c(1P) \rightarrow p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $= (2.49 \pm 0.27 \pm 0.28) \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$   
 $= (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is  
the systematic error from using our best value.

NODE=M144R08;LINKAGE=A

| $\Gamma(p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}$ |     |      | $\Gamma_6/\Gamma$    |           |                                      |
|----------------------------------------------------|-----|------|----------------------|-----------|--------------------------------------|
| VALUE                                              | CL% | EVTS | DOCUMENT ID          | TECN      | COMMENT                              |
| <b>&lt;5 × 10<sup>-4</sup></b>                     | 90  | 12   | <sup>1</sup> ABLIKIM | 20AH BES3 | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |

NODE=M144R10  
NODE=M144R10

<sup>1</sup> ABLIKIM 20AH reports  $[\Gamma(h_c(1P) \rightarrow p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $< 4.4 \times 10^{-7}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ .

NODE=M144R10;LINKAGE=A

| $\Gamma(K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}}$ |     |                      | $\Gamma_{11}/\Gamma$ |                                      |  |
|-----------------------------------------------------|-----|----------------------|----------------------|--------------------------------------|--|
| VALUE                                               | CL% | DOCUMENT ID          | TECN                 | COMMENT                              |  |
| <b>&lt;6 × 10<sup>-4</sup></b>                      | 90  | <sup>1</sup> ABLIKIM | 19AG BES3            | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |  |

NODE=M144R09  
NODE=M144R09

<sup>1</sup> ABLIKIM 19AG reports  $[\Gamma(h_c(1P) \rightarrow K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $< 0.5 \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$   
 $= 8.6 \times 10^{-4}$ .

NODE=M144R09;LINKAGE=A

| $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$ |      |                      | $\Gamma_{12}/\Gamma$ |                                      |  |
|-----------------------------------------------------------|------|----------------------|----------------------|--------------------------------------|--|
| VALUE (units 10 <sup>-3</sup> )                           | EVTS | DOCUMENT ID          | TECN                 | COMMENT                              |  |
| <b>3.2±0.7±0.5</b>                                        | 80   | <sup>1</sup> ABLIKIM | 20AH BES3            | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |  |

NODE=M144R12  
NODE=M144R12

<sup>1</sup> ABLIKIM 20AH reports  $[\Gamma(h_c(1P) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $= (2.8 \pm 0.5 \pm 0.3) \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$   
 $= (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our  
second error is the systematic error from using our best value.

NODE=M144R12;LINKAGE=A

| $\Gamma(K^+ K^- \pi^+ \pi^- \eta)/\Gamma_{\text{total}}$ |     |      | $\Gamma_{13}/\Gamma$ |           |                                      |
|----------------------------------------------------------|-----|------|----------------------|-----------|--------------------------------------|
| VALUE                                                    | CL% | EVTS | DOCUMENT ID          | TECN      | COMMENT                              |
| <b>&lt;2.3 × 10<sup>-3</sup></b>                         | 90  | 24   | <sup>1</sup> ABLIKIM | 20AH BES3 | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |

NODE=M144R13  
NODE=M144R13

<sup>1</sup> ABLIKIM 20AH reports  $[\Gamma(h_c(1P) \rightarrow K^+ K^- \pi^+ \pi^- \eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $< 2.0 \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$   
 $= 8.6 \times 10^{-4}$ .

NODE=M144R13;LINKAGE=A

| $\Gamma(K^+ K^- \pi^0)/\Gamma_{\text{total}}$ |     |      | $\Gamma_{14}/\Gamma$ |           |                                      |
|-----------------------------------------------|-----|------|----------------------|-----------|--------------------------------------|
| VALUE                                         | CL% | EVTS | DOCUMENT ID          | TECN      | COMMENT                              |
| <b>&lt;6 × 10<sup>-4</sup></b>                | 90  | 20   | <sup>1</sup> ABLIKIM | 20AH BES3 | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |

NODE=M144R14  
NODE=M144R14

<sup>1</sup> ABLIKIM 20AH reports  $[\Gamma(h_c(1P) \rightarrow K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   
 $< 4.8 \times 10^{-7}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ .

NODE=M144R14;LINKAGE=A

$\Gamma(2K^+2K^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                        | CL% | EVTs | DOCUMENT ID          | TECN      | COMMENT                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|----------------------|-----------|--------------------------------------|
| $<2.4 \times 10^{-4}$                                                                                                                                                                                                                                                        | 90  | 11   | <sup>1</sup> ABLIKIM | 20AH BES3 | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |
| <sup>1</sup> ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow 2K^+2K^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$ $< 2.1 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ . |     |      |                      |           |                                      |

NODE=M144R17  
 NODE=M144R17

NODE=M144R17;LINKAGE=A

 $\Gamma(K^+K^-\pi^0\eta)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                          | CL% | EVTs | DOCUMENT ID          | TECN      | COMMENT                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|----------------------|-----------|--------------------------------------|
| $<2.1 \times 10^{-3}$                                                                                                                                                                                                                                                          | 90  | 20   | <sup>1</sup> ABLIKIM | 20AH BES3 | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |
| <sup>1</sup> ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K^+K^-\pi^0\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$ $< 1.8 \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ . |     |      |                      |           |                                      |

NODE=M144R15  
 NODE=M144R15

NODE=M144R15;LINKAGE=A

 $\Gamma(K^+K^-\eta)/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                     | CL% | EVTs | DOCUMENT ID          | TECN      | COMMENT                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|----------------------|-----------|--------------------------------------|
| $<9 \times 10^{-4}$                                                                                                                                                                                                                                                       | 90  | 18   | <sup>1</sup> ABLIKIM | 20AH BES3 | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |
| <sup>1</sup> ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K^+K^-\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$ $< 7.5 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ . |     |      |                      |           |                                      |

NODE=M144R16  
 NODE=M144R16

NODE=M144R16;LINKAGE=A

 $\Gamma(K_S^0 K^\pm \pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                              | CL% | EVTs | DOCUMENT ID          | TECN      | COMMENT                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|----------------------|-----------|--------------------------------------|
| $<6 \times 10^{-4}$                                                                                                                                                                                                                                                                | 90  | 17   | <sup>1</sup> ABLIKIM | 20AH BES3 | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |
| <sup>1</sup> ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K_S^0 K^\pm \pi^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$ $< 4.8 \times 10^{-7}$ which we divide by our best value $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = 8.6 \times 10^{-4}$ . |     |      |                      |           |                                      |

NODE=M144R18  
 NODE=M144R18

NODE=M144R18;LINKAGE=A

 $\Gamma(K_S^0 K^\pm \pi^\mp \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                                                                                                                                                                                                                                       | EVTs | DOCUMENT ID          | TECN      | COMMENT                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|-----------|--------------------------------------|
| $2.8 \pm 0.9 \pm 0.4$                                                                                                                                                                                                                                                                                                                                                                                                                          | 41   | <sup>1</sup> ABLIKIM | 20AH BES3 | $\psi(2S) \rightarrow \pi^0 h_c(1P)$ |
| <sup>1</sup> ABLIKIM 20AH reports $[\Gamma(h_c(1P) \rightarrow K_S^0 K^\pm \pi^\mp \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$ $= (2.4 \pm 0.7 \pm 0.3) \times 10^{-6}$ which we divide by our best value $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |           |                                      |

NODE=M144R19  
 NODE=M144R19

NODE=M144R19;LINKAGE=A

## RADIATIVE DECAYS

 $\Gamma(\gamma\eta)/\Gamma_{\text{total}}$  $\Gamma_{20}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTs | DOCUMENT ID | TECN     | COMMENT                                  |
|--------------------------|------|-------------|----------|------------------------------------------|
| $4.7 \pm 1.5 \pm 1.4$    | 18   | ABLIKIM     | 16I BES3 | $\psi(2S) \rightarrow \pi^0 \gamma \eta$ |

NODE=M144230

NODE=M144R06  
 NODE=M144R06

 $\Gamma(\gamma\eta'(958))/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN     | COMMENT                                        |
|--------------------------|------|-------------|----------|------------------------------------------------|
| $1.52 \pm 0.27 \pm 0.29$ | 44   | ABLIKIM     | 16I BES3 | $\psi(2S) \rightarrow \pi^0 \gamma \eta'(958)$ |

NODE=M144R00  
 NODE=M144R00

 $\Gamma(\gamma\eta_c(1S))/\Gamma_{\text{total}}$  $\Gamma_{22}/\Gamma$ 

| VALUE (units $10^{-2}$ )                                                      | EVTs        | DOCUMENT ID          | TECN     | COMMENT                                    |
|-------------------------------------------------------------------------------|-------------|----------------------|----------|--------------------------------------------|
| $50 \pm 9$                                                                    | OUR AVERAGE |                      |          |                                            |
| [(51 $\pm$ 6) $\times 10^{-2}$ OUR 2020 AVERAGE]                              |             |                      |          |                                            |
| 53 $\pm$ 7 $\pm$ 8                                                            | 3679        | <sup>1</sup> ABLIKIM | 10B BES3 | $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$ |
| 48 $\pm$ 6 $\pm$ 7                                                            |             | <sup>2</sup> DOBBS   | 08A CLEO | $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |                      |          |                                            |
| 48 $\pm$ 6 $\pm$ 7                                                            | 1282        | <sup>3</sup> DOBBS   | 08A CLEO | $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$ |
| 46 $\pm$ 12 $\pm$ 7                                                           | 168         | <sup>4</sup> ROSNER  | 05 CLEO  | $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$ |

NODE=M144R2  
 NODE=M144R2

NEW

OCCUR=2

<sup>1</sup> ABLIKIM 10B reports  $[\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   $= (4.58 \pm 0.40 \pm 0.50) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M144R2;LINKAGE=A

<sup>2</sup> Average of DOBBS 08A and ROSNER 05. DOBBS 08A reports  $[\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   $= (4.16 \pm 0.30 \pm 0.37) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M144R2;LINKAGE=DB

<sup>3</sup> DOBBS 08A reports  $[\Gamma(h_c(1P) \rightarrow \gamma\eta_c(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))]$   $= (4.19 \pm 0.32 \pm 0.45) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$

NODE=M144R2;LINKAGE=DO

$= (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>4</sup>ROSNER 05 reports  $[\Gamma(h_c(1P) \rightarrow \gamma \eta_c(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \pi^0 h_c(1P))] = (4.0 \pm 0.8 \pm 0.7) \times 10^{-4}$  which we divide by our best value  $B(\psi(2S) \rightarrow \pi^0 h_c(1P)) = (8.6 \pm 1.3) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M144R2;LINKAGE=RO

## $h_c(1P)$ REFERENCES

|            |      |                |                              |                           |
|------------|------|----------------|------------------------------|---------------------------|
| ABLIKIM    | 20AH | PR D102 112007 | M. Ablikim <i>et al.</i>     | (BESIII Collab.)          |
| ABLIKIM    | 19AG | PR D99 072008  | M. Ablikim <i>et al.</i>     | (BESIII Collab.)          |
| ABLIKIM    | 18M  | PR D97 052008  | M. Ablikim <i>et al.</i>     | (BESIII Collab.)          |
| ABLIKIM    | 16I  | PRL 116 251802 | M. Ablikim <i>et al.</i>     | (BESIII Collab.)          |
| ABLIKIM    | 13V  | PR D88 112001  | M. Ablikim <i>et al.</i>     | (BESIII Collab.)          |
| ABLIKIM    | 12N  | PR D86 092009  | M. Ablikim <i>et al.</i>     | (BESIII Collab.)          |
| ABLIKIM    | 10B  | PRL 104 132002 | M. Ablikim <i>et al.</i>     | (BESIII Collab.)          |
| ADAMS      | 09   | PR D80 051106  | G.S. Adams <i>et al.</i>     | (CLEO Collab.)            |
| DOBBS      | 08A  | PRL 101 182003 | S. Dobbs <i>et al.</i>       | (CLEO Collab.)            |
| ANDREOTTI  | 05B  | PR D72 032001  | M. Andreotti <i>et al.</i>   | (FNAL E835 Collab.)       |
| ROSNER     | 05   | PRL 95 102003  | J.L. Rosner <i>et al.</i>    | (CLEO Collab.)            |
| AULCHENKO  | 03   | PL B573 63     | V.M. Aulchenko <i>et al.</i> | (KEDR Collab.)            |
| ANTONIAZZI | 94   | PR D50 4258    | L. Antoniazzi <i>et al.</i>  | (E705 Collab.)            |
| ARMSTRONG  | 93B  | PR D47 772     | T.A. Armstrong <i>et al.</i> | (FNAL E760 Collab.)       |
| ARMSTRONG  | 92D  | PRL 69 2337    | T.A. Armstrong <i>et al.</i> | (FNAL, FERR, GENO+)       |
| BAGLIN     | 86   | PL B171 135    | C. Baglin <i>et al.</i>      | (LAPP, CERN, TORI, STRB+) |

NODE=M144

REFID=60750  
REFID=59858  
REFID=58901  
REFID=57450  
REFID=55583  
REFID=54741  
REFID=53348  
REFID=53103  
REFID=52579  
REFID=50768  
REFID=50812  
REFID=49579  
REFID=44074  
REFID=43307  
REFID=43174  
REFID=43180

$\chi_{c2}(1P)$

$$J^G(J^{PC}) = 0^+(2^{++})$$

See the Review on " $\psi(2S)$  and  $\chi_c$  branching ratios" before the  $\chi_{c0}(1P)$  Listings.

NODE=M057

NODE=M057

## $\chi_{c2}(1P)$ MASS

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID              | TECN      | COMMENT                                                |
|-------------------------------------------------------------------------------|------|--------------------------|-----------|--------------------------------------------------------|
| <b>3556.17 <math>\pm</math> 0.07 OUR AVERAGE</b>                              |      |                          |           |                                                        |
| 3557.3 $\pm$ 1.7 $\pm$ 0.7                                                    | 611  | <sup>1</sup> AAIJ        | 17BB LHCB | $pp \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$      |
| 3556.10 $\pm$ 0.06 $\pm$ 0.11                                                 | 4.0k | <sup>2</sup> AAIJ        | 17BI LHCB | $\chi_{c2} \rightarrow J/\psi \mu^+ \mu^-$             |
| 3555.3 $\pm$ 0.6 $\pm$ 2.2                                                    | 2.5k | UEHARA                   | 08 BELL   | $\gamma\gamma \rightarrow \text{hadrons}$              |
| 3555.70 $\pm$ 0.59 $\pm$ 0.39                                                 |      | ABLIKIM                  | 05G BES2  | $\psi(2S) \rightarrow \gamma \chi_{c2}$                |
| 3556.173 $\pm$ 0.123 $\pm$ 0.020                                              |      | ANDREOTTI                | 05A E835  | $p\bar{p} \rightarrow e^+ e^- \gamma$                  |
| 3559.9 $\pm$ 2.9                                                              |      | EISENSTEIN               | 01 CLE2   | $e^+ e^- \rightarrow e^+ e^- \chi_{c2}$                |
| 3556.4 $\pm$ 0.7                                                              |      | BAI                      | 99B BES   | $\psi(2S) \rightarrow \gamma X$                        |
| 3556.22 $\pm$ 0.131 $\pm$ 0.020                                               | 585  | <sup>3</sup> ARMSTRONG   | 92 E760   | $\bar{p}p \rightarrow e^+ e^- \gamma$                  |
| 3556.9 $\pm$ 0.4 $\pm$ 0.5                                                    | 50   | BAGLIN                   | 86B SPEC  | $\bar{p}p \rightarrow e^+ e^- X$                       |
| 3557.8 $\pm$ 0.2 $\pm$ 4                                                      |      | <sup>4</sup> GAISER      | 86 CBAL   | $\psi(2S) \rightarrow \gamma X$                        |
| 3553.4 $\pm$ 2.2                                                              | 66   | <sup>5</sup> LEMOIGNE    | 82 GOLI   | $185 \pi^- \text{Be} \rightarrow \gamma \mu^+ \mu^- A$ |
| 3555.9 $\pm$ 0.7                                                              |      | <sup>6</sup> OREGLIA     | 82 CBAL   | $e^+ e^- \rightarrow J/\psi 2\gamma$                   |
| 3557 $\pm$ 1.5                                                                | 69   | <sup>7</sup> HIMEL       | 80 MRK2   | $e^+ e^- \rightarrow J/\psi 2\gamma$                   |
| 3551 $\pm$ 11                                                                 | 15   | BRANDELIK                | 79B DASP  | $e^+ e^- \rightarrow J/\psi 2\gamma$                   |
| 3553 $\pm$ 4                                                                  |      | <sup>7</sup> BARTEL      | 78B CNTR  | $e^+ e^- \rightarrow J/\psi 2\gamma$                   |
| 3553 $\pm$ 4 $\pm$ 4                                                          |      | <sup>7,8</sup> TANENBAUM | 78 MRK1   | $e^+ e^-$                                              |
| 3563 $\pm$ 7                                                                  | 360  | <sup>7</sup> BIDDICK     | 77 CNTR   | $e^+ e^- \rightarrow \gamma X$                         |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                          |           |                                                        |
| 3555.4 $\pm$ 1.3                                                              | 53   | UEHARA                   | 13 BELL   | $\gamma\gamma \rightarrow K_S^0 K_S^0$                 |
| 3543 $\pm$ 10                                                                 | 4    | WHITAKER                 | 76 MRK1   | $e^+ e^- \rightarrow J/\psi 2\gamma$                   |

<sup>1</sup> From a fit of the  $\phi\phi$  invariant mass with the width of  $\chi_{c2}(1P)$  fixed to the PDG 16 value.

<sup>2</sup> AAIJ 17BI reports also  $m(\chi_{c2}) - m(\chi_{c1}) = 45.39 \pm 0.07 \pm 0.03$  MeV.

<sup>3</sup> Recalculated by ANDREOTTI 05A, using the value of  $\psi(2S)$  mass from AULCHENKO 03.

<sup>4</sup> Using mass of  $\psi(2S) = 3686.0$  MeV.

<sup>5</sup>  $J/\psi(1S)$  mass constrained to 3097 MeV.

<sup>6</sup> Assuming  $\psi(2S)$  mass = 3686 MeV and  $J/\psi(1S)$  mass = 3097 MeV.

<sup>7</sup> Mass value shifted by us by amount appropriate for  $\psi(2S)$  mass = 3686 MeV and  $J/\psi(1S)$  mass = 3097 MeV.

<sup>8</sup> From a simultaneous fit to radiative and hadronic decay channels.

NODE=M057M

NODE=M057M

NODE=M057M;LINKAGE=A

NODE=M057M;LINKAGE=B  
NODE=M057M;LINKAGE=NW  
NODE=M057M;LINKAGE=C  
NODE=M057M;LINKAGE=P  
NODE=M057M;LINKAGE=E  
NODE=M057M;LINKAGE=D

NODE=M057M;LINKAGE=M



$\chi_{c2}(1P)$  WIDTH

NODE=M057W

| VALUE (MeV)                         | EVTS | DOCUMENT ID            | TECN      | COMMENT                                    |
|-------------------------------------|------|------------------------|-----------|--------------------------------------------|
| <b>1.97 ±0.09 OUR FIT</b>           |      |                        |           |                                            |
| <b>2.00 ±0.11 OUR AVERAGE</b>       |      |                        |           |                                            |
| 2.10 ±0.20 ±0.02                    | 4.0k | AAIJ                   | 17BI LHCb | $\chi_{c2} \rightarrow J/\psi \mu^+ \mu^-$ |
| 1.915 ±0.188 ±0.013                 |      | ANDREOTTI              | 05A E835  | $p\bar{p} \rightarrow e^+ e^- \gamma$      |
| 1.96 ±0.17 ±0.07                    | 585  | <sup>1</sup> ARMSTRONG | 92 E760   | $p\bar{p} \rightarrow e^+ e^- \gamma$      |
| 2.6 <sup>+1.4</sup> <sub>-1.0</sub> | 50   | BAGLIN                 | 86B SPEC  | $p\bar{p} \rightarrow e^+ e^- X$           |
| 2.8 <sup>+2.1</sup> <sub>-2.0</sub> |      | <sup>2</sup> GAISER    | 86 CBAL   | $\psi(2S) \rightarrow \gamma X$            |

<sup>1</sup> Recalculated by ANDREOTTI 05A.<sup>2</sup> Errors correspond to 90% confidence level; authors give only width range.

NODE=M057W

NODE=M057W;LINKAGE=AN  
NODE=M057W;LINKAGE=E $\chi_{c2}(1P)$  DECAY MODES

NODE=M057215;NODE=M057

| Mode                                                                                                | Fraction ( $\Gamma_i/\Gamma$ )  | Confidence level |
|-----------------------------------------------------------------------------------------------------|---------------------------------|------------------|
| <b>Hadronic decays</b>                                                                              |                                 |                  |
| $\Gamma_1$ $2(\pi^+ \pi^-)$                                                                         | ( 1.02 ±0.09 ) %                |                  |
| $\Gamma_2$ $\rho \rho$                                                                              |                                 |                  |
| $\Gamma_3$ $\pi^+ \pi^- \pi^0 \pi^0$                                                                | ( 1.83 ±0.23 ) %                |                  |
| $\Gamma_4$ $\rho^+ \pi^- \pi^0 + \text{c.c.}$                                                       | ( 2.19 ±0.34 ) %                |                  |
| $\Gamma_5$ $4\pi^0$                                                                                 | ( 1.11 ±0.15 ) $\times 10^{-3}$ |                  |
| $\Gamma_6$ $K^+ K^- \pi^0 \pi^0$                                                                    | ( 2.1 ±0.4 ) $\times 10^{-3}$   |                  |
| $\Gamma_7$ $K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$                                                | ( 1.38 ±0.20 ) %                |                  |
| $\Gamma_8$ $\rho^- K^+ \bar{K}^0 + \text{c.c.}$                                                     | ( 4.1 ±1.2 ) $\times 10^{-3}$   |                  |
| $\Gamma_9$ $K^*(892)^0 K^- \pi^+ \rightarrow$<br>$K^- \pi^+ K^0 \pi^0 + \text{c.c.}$                | ( 2.9 ±0.8 ) $\times 10^{-3}$   |                  |
| $\Gamma_{10}$ $K^*(892)^0 \bar{K}^0 \pi^0 \rightarrow$<br>$K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$ | ( 3.8 ±0.9 ) $\times 10^{-3}$   |                  |
| $\Gamma_{11}$ $K^*(892)^- K^+ \pi^0 \rightarrow$<br>$K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$       | ( 3.7 ±0.8 ) $\times 10^{-3}$   |                  |
| $\Gamma_{12}$ $K^*(892)^+ \bar{K}^0 \pi^- \rightarrow$<br>$K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.}$ | ( 2.9 ±0.8 ) $\times 10^{-3}$   |                  |
| $\Gamma_{13}$ $K^+ K^- \eta \pi^0$                                                                  | ( 1.3 ±0.4 ) $\times 10^{-3}$   |                  |
| $\Gamma_{14}$ $K^+ K^- \pi^+ \pi^-$                                                                 | ( 8.4 ±0.9 ) $\times 10^{-3}$   |                  |
| $\Gamma_{15}$ $K^+ K^- \pi^+ \pi^- \pi^0$                                                           | ( 1.17 ±0.13 ) %                |                  |
| $\Gamma_{16}$ $K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$                                                     | ( 7.3 ±0.8 ) $\times 10^{-3}$   |                  |
| $\Gamma_{17}$ $K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$                                            | ( 2.1 ±1.1 ) $\times 10^{-3}$   |                  |
| $\Gamma_{18}$ $K^*(892)^0 \bar{K}^*(892)^0$                                                         | ( 2.3 ±0.4 ) $\times 10^{-3}$   |                  |
| $\Gamma_{19}$ $3(\pi^+ \pi^-)$                                                                      | ( 8.6 ±1.8 ) $\times 10^{-3}$   |                  |
| $\Gamma_{20}$ $\phi \phi$                                                                           | ( 1.06 ±0.09 ) $\times 10^{-3}$ |                  |
| $\Gamma_{21}$ $\phi \phi \eta$                                                                      | ( 5.3 ±0.6 ) $\times 10^{-4}$   |                  |
| $\Gamma_{22}$ $\omega \omega$                                                                       | ( 8.4 ±1.0 ) $\times 10^{-4}$   |                  |
| $\Gamma_{23}$ $\omega K^+ K^-$                                                                      | ( 7.3 ±0.9 ) $\times 10^{-4}$   |                  |
| $\Gamma_{24}$ $\omega \phi$                                                                         | ( 9.6 ±2.7 ) $\times 10^{-6}$   |                  |
| $\Gamma_{25}$ $\pi \pi$                                                                             | ( 2.23 ±0.09 ) $\times 10^{-3}$ |                  |
| $\Gamma_{26}$ $\rho^0 \pi^+ \pi^-$                                                                  | ( 3.7 ±1.6 ) $\times 10^{-3}$   |                  |
| $\Gamma_{27}$ $\pi^+ \pi^- \pi^0 (\text{non-resonant})$                                             | ( 2.0 ±0.4 ) $\times 10^{-5}$   |                  |
| $\Gamma_{28}$ $\rho(770)^\pm \pi^\mp$                                                               | ( 6 ±4 ) $\times 10^{-6}$       |                  |
| $\Gamma_{29}$ $\pi^+ \pi^- \eta$                                                                    | ( 4.8 ±1.3 ) $\times 10^{-4}$   |                  |
| $\Gamma_{30}$ $\pi^+ \pi^- \eta'$                                                                   | ( 5.0 ±1.8 ) $\times 10^{-4}$   |                  |
| $\Gamma_{31}$ $\eta \eta$                                                                           | ( 5.4 ±0.4 ) $\times 10^{-4}$   |                  |
| $\Gamma_{32}$ $K^+ K^-$                                                                             | ( 1.01 ±0.06 ) $\times 10^{-3}$ |                  |
| $\Gamma_{33}$ $K_S^0 K_S^0$                                                                         | ( 5.2 ±0.4 ) $\times 10^{-4}$   |                  |
| $\Gamma_{34}$ $K^*(892)^\pm K^\mp$                                                                  | ( 1.44 ±0.21 ) $\times 10^{-4}$ |                  |
| $\Gamma_{35}$ $K^*(892)^0 \bar{K}^0 + \text{c.c.}$                                                  | ( 1.24 ±0.27 ) $\times 10^{-4}$ |                  |
| $\Gamma_{36}$ $K_2^*(1430)^\pm K^\mp$                                                               | ( 1.48 ±0.12 ) $\times 10^{-3}$ |                  |
| $\Gamma_{37}$ $K_2^*(1430)^0 \bar{K}^0 + \text{c.c.}$                                               | ( 1.24 ±0.17 ) $\times 10^{-3}$ |                  |
| $\Gamma_{38}$ $K_3^*(1780)^\pm K^\mp$                                                               | ( 5.2 ±0.8 ) $\times 10^{-4}$   |                  |
| $\Gamma_{39}$ $K_3^*(1780)^0 \bar{K}^0 + \text{c.c.}$                                               | ( 5.6 ±2.1 ) $\times 10^{-4}$   |                  |

NODE=M057;CLUMP=A  
DESIG=3

DESIG=43

DESIG=50

DESIG=51

DESIG=62

DESIG=52

DESIG=54

DESIG=55

DESIG=60

DESIG=56

DESIG=57

DESIG=58

DESIG=59

DESIG=5

DESIG=67

DESIG=78

DESIG=10

DESIG=21

DESIG=4

DESIG=16

DESIG=99

DESIG=25

DESIG=79

DESIG=68

DESIG=22

DESIG=9

DESIG=95

DESIG=96

DESIG=39

DESIG=42

DESIG=14

DESIG=2

DESIG=15

DESIG=87

DESIG=88

DESIG=89

DESIG=90

DESIG=91

DESIG=92

|     |                                                           |                                  |     |           |
|-----|-----------------------------------------------------------|----------------------------------|-----|-----------|
| Г40 | $a_2(1320)^0 \pi^0$                                       | $(1.29 \pm 0.34) \times 10^{-3}$ |     | DESIG=93  |
| Г41 | $a_2(1320)^\pm \pi^\mp$                                   | $(1.8 \pm 0.6) \times 10^{-3}$   |     | DESIG=94  |
| Г42 | $\bar{K}^0 K^+ \pi^- + \text{c.c.}$                       | $(1.28 \pm 0.18) \times 10^{-3}$ |     | DESIG=17  |
| Г43 | $K^+ K^- \pi^0$                                           | $(3.0 \pm 0.8) \times 10^{-4}$   |     | DESIG=36  |
| Г44 | $K^+ K^- \eta$                                            | $< 3.2 \times 10^{-4}$           | 90% | DESIG=40  |
| Г45 | $K^+ K^- \eta'(958)$                                      | $(1.94 \pm 0.34) \times 10^{-4}$ |     | DESIG=82  |
| Г46 | $\eta \eta'$                                              | $(2.2 \pm 0.5) \times 10^{-5}$   |     | DESIG=34  |
| Г47 | $\eta' \eta'$                                             | $(4.6 \pm 0.6) \times 10^{-5}$   |     | DESIG=35  |
| Г48 | $\pi^+ \pi^- K_S^0 K_S^0$                                 | $(2.2 \pm 0.5) \times 10^{-3}$   |     | DESIG=29  |
| Г49 | $K^+ K^- K_S^0 K_S^0$                                     | $< 4 \times 10^{-4}$             | 90% | DESIG=30  |
| Г50 | $K_S^0 K_S^0 K_S^0 K_S^0$                                 | $(1.13 \pm 0.18) \times 10^{-4}$ |     | DESIG=97  |
| Г51 | $K^+ K^- K^+ K^-$                                         | $(1.65 \pm 0.20) \times 10^{-3}$ |     | DESIG=24  |
| Г52 | $K^+ K^- \phi$                                            | $(1.42 \pm 0.29) \times 10^{-3}$ |     | DESIG=32  |
| Г53 | $\bar{K}^0 K^+ \pi^- \phi + \text{c.c.}$                  | $(4.8 \pm 0.7) \times 10^{-3}$   |     | DESIG=83  |
| Г54 | $K^+ K^- \pi^0 \phi$                                      | $(2.7 \pm 0.5) \times 10^{-3}$   |     | DESIG=84  |
| Г55 | $\phi \pi^+ \pi^- \pi^0$                                  | $(9.3 \pm 1.2) \times 10^{-4}$   |     | DESIG=80  |
| Г56 | $\rho \bar{\rho}$                                         | $(7.33 \pm 0.33) \times 10^{-5}$ |     | DESIG=11  |
| Г57 | $\rho \bar{\rho} \pi^0$                                   | $(4.7 \pm 0.4) \times 10^{-4}$   |     | DESIG=37  |
| Г58 | $\rho \bar{\rho} \eta$                                    | $(1.74 \pm 0.25) \times 10^{-4}$ |     | DESIG=41  |
| Г59 | $\rho \bar{\rho} \omega$                                  | $(3.6 \pm 0.4) \times 10^{-4}$   |     | DESIG=61  |
| Г60 | $\rho \bar{\rho} \phi$                                    | $(2.8 \pm 0.9) \times 10^{-5}$   |     | DESIG=66  |
| Г61 | $\rho \bar{\rho} \pi^+ \pi^-$                             | $(1.32 \pm 0.34) \times 10^{-3}$ |     | DESIG=8   |
| Г62 | $\rho \bar{\rho} \pi^0 \pi^0$                             | $(7.8 \pm 2.3) \times 10^{-4}$   |     | DESIG=53  |
| Г63 | $\rho \bar{\rho} K^+ K^- (\text{non-resonant})$           | $(1.91 \pm 0.32) \times 10^{-4}$ |     | DESIG=63  |
| Г64 | $\rho \bar{\rho} K_S^0 K_S^0$                             | $< 7.9 \times 10^{-4}$           | 90% | DESIG=28  |
| Г65 | $\rho \bar{n} \pi^-$                                      | $(8.5 \pm 0.9) \times 10^{-4}$   |     | DESIG=31  |
| Г66 | $\bar{\rho} n \pi^+$                                      | $(8.9 \pm 0.8) \times 10^{-4}$   |     | DESIG=75  |
| Г67 | $\rho \bar{n} \pi^- \pi^0$                                | $(2.17 \pm 0.18) \times 10^{-3}$ |     | DESIG=76  |
| Г68 | $\bar{\rho} n \pi^+ \pi^0$                                | $(2.11 \pm 0.18) \times 10^{-3}$ |     | DESIG=77  |
| Г69 | $\Lambda \bar{\Lambda}$                                   | $(1.84 \pm 0.15) \times 10^{-4}$ |     | DESIG=19  |
| Г70 | $\Lambda \bar{\Lambda} \pi^+ \pi^-$                       | $(1.25 \pm 0.15) \times 10^{-3}$ |     | DESIG=27  |
| Г71 | $\Lambda \bar{\Lambda} \pi^+ \pi^- (\text{non-resonant})$ | $(6.6 \pm 1.5) \times 10^{-4}$   |     | DESIG=70  |
| Г72 | $\Sigma(1385)^+ \bar{\Lambda} \pi^- + \text{c.c.}$        | $< 4 \times 10^{-4}$             | 90% | DESIG=71  |
| Г73 | $\Sigma(1385)^- \bar{\Lambda} \pi^+ + \text{c.c.}$        | $< 6 \times 10^{-4}$             | 90% | DESIG=72  |
| Г74 | $K^+ \bar{p} \Lambda + \text{c.c.}$                       | $(7.8 \pm 0.5) \times 10^{-4}$   |     | DESIG=38  |
| Г75 | $K^*(892)^+ \bar{p} \Lambda + \text{c.c.}$                | $(8.2 \pm 1.1) \times 10^{-4}$   |     | DESIG=101 |
| Г76 | $K^+ \bar{p} \Lambda(1520) + \text{c.c.}$                 | $(2.8 \pm 0.7) \times 10^{-4}$   |     | DESIG=64  |
| Г77 | $\Lambda(1520) \bar{\Lambda}(1520)$                       | $(4.6 \pm 1.5) \times 10^{-4}$   |     | DESIG=65  |
| Г78 | $\Sigma^0 \bar{\Sigma}^0$                                 | $(3.7 \pm 0.6) \times 10^{-5}$   |     | DESIG=47  |
| Г79 | $\Sigma^+ \bar{p} K_S^0 + \text{c.c.}$                    | $(8.2 \pm 0.9) \times 10^{-5}$   |     | DESIG=100 |
| Г80 | $\Sigma^0 \bar{p} K^+ + \text{c.c.}$                      | $(9.1 \pm 0.8) \times 10^{-5}$   |     | DESIG=103 |
| Г81 | $\Sigma^+ \bar{\Sigma}^-$                                 | $(3.4 \pm 0.7) \times 10^{-5}$   |     | DESIG=48  |
| Г82 | $\Sigma^- \bar{\Sigma}^+$                                 | $(4.4 \pm 1.8) \times 10^{-5}$   |     | DESIG=102 |
| Г83 | $\Sigma(1385)^+ \bar{\Sigma}(1385)^-$                     | $< 1.6 \times 10^{-4}$           | 90% | DESIG=73  |
| Г84 | $\Sigma(1385)^- \bar{\Sigma}(1385)^+$                     | $< 8 \times 10^{-5}$             | 90% | DESIG=74  |
| Г85 | $K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$                   | $(1.76 \pm 0.32) \times 10^{-4}$ |     | DESIG=85  |
| Г86 | $\Xi^0 \bar{\Xi}^0$                                       | $< 1.0 \times 10^{-4}$           | 90% | DESIG=49  |
| Г87 | $\Xi^- \bar{\Xi}^+$                                       | $(1.42 \pm 0.32) \times 10^{-4}$ |     | DESIG=26  |
| Г88 | $J/\psi(1S) \pi^+ \pi^- \pi^0$                            | $< 1.5 \%$                       | 90% | DESIG=12  |
| Г89 | $\pi^0 \eta_c$                                            | $< 3.2 \times 10^{-3}$           | 90% | DESIG=81  |
| Г90 | $\eta_c(1S) \pi^+ \pi^-$                                  | $< 5.4 \times 10^{-3}$           | 90% | DESIG=69  |

**Radiative decays**

|     |                          |                                  |     |                              |
|-----|--------------------------|----------------------------------|-----|------------------------------|
| Г91 | $\gamma J/\psi(1S)$      | $(19.0 \pm 0.5) \%$              |     | NODE=M057;CLUMP=B<br>DESIG=6 |
| Г92 | $\gamma \rho^0$          | $< 1.9 \times 10^{-5}$           | 90% | DESIG=44                     |
| Г93 | $\gamma \omega$          | $< 6 \times 10^{-6}$             | 90% | DESIG=45                     |
| Г94 | $\gamma \phi$            | $< 7 \times 10^{-6}$             | 90% | DESIG=46                     |
| Г95 | $\gamma \gamma$          | $(2.85 \pm 0.10) \times 10^{-4}$ |     | DESIG=7                      |
| Г96 | $e^+ e^- J/\psi(1S)$     | $(2.15 \pm 0.14) \times 10^{-3}$ |     | DESIG=86                     |
| Г97 | $\mu^+ \mu^- J/\psi(1S)$ | $(2.02 \pm 0.33) \times 10^{-4}$ |     | DESIG=98                     |

## CONSTRAINED FIT INFORMATION

A multiparticle fit to  $\chi_{c1}(1P)$ ,  $\chi_{c0}(1P)$ ,  $\chi_{c2}(1P)$ , and  $\psi(2S)$  with 4 total widths, a partial width, 25 combinations of partial widths obtained from integrated cross section, and 84 branching ratios uses 248 measurements to determine 49 parameters. The overall fit has a  $\chi^2 = 378.1$  for 199 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ .

|          |       |          |          |          |          |          |          |          |          |          |
|----------|-------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| $x_{14}$ | 7     |          |          |          |          |          |          |          |          |          |
| $x_{17}$ | 2     | 21       |          |          |          |          |          |          |          |          |
| $x_{18}$ | 4     | 3        | 1        |          |          |          |          |          |          |          |
| $x_{20}$ | 7     | 5        | 1        | 3        |          |          |          |          |          |          |
| $x_{25}$ | 7     | 6        | 1        | 4        | 10       |          |          |          |          |          |
| $x_{26}$ | 18    | 2        | 0        | 1        | 1        | 1        |          |          |          |          |
| $x_{31}$ | 3     | 3        | 1        | 2        | 5        | 12       | 1        |          |          |          |
| $x_{32}$ | 5     | 4        | 1        | 3        | 7        | 15       | 1        | 8        |          |          |
| $x_{33}$ | 5     | 4        | 1        | 2        | 6        | 13       | 1        | 7        | 8        |          |
| $x_{42}$ | 2     | 2        | 0        | 1        | 3        | 7        | 0        | 3        | 4        | 4        |
| $x_{51}$ | 4     | 3        | 1        | 2        | 4        | 7        | 1        | 4        | 5        | 4        |
| $x_{56}$ | 10    | 9        | 2        | 5        | 9        | 11       | 2        | 5        | 8        | 7        |
| $x_{69}$ | 3     | 3        | 1        | 2        | 5        | 13       | 1        | 7        | 8        | 7        |
| $x_{91}$ | 12    | 10       | 2        | 6        | 15       | 34       | 2        | 18       | 22       | 18       |
| $x_{95}$ | -6    | -4       | -1       | -2       | 2        | 20       | -2       | 12       | 12       | 10       |
| $\Gamma$ | -23   | -19      | -4       | -11      | -19      | -25      | -5       | -12      | -18      | -15      |
|          | $x_1$ | $x_{14}$ | $x_{17}$ | $x_{18}$ | $x_{20}$ | $x_{25}$ | $x_{26}$ | $x_{31}$ | $x_{32}$ | $x_{33}$ |

|          |          |          |          |          |          |          |  |  |  |  |
|----------|----------|----------|----------|----------|----------|----------|--|--|--|--|
| $x_{51}$ | 2        |          |          |          |          |          |  |  |  |  |
| $x_{56}$ | 4        | 5        |          |          |          |          |  |  |  |  |
| $x_{69}$ | 4        | 4        | 6        |          |          |          |  |  |  |  |
| $x_{91}$ | 10       | 11       | 4        | 18       |          |          |  |  |  |  |
| $x_{95}$ | 5        | 4        | 18       | 12       | 34       |          |  |  |  |  |
| $\Gamma$ | -8       | -11      | -45      | -12      | -46      | -43      |  |  |  |  |
|          | $x_{42}$ | $x_{51}$ | $x_{56}$ | $x_{69}$ | $x_{91}$ | $x_{95}$ |  |  |  |  |

### $\chi_{c2}(1P)$ PARTIAL WIDTHS

————  $\chi_{c2}(1P) \Gamma(i) \Gamma(\gamma J/\psi(1S)) / \Gamma(\text{total})$  ————

NODE=M057220

NODE=M057223

$\Gamma(p\bar{p}) \times \Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}}$

$\Gamma_{56} \Gamma_{91} / \Gamma$

VALUE (eV)

DOCUMENT ID

TECN

COMMENT

**27.5 ± 1.2 OUR FIT**

**27.5 ± 1.5 OUR AVERAGE**

27.0 ± 1.5 ± 1.1

<sup>1</sup> ANDREOTTI 05A E835  $p\bar{p} \rightarrow e^+ e^- \gamma$

27.7 ± 1.5 ± 2.0

<sup>1,2</sup> ARMSTRONG 92 E760  $p\bar{p} \rightarrow e^+ e^- \gamma$

36 ± 8

<sup>1</sup> BAGLIN 86B SPEC  $p\bar{p} \rightarrow e^+ e^- X$

<sup>1</sup> Calculated by us using  $B(J/\psi(1S) \rightarrow e^+ e^-) = 0.0593 \pm 0.0010$ .

<sup>2</sup> Recalculated by ANDREOTTI 05A.

NODE=M057G;LINKAGE=7A

NODE=M057G;LINKAGE=AN

$\Gamma(\gamma\gamma) \times \Gamma(\gamma J/\psi(1S)) / \Gamma_{\text{total}}$

$\Gamma_{95} \Gamma_{91} / \Gamma$

VALUE (eV)

EVTs

DOCUMENT ID

TECN

COMMENT

**107 ± 5 OUR FIT**

**117 ± 10 OUR AVERAGE**

111 ± 12 ± 9 147 ± 15

<sup>1</sup> DOBBS 06 CLE3 10.4  $e^+ e^- \rightarrow$

$e^+ e^- \chi_{c2}$

114 ± 11 ± 9 136 ± 13.3

<sup>1,2</sup> ABE 02T BELL  $e^+ e^- \rightarrow e^+ e^- \chi_{c2}$

139 ± 55 ± 21

<sup>1,3</sup> ACCIARRI 99E L3  $e^+ e^- \rightarrow e^+ e^- \chi_{c2}$

NODE=M057G2

NODE=M057G2

|                 |                 |    |      |                                       |
|-----------------|-----------------|----|------|---------------------------------------|
| 242 ± 65 ± 51   | 1,4 ACKER.,K... | 98 | OPAL | $e^+e^- \rightarrow e^+e^- \chi_{c2}$ |
| 150 ± 42 ± 36   | 1,5 DOMINICK    | 94 | CLE2 | $e^+e^- \rightarrow e^+e^- \chi_{c2}$ |
| 470 ± 240 ± 120 | 1,6 BAUER       | 93 | TPC  | $e^+e^- \rightarrow e^+e^- \chi_{c2}$ |

<sup>1</sup> Calculated by us using  $B(J/\psi \rightarrow \ell^+ \ell^-) = 0.1187 \pm 0.0008$ .

<sup>2</sup> All systematic errors added in quadrature.

<sup>3</sup> The value for  $\Gamma(\chi_{c2} \rightarrow \gamma\gamma)$  reported in ACCIARRI 99E is derived using  $B(\chi_{c2} \rightarrow \gamma J/\psi(1S)) \times B(J/\psi(1S) \rightarrow \ell^+ \ell^-) = 0.0162 \pm 0.0014$ .

<sup>4</sup> The value for  $\Gamma(\chi_{c2} \rightarrow \gamma\gamma)$  reported in ACKERSTAFF, K 98 is derived using  $B(\chi_{c2} \rightarrow \gamma J/\psi(1S)) = 0.135 \pm 0.011$  and  $B(J/\psi(1S) \rightarrow \ell^+ \ell^-) = 0.1203 \pm 0.0038$ .

<sup>5</sup> The value for  $\Gamma(\chi_{c2} \rightarrow \gamma\gamma)$  reported in DOMINICK 94 is derived using  $B(\chi_{c2} \rightarrow \gamma J/\psi(1S)) = 0.135 \pm 0.011$ ,  $B(J/\psi(1S) \rightarrow e^+e^-) = 0.0627 \pm 0.0020$ , and  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = 0.0597 \pm 0.0025$ .

<sup>6</sup> The value for  $\Gamma(\chi_{c2} \rightarrow \gamma\gamma)$  reported in BAUER 93 is derived using  $B(\chi_{c2} \rightarrow \gamma J/\psi(1S)) = 0.135 \pm 0.011$ ,  $B(J/\psi(1S) \rightarrow e^+e^-) = 0.0627 \pm 0.0020$ , and  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = 0.0597 \pm 0.0025$ .

NODE=M057G;LINKAGE=LL

NODE=M057G;LINKAGE=GT

NODE=M057G;LINKAGE=J4

NODE=M057G;LINKAGE=J5

NODE=M057G;LINKAGE=J6

NODE=M057G;LINKAGE=J7

### ———— $\chi_{c2}(1P) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$ ————

NODE=M057224

$\Gamma(2(\pi^+\pi^-)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_1 \Gamma_{95} / \Gamma$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**5.7 ± 0.5 OUR FIT**

**5.2 ± 0.7 OUR AVERAGE**

|                    |            |        |    |      |                                                                |
|--------------------|------------|--------|----|------|----------------------------------------------------------------|
| 5.01 ± 0.44 ± 0.55 | 1597 ± 138 | UEHARA | 08 | BELL | $\gamma\gamma \rightarrow \chi_{c2} \rightarrow 2(\pi^+\pi^-)$ |
|--------------------|------------|--------|----|------|----------------------------------------------------------------|

|                 |  |            |    |      |                                       |
|-----------------|--|------------|----|------|---------------------------------------|
| 6.4 ± 1.8 ± 0.8 |  | EISENSTEIN | 01 | CLE2 | $e^+e^- \rightarrow e^+e^- \chi_{c2}$ |
|-----------------|--|------------|----|------|---------------------------------------|

NODE=M057G3

NODE=M057G3

$\Gamma(\rho\rho) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_2 \Gamma_{95} / \Gamma$

| VALUE (eV) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|-----|------|-------------|------|---------|
|------------|-----|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |      |        |    |      |                                                                |
|------|----|------|--------|----|------|----------------------------------------------------------------|
| <7.8 | 90 | <598 | UEHARA | 08 | BELL | $\gamma\gamma \rightarrow \chi_{c2} \rightarrow 2(\pi^+\pi^-)$ |
|------|----|------|--------|----|------|----------------------------------------------------------------|

NODE=M057G08

NODE=M057G08

$\Gamma(K^+K^-\pi^+\pi^-) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_{14} \Gamma_{95} / \Gamma$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**4.7 ± 0.5 OUR FIT**

|                           |          |        |    |      |                                                                   |
|---------------------------|----------|--------|----|------|-------------------------------------------------------------------|
| <b>4.42 ± 0.42 ± 0.53</b> | 780 ± 74 | UEHARA | 08 | BELL | $\gamma\gamma \rightarrow \chi_{c2} \rightarrow K^+K^-\pi^+\pi^-$ |
|---------------------------|----------|--------|----|------|-------------------------------------------------------------------|

NODE=M057G09

NODE=M057G09

$\Gamma(K^+K^-\pi^+\pi^-\pi^0) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_{15} \Gamma_{95} / \Gamma$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                        |      |                 |      |                                                  |
|------------------------|------|-----------------|------|--------------------------------------------------|
| <b>6.5 ± 0.9 ± 1.5</b> | 1250 | DEL-AMO-SA..11M | BABR | $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$ |
|------------------------|------|-----------------|------|--------------------------------------------------|

NODE=M057G02

NODE=M057G02

$\Gamma(K^*(892)^0 \bar{K}^*(892)^0) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_{18} \Gamma_{95} / \Gamma$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**1.26 ± 0.24 OUR FIT**

|                          |          |        |    |      |                                                                   |
|--------------------------|----------|--------|----|------|-------------------------------------------------------------------|
| <b>0.8 ± 0.17 ± 0.27</b> | 151 ± 30 | UEHARA | 08 | BELL | $\gamma\gamma \rightarrow \chi_{c2} \rightarrow K^+K^-\pi^+\pi^-$ |
|--------------------------|----------|--------|----|------|-------------------------------------------------------------------|

NODE=M057G10

NODE=M057G10

$\Gamma(\phi\phi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_{20} \Gamma_{95} / \Gamma$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**0.60 ± 0.05 OUR FIT**

|                           |         |                  |     |      |                                      |
|---------------------------|---------|------------------|-----|------|--------------------------------------|
| <b>0.62 ± 0.07 ± 0.05</b> | 89 ± 11 | <sup>1</sup> LIU | 12B | BELL | $\gamma\gamma \rightarrow 2(K^+K^-)$ |
|---------------------------|---------|------------------|-----|------|--------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                    |            |        |    |      |                                                            |
|--------------------|------------|--------|----|------|------------------------------------------------------------|
| 0.58 ± 0.18 ± 0.16 | 26.5 ± 8.1 | UEHARA | 08 | BELL | $\gamma\gamma \rightarrow \chi_{c2} \rightarrow 2(K^+K^-)$ |
|--------------------|------------|--------|----|------|------------------------------------------------------------|

<sup>1</sup> Supersedes UEHARA 08. Using  $B(\phi \rightarrow K^+K^-) = (48.9 \pm 0.5)\%$ .

NODE=M057G12

NODE=M057G12

NODE=M057G12;LINKAGE=LI

$\Gamma(\omega\omega) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_{22} \Gamma_{95} / \Gamma$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                  |     |      |                                               |
|-------|----|------------------|-----|------|-----------------------------------------------|
| <0.64 | 90 | <sup>1</sup> LIU | 12B | BELL | $\gamma\gamma \rightarrow 2(\pi^+\pi^-\pi^0)$ |
|-------|----|------------------|-----|------|-----------------------------------------------|

<sup>1</sup> Using  $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7)\%$ .

NODE=M057G03

NODE=M057G03

NODE=M057G03;LINKAGE=LI

$\Gamma(\omega\phi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_{24} \Gamma_{95} / \Gamma$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                  |     |      |                                                  |
|-------|----|------------------|-----|------|--------------------------------------------------|
| <0.04 | 90 | <sup>1</sup> LIU | 12B | BELL | $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$ |
|-------|----|------------------|-----|------|--------------------------------------------------|

<sup>1</sup> Using  $B(\phi \rightarrow K^+K^-) = (48.9 \pm 0.5)\%$  and  $B(\omega \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7)\%$ .

NODE=M057G04

NODE=M057G04

NODE=M057G04;LINKAGE=LI

$$\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{25}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**1.25±0.07 OUR FIT**

**1.18±0.25 OUR AVERAGE**

|                |         |                       |         |                                                                                                  |
|----------------|---------|-----------------------|---------|--------------------------------------------------------------------------------------------------|
| 1.44±0.54±0.47 | 34 ± 13 | <sup>1</sup> UEHARA   | 09 BELL | 10.6 e <sup>+</sup> e <sup>-</sup> → e <sup>+</sup> e <sup>-</sup> π <sup>0</sup> π <sup>0</sup> |
| 1.14±0.21±0.17 | 54 ± 10 | <sup>2</sup> NAKAZAWA | 05 BELL | 10.6 e <sup>+</sup> e <sup>-</sup> → e <sup>+</sup> e <sup>-</sup> π <sup>+</sup> π <sup>-</sup> |

<sup>1</sup> We multiplied the measurement by 3 to convert from π<sup>0</sup>π<sup>0</sup> to ππ. Interference with the continuum included.

<sup>2</sup> We have multiplied π<sup>+</sup>π<sup>-</sup> measurement by 3/2 to obtain ππ.

NODE=M057G4  
NODE=M057G4

NODE=M057G4;LINKAGE=UE

NODE=M057G;LINKAGE=NA

$$\Gamma(\rho^0\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{26}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**2.1±0.9 OUR FIT**

|             |           |        |         |                                                          |
|-------------|-----------|--------|---------|----------------------------------------------------------|
| 3.2±1.9±0.5 | 986 ± 578 | UEHARA | 08 BELL | γγ → χ <sub>c2</sub> → 2(π <sup>+</sup> π <sup>-</sup> ) |
|-------------|-----------|--------|---------|----------------------------------------------------------|

NODE=M057G07  
NODE=M057G07

$$\Gamma(\eta\eta) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{31}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**0.53±0.22±0.09**

|   |                     |          |                                                                       |
|---|---------------------|----------|-----------------------------------------------------------------------|
| 8 | <sup>1</sup> UEHARA | 10A BELL | 10.6 e <sup>+</sup> e <sup>-</sup> → e <sup>+</sup> e <sup>-</sup> ηη |
|---|---------------------|----------|-----------------------------------------------------------------------|

<sup>1</sup> Interference with the continuum not included.

NODE=M057G13  
NODE=M057G13

NODE=M057G13;LINKAGE=UE

$$\Gamma(K^+K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{32}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**0.56±0.04 OUR FIT**

|                |        |          |         |                                                                                                  |
|----------------|--------|----------|---------|--------------------------------------------------------------------------------------------------|
| 0.44±0.11±0.07 | 33 ± 8 | NAKAZAWA | 05 BELL | 10.6 e <sup>+</sup> e <sup>-</sup> → e <sup>+</sup> e <sup>-</sup> K <sup>+</sup> K <sup>-</sup> |
|----------------|--------|----------|---------|--------------------------------------------------------------------------------------------------|

NODE=M057G5  
NODE=M057G5

$$\Gamma(K_S^0 K_S^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{33}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**0.294±0.025 OUR FIT**

|                                                |    |                     |         |                                                              |
|------------------------------------------------|----|---------------------|---------|--------------------------------------------------------------|
| 0.27 <sup>+0.07</sup> / <sub>-0.06</sub> ±0.03 | 53 | <sup>1</sup> UEHARA | 13 BELL | γγ → K <sub>S</sub> <sup>0</sup> K <sub>S</sub> <sup>0</sup> |
|------------------------------------------------|----|---------------------|---------|--------------------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                  |        |      |          |                                                                               |
|------------------|--------|------|----------|-------------------------------------------------------------------------------|
| 0.31 ±0.05 ±0.03 | 38 ± 7 | CHEN | 07B BELL | e <sup>+</sup> e <sup>-</sup> → e <sup>+</sup> e <sup>-</sup> χ <sub>c2</sub> |
|------------------|--------|------|----------|-------------------------------------------------------------------------------|

<sup>1</sup> Supersedes CHEN 07B.

NODE=M057G6  
NODE=M057G6

NODE=M057G6;LINKAGE=UE

$$\Gamma(\bar{K}^0 K^+ \pi^- + \text{c.c.}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{42}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**0.72±0.11 OUR FIT**

|                |     |                              |      |                                                                |
|----------------|-----|------------------------------|------|----------------------------------------------------------------|
| 1.20±0.33±0.13 | 126 | <sup>1</sup> DEL-AMO-SA..11M | BABR | γγ → K <sub>S</sub> <sup>0</sup> K <sup>±</sup> π <sup>∓</sup> |
|----------------|-----|------------------------------|------|----------------------------------------------------------------|

<sup>1</sup> We have multiplied  $\bar{K}K\pi$  by 2/3 to obtain  $\bar{K}^0 K^+ \pi^- + \text{c.c.}$

NODE=M057G01  
NODE=M057G01

NODE=M057G01;LINKAGE=DE

$$\Gamma(K^+K^-K^+K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{51}\Gamma_{95}/\Gamma$$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**0.93±0.11 OUR FIT**

|                |          |        |         |                                                          |
|----------------|----------|--------|---------|----------------------------------------------------------|
| 1.10±0.21±0.15 | 126 ± 24 | UEHARA | 08 BELL | γγ → χ <sub>c2</sub> → 2(K <sup>+</sup> K <sup>-</sup> ) |
|----------------|----------|--------|---------|----------------------------------------------------------|

NODE=M057G11  
NODE=M057G11

$$\Gamma(\eta_c(1S)\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{90}\Gamma_{95}/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

**<15.7**

|    |      |           |                                                                                                            |
|----|------|-----------|------------------------------------------------------------------------------------------------------------|
| 90 | LEES | 12AE BABR | e <sup>+</sup> e <sup>-</sup> → e <sup>+</sup> e <sup>-</sup> π <sup>+</sup> π <sup>-</sup> η <sub>c</sub> |
|----|------|-----------|------------------------------------------------------------------------------------------------------------|

NODE=M057G05  
NODE=M057G05

## χ<sub>c2</sub>(1P) BRANCHING RATIOS

NODE=M057225

## HADRONIC DECAYS

NODE=M057305

$$\Gamma(2(\pi^+\pi^-))/\Gamma_{\text{total}} \quad \Gamma_1/\Gamma$$

| VALUE | DOCUMENT ID |
|-------|-------------|
|-------|-------------|

**0.0102±0.0009 OUR FIT**

NODE=M057R2  
NODE=M057R2

$$\Gamma(\rho^0\pi^+\pi^-)/\Gamma(2(\pi^+\pi^-)) \quad \Gamma_{26}/\Gamma_1$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.36±0.15 OUR FIT**

|           |           |         |                          |
|-----------|-----------|---------|--------------------------|
| 0.31±0.17 | TANENBAUM | 78 MRK1 | ψ(2S) → γχ <sub>c2</sub> |
|-----------|-----------|---------|--------------------------|

NODE=M057R38  
NODE=M057R38

$$\Gamma(\pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}} \quad \Gamma_3/\Gamma$$

| VALUE (%)             | EVTS  | DOCUMENT ID     | TECN     | COMMENT                                     |
|-----------------------|-------|-----------------|----------|---------------------------------------------|
| <b>1.83±0.23±0.04</b> | 903.5 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M057R46  
NODE=M057R46

<sup>1</sup> HE 08B reports  $1.87 \pm 0.07 \pm 0.22 \pm 0.13$  % from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \pi^+\pi^-\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R46;LINKAGE=HE

$$\Gamma(\rho^+\pi^-\pi^0 + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$$

| VALUE (%)             | EVTS   | DOCUMENT ID       | TECN     | COMMENT                                     |
|-----------------------|--------|-------------------|----------|---------------------------------------------|
| <b>2.19±0.34±0.05</b> | 1031.9 | <sup>1,2</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M057R47  
NODE=M057R47

<sup>1</sup> HE 08B reports  $2.23 \pm 0.11 \pm 0.32 \pm 0.16$  % from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \rho^+\pi^-\pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R47;LINKAGE=HE

<sup>2</sup> Calculated by us. We have added the values from HE 08B for  $\rho^+\pi^-\pi^0$  and  $\rho^-\pi^+\pi^0$  decays assuming uncorrelated statistical and fully correlated systematic uncertainties.

NODE=M057R47;LINKAGE=OC

$$\Gamma(4\pi^0)/\Gamma_{\text{total}} \quad \Gamma_5/\Gamma$$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|--------------------------|------|----------------------|----------|-----------------------------------------------------------|
| <b>1.11±0.15±0.02</b>    | 1164 | <sup>1</sup> ABLIKIM | 11A BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c2}$ |

NODE=M057R58  
NODE=M057R58

<sup>1</sup> ABLIKIM 11A reports  $(1.21 \pm 0.05 \pm 0.16) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow 4\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R58;LINKAGE=AB

$$\Gamma(K^+K^-\pi^0\pi^0)/\Gamma_{\text{total}} \quad \Gamma_6/\Gamma$$

| VALUE (%)                | EVTS | DOCUMENT ID     | TECN     | COMMENT                                     |
|--------------------------|------|-----------------|----------|---------------------------------------------|
| <b>0.206±0.040±0.004</b> | 76.9 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M057R48  
NODE=M057R48

<sup>1</sup> HE 08B reports  $0.21 \pm 0.03 \pm 0.03 \pm 0.01$  % from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^+K^-\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R48;LINKAGE=HE

$$\Gamma(K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_7/\Gamma$$

| VALUE (%)             | EVTS  | DOCUMENT ID     | TECN     | COMMENT                                     |
|-----------------------|-------|-----------------|----------|---------------------------------------------|
| <b>1.38±0.19±0.03</b> | 211.6 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M057R50  
NODE=M057R50

<sup>1</sup> HE 08B reports  $1.41 \pm 0.11 \pm 0.16 \pm 0.10$  % from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^+\pi^-\bar{K}^0\pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R50;LINKAGE=HE

$$\Gamma(\rho^-K^+\bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_8/\Gamma$$

| VALUE (%)             | EVTS | DOCUMENT ID     | TECN     | COMMENT                                     |
|-----------------------|------|-----------------|----------|---------------------------------------------|
| <b>0.41±0.12±0.01</b> | 62.9 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M057R51  
NODE=M057R51

<sup>1</sup> HE 08B reports  $0.42 \pm 0.11 \pm 0.06 \pm 0.03$  % from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \rho^-K^+\bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R51;LINKAGE=HE

$$\Gamma(K^*(892)^0 K^- \pi^+ \rightarrow K^- \pi^+ K^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_9/\Gamma$$

| VALUE (%)             | EVTS | DOCUMENT ID     | TECN     | COMMENT                                     |
|-----------------------|------|-----------------|----------|---------------------------------------------|
| <b>0.29±0.08±0.01</b> | 38.7 | <sup>1</sup> HE | 08B CLEO | $e^+e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M057R57  
NODE=M057R57

<sup>1</sup> HE 08B reports  $0.30 \pm 0.07 \pm 0.04 \pm 0.02$  % from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^0 K^- \pi^+ \rightarrow K^- \pi^+ K^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R57;LINKAGE=HE

$$\Gamma(K^*(892)^0 \bar{K}^0 \pi^0 \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{10}/\Gamma$$

| VALUE (%)             | EVTS | DOCUMENT ID     | TECN     | COMMENT                                      |
|-----------------------|------|-----------------|----------|----------------------------------------------|
| <b>0.38±0.09±0.01</b> | 63.0 | <sup>1</sup> HE | 08B CLEO | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M057R52  
NODE=M057R52

<sup>1</sup> HE 08B reports  $0.39 \pm 0.07 \pm 0.05 \pm 0.03$  % from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^0 \bar{K}^0 \pi^0 \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R52;LINKAGE=HE

$$\Gamma(K^*(892)^- K^+ \pi^0 \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{11}/\Gamma$$

| VALUE (%)             | EVTS | DOCUMENT ID     | TECN     | COMMENT                                      |
|-----------------------|------|-----------------|----------|----------------------------------------------|
| <b>0.37±0.08±0.01</b> | 51.1 | <sup>1</sup> HE | 08B CLEO | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M057R53  
NODE=M057R53

<sup>1</sup> HE 08B reports  $0.38 \pm 0.07 \pm 0.04 \pm 0.03$  % from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^- K^+ \pi^0 \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R53;LINKAGE=HE

$$\Gamma(K^*(892)^+ \bar{K}^0 \pi^- \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{12}/\Gamma$$

| VALUE (%)             | EVTS | DOCUMENT ID     | TECN     | COMMENT                                      |
|-----------------------|------|-----------------|----------|----------------------------------------------|
| <b>0.29±0.08±0.01</b> | 39.3 | <sup>1</sup> HE | 08B CLEO | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M057R54  
NODE=M057R54

<sup>1</sup> HE 08B reports  $0.30 \pm 0.07 \pm 0.04 \pm 0.02$  % from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^+ \bar{K}^0 \pi^- \rightarrow K^+ \pi^- \bar{K}^0 \pi^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R54;LINKAGE=HE

$$\Gamma(K^+ K^- \eta \pi^0)/\Gamma_{\text{total}} \quad \Gamma_{13}/\Gamma$$

| VALUE (%)                | EVTS | DOCUMENT ID     | TECN     | COMMENT                                      |
|--------------------------|------|-----------------|----------|----------------------------------------------|
| <b>0.127±0.044±0.003</b> | 22.9 | <sup>1</sup> HE | 08B CLEO | $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ |

NODE=M057R55  
NODE=M057R55

<sup>1</sup> HE 08B reports  $0.13 \pm 0.04 \pm 0.02 \pm 0.01$  % from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^- \eta \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R55;LINKAGE=HE

$$\Gamma(K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}} \quad \Gamma_{14}/\Gamma$$

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>8.4±0.9 OUR FIT</b>   |             |

NODE=M057R3  
NODE=M057R3

$$\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}} \quad \Gamma_{15}/\Gamma$$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                     |
|--------------------------|------|----------------------|----------|-------------------------------------------------------------|
| <b>11.69±0.13±1.31</b>   | 11k  | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c2}$ |

NODE=M057R00  
NODE=M057R00

<sup>1</sup> Using  $1.06 \times 10^8$   $\psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c2} \gamma) = (8.72 \pm 0.34)\%$ .

NODE=M057R00;LINKAGE=A

$$\Gamma(K_S^0 K^\pm \pi^\mp \pi^+ \pi^-)/\Gamma_{\text{total}} \quad \Gamma_{16}/\Gamma$$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                     |
|--------------------------|------|----------------------|----------|-------------------------------------------------------------|
| <b>7.30±0.11±0.75</b>    | 4.5k | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c2}$ |

NODE=M057R73  
NODE=M057R73

<sup>1</sup> Using  $1.06 \times 10^8$   $\psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c2} \gamma) = (8.72 \pm 0.34)\%$ .

NODE=M057R73;LINKAGE=A

$$\Gamma(K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.})/\Gamma(K^+ K^- \pi^+ \pi^-) \quad \Gamma_{17}/\Gamma_{14}$$

| VALUE                    | DOCUMENT ID  | TECN | COMMENT                                 |
|--------------------------|--------------|------|-----------------------------------------|
| <b>0.25±0.13 OUR FIT</b> |              |      |                                         |
| <b>0.25±0.13</b>         | TANENBAUM 78 | MRK1 | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |

NODE=M057R39  
NODE=M057R39

$$\Gamma(K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{17}/\Gamma$$

| VALUE (units $10^{-4}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>21±11 OUR FIT</b>     |             |

NODE=M057R9  
NODE=M057R9

$$\Gamma(K^*(892)^0 \bar{K}^*(892)^0)/\Gamma_{\text{total}} \quad \Gamma_{18}/\Gamma$$

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>2.3±0.4 OUR FIT</b>   |             |

NODE=M057R26  
NODE=M057R26

$\Gamma(3(\pi^+\pi^-))/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**8.6±1.8 OUR EVALUATION** Treating systematic error as correlated.**8.6±1.8 OUR AVERAGE**

8.6±0.9±1.6

<sup>1</sup> BAI 99B BES  $\psi(2S) \rightarrow \gamma\chi_{c2}$ 

8.7±5.9±0.4

<sup>1</sup> TANENBAUM 78 MRK1  $\psi(2S) \rightarrow \gamma\chi_{c2}$ 

<sup>1</sup> Rescaled by us using  $B(\psi(2S) \rightarrow \gamma\chi_{c2}) = (8.3 \pm 0.4)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$ . Multiplied by a factor of 2 to convert from  $K_S^0 K^+\pi^-$  to  $K^0 K^+\pi^-$  decay.

 $\Gamma_{19}/\Gamma$ NODE=M057R4  
NODE=M057R4

→ UNCHECKED ←

NODE=M057R;LINKAGE=X3

 $\Gamma(\phi\phi)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

**1.06±0.09 OUR FIT** $\Gamma_{20}/\Gamma$ NODE=M057R20  
NODE=M057R20 $\Gamma(\phi\phi\eta)/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**5.3±0.5±0.4**

143.6

<sup>1</sup> ABLIKIM 20B BES3  $\psi(2S) \rightarrow \gamma\phi\phi\eta$ 

<sup>1</sup> ABLIKIM 20B reports  $(5.33 \pm 0.52 \pm 0.39) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \phi\phi\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ .

 $\Gamma_{21}/\Gamma$ NODE=M057R97  
NODE=M057R97

NODE=M057R97;LINKAGE=A

 $\Gamma(\omega\omega)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**0.84±0.10 OUR AVERAGE**

0.82±0.10±0.02

762

<sup>1</sup> ABLIKIM 11K BES3  $\psi(2S) \rightarrow \gamma$  hadrons

1.73±0.57±0.04

27.7 ± 7.4

<sup>2</sup> ABLIKIM 05N BES2  $\psi(2S) \rightarrow \gamma\chi_{c2} \rightarrow \gamma 6\pi$ 

<sup>1</sup> ABLIKIM 11K reports  $(8.9 \pm 0.3 \pm 1.1) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \omega\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ABLIKIM 05N reports  $[\Gamma(\chi_{c2}(1P) \rightarrow \omega\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))] = (0.165 \pm 0.044 \pm 0.032) \times 10^{-3}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

 $\Gamma_{22}/\Gamma$ NODE=M057R28  
NODE=M057R28

NODE=M057R28;LINKAGE=AL

NODE=M057R28;LINKAGE=AB

 $\Gamma(\omega K^+ K^-)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**0.73±0.04±0.08**

512

<sup>1</sup> ABLIKIM 13B BES3  $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c2}$ 

<sup>1</sup> Using  $1.06 \times 10^8$   $\psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c2}\gamma) = (8.72 \pm 0.34)\%$ .

 $\Gamma_{23}/\Gamma$ NODE=M057R74  
NODE=M057R74

NODE=M057R74;LINKAGE=A

 $\Gamma(\omega\phi)/\Gamma_{\text{total}}$ VALUE (units  $10^{-6}$ )

CL%

EVTS

DOCUMENT ID

TECN

COMMENT

**9.6±2.7±0.2**

33

<sup>1</sup> ABLIKIM 19J BES3  $\psi(2S) \rightarrow \gamma$  hadrons

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt;18

90

<sup>2,3</sup> ABLIKIM 11K BES3  $\psi(2S) \rightarrow \gamma$  hadrons

<sup>1</sup> ABLIKIM 19J reports  $[\Gamma(\chi_{c2}(1P) \rightarrow \omega\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))] = (0.91 \pm 0.23 \pm 0.12) \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ABLIKIM 11K reports  $< 2 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \omega\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

<sup>3</sup> Superseded by ABLIKIM 19J.

 $\Gamma_{24}/\Gamma$ NODE=M057R63  
NODE=M057R63

NODE=M057R63;LINKAGE=A

NODE=M057R63;LINKAGE=AL

NODE=M057R63;LINKAGE=B

 $\Gamma(\pi\pi)/\Gamma_{\text{total}}$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

**2.23±0.09 OUR FIT** $\Gamma_{25}/\Gamma$ NODE=M057R27  
NODE=M057R27 $\Gamma(\rho^0\pi^+\pi^-)/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

**37±16 OUR FIT** $\Gamma_{26}/\Gamma$ NODE=M057R8  
NODE=M057R8



$\Gamma(\pi^+\pi^-\pi^0(\text{non-resonant}))/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | EVTs | DOCUMENT ID          | TECN      | COMMENT                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|-----------|----------------------------------------------|
| <b>2.01±0.42±0.04</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 64   | <sup>1</sup> ABLIKIM | 17AG BES3 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-\pi^0$ |
| <sup>1</sup> ABLIKIM 17AG reports $(2.1 \pm 0.4 \pm 0.2) \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{c2}(1P) \rightarrow \pi^+\pi^-\pi^0(\text{non-resonant}))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |           |                                              |

NODE=M057R84  
 NODE=M057R84

OCCUR=2

NODE=M057R84;LINKAGE=B

 $\Gamma(\rho(770)^\pm\pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{28}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | EVTs | DOCUMENT ID          | TECN      | COMMENT                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|-----------|----------------------------------------------|
| <b>0.61±0.38±0.01</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 15   | <sup>1</sup> ABLIKIM | 17AG BES3 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-\pi^0$ |
| <sup>1</sup> ABLIKIM 17AG reports $(0.64 \pm 0.39 \pm 0.07) \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{c2}(1P) \rightarrow \rho(770)^\pm\pi^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |           |                                              |

NODE=M057R85  
 NODE=M057R85

NODE=M057R85;LINKAGE=A

 $\Gamma(\pi^+\pi^-\eta)/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CL% | DOCUMENT ID          | TECN     | COMMENT                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------|----------|-------------------------------------------|
| <b>0.48±0.13±0.01</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |     | <sup>1</sup> ATHAR   | 07 CLEO  | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |     |                      |          |                                           |
| <1.4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 90  | <sup>2</sup> ABLIKIM | 06R BES2 | $\psi(2S) \rightarrow \gamma\chi_{c2}$    |
| <sup>1</sup> ATHAR 07 reports $(0.49 \pm 0.12 \pm 0.06) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c2}(1P) \rightarrow \pi^+\pi^-\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |     |                      |          |                                           |
| <sup>2</sup> ABLIKIM 06R reports $< 1.7 \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c2}(1P) \rightarrow \pi^+\pi^-\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (8.1 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .                                                                                                                                                           |     |                      |          |                                           |

NODE=M057R08  
 NODE=M057R08

NODE=M057R08;LINKAGE=AT

NODE=M057R08;LINKAGE=AB

 $\Gamma(\pi^+\pi^-\eta')/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | DOCUMENT ID        | TECN    | COMMENT                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|---------|-------------------------------------------|
| <b>0.50±0.18±0.01</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <sup>1</sup> ATHAR | 07 CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |
| <sup>1</sup> ATHAR 07 reports $(0.51 \pm 0.18 \pm 0.06) \times 10^{-3}$ from a measurement of $[\Gamma(\chi_{c2}(1P) \rightarrow \pi^+\pi^-\eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |                    |         |                                           |

NODE=M057R35  
 NODE=M057R35

NODE=M057R35;LINKAGE=AT

 $\Gamma(\eta\eta)/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>5.4±0.4 OUR FIT</b>   |             |

NODE=M057R16  
 NODE=M057R16

 $\Gamma(K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>1.01±0.06 OUR FIT</b> |             |

NODE=M057R11  
 NODE=M057R11

 $\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>0.52±0.04 OUR FIT</b> |             |

NODE=M057R19  
 NODE=M057R19

 $\Gamma(K_S^0 K_S^0)/\Gamma(\pi\pi)$  $\Gamma_{33}/\Gamma_{25}$ 

| VALUE                      | DOCUMENT ID | TECN | COMMENT |
|----------------------------|-------------|------|---------|
| <b>0.235±0.019 OUR FIT</b> |             |      |         |

NODE=M057R36  
 NODE=M057R36

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.27 ±0.07 ±0.04 <sup>1,2</sup> CHEN 07B BELL  $e^+e^- \rightarrow e^+e^-\chi_{c2}$

<sup>1</sup> Using  $\Gamma(\pi\pi) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  from the  $\pi^+\pi^-$  measurement of NAKAZAWA 05 rescaled by 3/2 to convert to  $\pi\pi$ .

<sup>2</sup> Not independent from other measurements.

NODE=M057R36;LINKAGE=CH

NODE=M057R36;LINKAGE=NI

$\Gamma(K_S^0 K_S^0)/\Gamma(K^+ K^-)$  $\Gamma_{33}/\Gamma_{32}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.52±0.05 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |          |          |                                         |
|----------------|----------|----------|-----------------------------------------|
| 0.70±0.21±0.12 | 1,2 CHEN | 07B BELL | $e^+ e^- \rightarrow e^+ e^- \chi_{c2}$ |
|----------------|----------|----------|-----------------------------------------|

<sup>1</sup> Using  $\Gamma(K^+ K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$  from NAKAZAWA 05.<sup>2</sup> Not independent from other measurements.

NODE=M057R37  
 NODE=M057R37

NODE=M057R37;LINKAGE=CH  
 NODE=M057R37;LINKAGE=NI

 $\Gamma(K^*(892)^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| VALUE (units 10 <sup>-4</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

**1.44±0.21±0.03**<sup>1</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K \bar{K} \pi$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

<sup>2</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K^+ K^- \pi^0$ <sup>3</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ <sup>1</sup> ABLIKIM 17AG reports  $(1.5 \pm 0.1 \pm 0.2) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^\pm K^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.<sup>2</sup> ABLIKIM 17AG reports  $(1.8 \pm 0.2 \pm 0.2) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^\pm K^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.<sup>3</sup> ABLIKIM 17AG reports  $(1.4 \pm 0.2 \pm 0.2) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^\pm K^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R86  
 NODE=M057R86

OCCUR=2  
 OCCUR=3

NODE=M057R86;LINKAGE=A

NODE=M057R86;LINKAGE=B

NODE=M057R86;LINKAGE=C

 $\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ 

| VALUE (units 10 <sup>-4</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

**1.24±0.27±0.03**<sup>1</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ <sup>1</sup> ABLIKIM 17AG reports  $(1.3 \pm 0.2 \pm 0.2) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R87  
 NODE=M057R87

NODE=M057R87;LINKAGE=A

 $\Gamma(K_2^*(1430)^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ 

| VALUE (units 10 <sup>-4</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

**14.8±1.2±0.3**<sup>1</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K \bar{K} \pi$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

<sup>2</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K^+ K^- \pi^0$ <sup>3</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ <sup>1</sup> ABLIKIM 17AG reports  $(15.5 \pm 0.6 \pm 1.2) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K_2^*(1430)^\pm K^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.<sup>2</sup> ABLIKIM 17AG reports  $(18.2 \pm 0.8 \pm 1.6) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K_2^*(1430)^\pm K^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.<sup>3</sup> ABLIKIM 17AG reports  $(13.6 \pm 0.8 \pm 1.4) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K_2^*(1430)^\pm K^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R88  
 NODE=M057R88

OCCUR=2  
 OCCUR=3

NODE=M057R88;LINKAGE=A

NODE=M057R88;LINKAGE=B

NODE=M057R88;LINKAGE=C

$\Gamma(K_2^*(1430)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**12.4 ± 1.7 ± 0.3**<sup>1</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ 

<sup>1</sup> ABLIKIM 17AG reports  $(13.0 \pm 1.0 \pm 1.5) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K_2^*(1430)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R89  
NODE=M057R89

NODE=M057R89;LINKAGE=A

 $\Gamma(K_3^*(1780)^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{38}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**5.2 ± 0.8 ± 0.1**<sup>1</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K \bar{K} \pi$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

5.1 ± 1.0 ± 0.1

<sup>2</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K^+ K^- \pi^0$ 

5.6 ± 1.8 ± 0.1

<sup>3</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ 

<sup>1</sup> ABLIKIM 17AG reports  $(5.4 \pm 0.5 \pm 0.7) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K_3^*(1780)^\pm K^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ABLIKIM 17AG reports  $(5.3 \pm 0.5 \pm 0.9) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K_3^*(1780)^\pm K^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> ABLIKIM 17AG reports  $(5.9 \pm 1.1 \pm 1.5) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K_3^*(1780)^\pm K^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R90  
NODE=M057R90

OCCUR=2

OCCUR=3

NODE=M057R90;LINKAGE=A

NODE=M057R90;LINKAGE=B

NODE=M057R90;LINKAGE=C

 $\Gamma(K_3^*(1780)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{39}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**5.6 ± 2.1 ± 0.1**<sup>1</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ 

<sup>1</sup> ABLIKIM 17AG reports  $(5.9 \pm 1.6 \pm 1.5) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K_3^*(1780)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R91  
NODE=M057R91

NODE=M057R91;LINKAGE=A

 $\Gamma(a_2(1320)^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{40}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**12.9 ± 3.4 ± 0.3**<sup>1</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K^+ K^- \pi^0$ 

<sup>1</sup> ABLIKIM 17AG reports  $(13.5 \pm 1.6 \pm 3.2) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow a_2(1320)^0 \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R92  
NODE=M057R92

NODE=M057R92;LINKAGE=A

 $\Gamma(a_2(1320)^\pm \pi^\mp)/\Gamma_{\text{total}}$  $\Gamma_{41}/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**17.6 ± 6.1 ± 0.4**<sup>1</sup> ABLIKIM 17AG BES3  $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ 

<sup>1</sup> ABLIKIM 17AG reports  $(18.4 \pm 3.3 \pm 5.5) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow a_2(1320)^\pm \pi^\mp)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R93  
NODE=M057R93

NODE=M057R93;LINKAGE=A

$\Gamma(K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{43}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**0.30±0.08±0.01**<sup>1</sup> ATHAR

07

CLEO

 $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ 

<sup>1</sup> ATHAR 07 reports  $(0.31 \pm 0.07 \pm 0.04) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R05  
 NODE=M057R05

NODE=M057R05;LINKAGE=AT

 $\Gamma(K^+ K^- \eta)/\Gamma_{\text{total}}$  $\Gamma_{44}/\Gamma$ VALUE (units  $10^{-3}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**<0.32**

90

<sup>1</sup> ATHAR

07

CLEO

 $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ 

<sup>1</sup> ATHAR 07 reports  $< 0.33 \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^- \eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R09  
 NODE=M057R09

NODE=M057R09;LINKAGE=AT

 $\Gamma(K^+ K^- \eta'(958))/\Gamma_{\text{total}}$  $\Gamma_{45}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.94±0.34**

107

<sup>1</sup> ABLIKIM

14J

BES3

 $\psi(2S) \rightarrow \gamma K^+ K^- \eta'(958)$ 

<sup>1</sup> Derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (8.72 \pm 0.34)\%$ . Uncertainty includes both statistical and systematic contributions combined in quadrature.

NODE=M057R78  
 NODE=M057R78

NODE=M057R78;LINKAGE=A

 $\Gamma(\eta\eta')/\Gamma_{\text{total}}$  $\Gamma_{46}/\Gamma$ VALUE (units  $10^{-5}$ )

CL%

EVTS

DOCUMENT ID

TECN

COMMENT

**2.17±0.47±0.05**

20

<sup>1</sup> ABLIKIM

17AI

BES3

 $\psi(2S) \rightarrow \gamma \eta' \eta$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt; 6

90

3.3 ± 8.0

<sup>2</sup> ASNER

09

CLEO

 $\psi(2S) \rightarrow \gamma \eta \eta'$ 

&lt;23

90

<sup>3</sup> ADAMS

07

CLEO

 $\psi(2S) \rightarrow \gamma \chi_{c2}$ 

<sup>1</sup> ABLIKIM 17AI reports  $(2.27 \pm 0.43 \pm 0.25) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \eta \eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R03;LINKAGE=A

<sup>2</sup> ASNER 09 reports  $< 0.6 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \eta \eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R03;LINKAGE=AS

<sup>3</sup> Superseded by ASNER 09. ADAMS 07 reports  $< 2.3 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \eta \eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 0.0933 \pm 0.0014 \pm 0.0061$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R03;LINKAGE=AD

 $\Gamma(\eta' \eta')/\Gamma_{\text{total}}$  $\Gamma_{47}/\Gamma$ VALUE (units  $10^{-5}$ )

CL%

EVTS

DOCUMENT ID

TECN

COMMENT

**4.6±0.6±0.1**

60

<sup>1</sup> ABLIKIM

17AI

BES3

 $\psi(2S) \rightarrow \gamma \eta' \eta'$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt;10

90

12 ± 7

<sup>2</sup> ASNER

09

CLEO

 $\psi(2S) \rightarrow \gamma \eta' \eta'$ 

&lt;30

90

<sup>3</sup> ADAMS

07

CLEO

 $\psi(2S) \rightarrow \gamma \chi_{c2}$ 

<sup>1</sup> ABLIKIM 17AI reports  $(4.76 \pm 0.56 \pm 0.38) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \eta' \eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R04;LINKAGE=A

<sup>2</sup> ASNER 09 reports  $< 1.0 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \eta' \eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R04;LINKAGE=AS

<sup>3</sup> Superseded by ASNER 09. ADAMS 07 reports  $< 3.1 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \eta' \eta')/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 0.0933 \pm 0.0014 \pm 0.0061$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R04;LINKAGE=AD

$\Gamma(\pi^+\pi^-K_S^0K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{48}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS    | DOCUMENT ID          | TECN     | COMMENT                                |
|--------------------------|---------|----------------------|----------|----------------------------------------|
| <b>2.17±0.54±0.05</b>    | 57 ± 11 | <sup>1</sup> ABLIKIM | 050 BES2 | $\psi(2S) \rightarrow \gamma\chi_{c2}$ |

NODE=M057R31  
NODE=M057R31

<sup>1</sup> ABLIKIM 050 reports  $[\Gamma(\chi_{c2}(1P) \rightarrow \pi^+\pi^-K_S^0K_S^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))] = (0.207 \pm 0.039 \pm 0.033) \times 10^{-3}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R31;LINKAGE=AB

 $\Gamma(K^+K^-K_S^0K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{49}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | EVTS      | DOCUMENT ID          | TECN     | COMMENT                              |
|--------------------------|-----|-----------|----------------------|----------|--------------------------------------|
| <b>&lt;4</b>             | 90  | 2.3 ± 2.2 | <sup>1</sup> ABLIKIM | 050 BES2 | $e^+e^- \rightarrow \chi_{c2}\gamma$ |

NODE=M057R32  
NODE=M057R32

<sup>1</sup> ABLIKIM 050 reports  $[\Gamma(\chi_{c2}(1P) \rightarrow K^+K^-K_S^0K_S^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))] < 3.5 \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R32;LINKAGE=AB

 $\Gamma(K_S^0K_S^0K_S^0K_S^0)/\Gamma_{\text{total}}$   $\Gamma_{50}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN      | COMMENT                              |
|--------------------------|------|----------------------|-----------|--------------------------------------|
| <b>1.13±0.18±0.02</b>    | 68   | <sup>1</sup> ABLIKIM | 19AA BES3 | $\psi(2S) \rightarrow \gamma 4K_S^0$ |

NODE=M057R94  
NODE=M057R94

<sup>1</sup> Using  $B(K_S^0 \rightarrow \pi^+\pi^-) = (69.20 \pm 0.05)\%$ . ABLIKIM 19AA reports  $[\Gamma(\chi_{c2}(1P) \rightarrow K_S^0K_S^0K_S^0K_S^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))] = (10.8 \pm 1.5 \pm 0.8) \times 10^{-6}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value..

NODE=M057R94;LINKAGE=A

 $\Gamma(K^+K^-K^+K^-)/\Gamma_{\text{total}}$   $\Gamma_{51}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>1.65±0.20 OUR FIT</b> |             |

NODE=M057R18  
NODE=M057R18

 $\Gamma(K^+K^-\phi)/\Gamma_{\text{total}}$   $\Gamma_{52}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                 |
|--------------------------|------|----------------------|----------|-----------------------------------------|
| <b>1.42±0.29±0.03</b>    | 52   | <sup>1</sup> ABLIKIM | 06T BES2 | $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ |

NODE=M057R01  
NODE=M057R01

<sup>1</sup> ABLIKIM 06T reports  $(1.67 \pm 0.26 \pm 0.24) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^+K^-\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (8.1 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R01;LINKAGE=AB

 $\Gamma(\bar{K}^0K^+\pi^-\phi + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{53}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID | TECN     | COMMENT                                |
|--------------------------|-------------|----------|----------------------------------------|
| <b>4.83±0.32±0.66</b>    | ABLIKIM     | 15M BES3 | $\psi(2S) \rightarrow \gamma\chi_{c2}$ |

NODE=M057R79  
NODE=M057R79

 $\Gamma(K^+K^-\pi^0\phi)/\Gamma_{\text{total}}$   $\Gamma_{54}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID | TECN     | COMMENT                                |
|--------------------------|-------------|----------|----------------------------------------|
| <b>2.74±0.16±0.44</b>    | ABLIKIM     | 15M BES3 | $\psi(2S) \rightarrow \gamma\chi_{c2}$ |

NODE=M057R80  
NODE=M057R80

 $\Gamma(\phi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{55}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|--------------------------|------|----------------------|----------|-----------------------------------------------------------|
| <b>0.93±0.06±0.10</b>    | 408  | <sup>1</sup> ABLIKIM | 13B BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma\chi_{c2}$ |

NODE=M057R75  
NODE=M057R75

<sup>1</sup> Using  $1.06 \times 10^8 \psi(2S)$  mesons and  $B(\psi(2S) \rightarrow \chi_{c2}\gamma) = (8.72 \pm 0.34)\%$ .

NODE=M057R75;LINKAGE=A

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$   $\Gamma_{56}/\Gamma$ 

| VALUE (units $10^{-4}$ )   | DOCUMENT ID |
|----------------------------|-------------|
| <b>0.733±0.033 OUR FIT</b> |             |

NODE=M057R12  
NODE=M057R12

 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{57}/\Gamma$ 

| VALUE (units $10^{-3}$ )     | DOCUMENT ID         | TECN    | COMMENT                                   |
|------------------------------|---------------------|---------|-------------------------------------------|
| <b>0.47±0.04 OUR AVERAGE</b> |                     |         |                                           |
| 0.47±0.04±0.01               | <sup>1</sup> ONYISI | 10 CLE3 | $\psi(2S) \rightarrow \gamma p\bar{p}X$   |
| 0.43±0.09±0.01               | <sup>2</sup> ATHAR  | 07 CLEO | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ |

NODE=M057R06  
NODE=M057R06

<sup>1</sup> ONYISI 10 reports  $(4.83 \pm 0.25 \pm 0.35 \pm 0.31) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{p}\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R06;LINKAGE=ON

<sup>2</sup> ATHAR 07 reports  $(0.44 \pm 0.08 \pm 0.05) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{p}\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R06;LINKAGE=AT

 **$\Gamma(p\bar{p}\eta)/\Gamma_{\text{total}}$**  **$\Gamma_{58}/\Gamma$** VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**0.174 $\pm$ 0.025 OUR AVERAGE**0.172 $\pm$ 0.026 $\pm$ 0.004<sup>1</sup> ONYISI

10

CLE3

 $\psi(2S) \rightarrow \gamma p\bar{p}X$ 0.186 $\pm$ 0.070 $\pm$ 0.004<sup>2</sup> ATHAR

07

CLEO

 $\psi(2S) \rightarrow \gamma h^+ h^- h^0$ 

<sup>1</sup> ONYISI 10 reports  $(1.76 \pm 0.23 \pm 0.14 \pm 0.11) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{p}\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R34;LINKAGE=ON

<sup>2</sup> ATHAR 07 reports  $(0.19 \pm 0.07 \pm 0.02) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{p}\eta)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R34;LINKAGE=AT

 **$\Gamma(p\bar{p}\omega)/\Gamma_{\text{total}}$**  **$\Gamma_{59}/\Gamma$** VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**0.36 $\pm$ 0.04 $\pm$ 0.01**<sup>1</sup> ONYISI

10

CLE3

 $\psi(2S) \rightarrow \gamma p\bar{p}X$ 

<sup>1</sup> ONYISI 10 reports  $(3.68 \pm 0.35 \pm 0.26 \pm 0.24) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{p}\omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R56  
NODE=M057R56

NODE=M057R56;LINKAGE=ON

 **$\Gamma(p\bar{p}\phi)/\Gamma_{\text{total}}$**  **$\Gamma_{60}/\Gamma$** VALUE (units  $10^{-5}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**2.8 $\pm$ 0.9 $\pm$ 0.1**24  $\pm$  7<sup>1</sup> ABLIKIM

11F

BES3

 $\psi(2S) \rightarrow \gamma p\bar{p}K^+ K^-$ 

<sup>1</sup> ABLIKIM 11F reports  $(3.04 \pm 0.85 \pm 0.43) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{p}\phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R62  
NODE=M057R62

NODE=M057R62;LINKAGE=AB

 **$\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$**  **$\Gamma_{61}/\Gamma$** VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**1.32 $\pm$ 0.34 OUR EVALUATION**

Treating systematic error as correlated.

**1.3  $\pm$  0.4 OUR AVERAGE**

Error includes scale factor of 1.3.

1.17 $\pm$ 0.19 $\pm$ 0.30<sup>1</sup> BAI

99B

BES

 $\psi(2S) \rightarrow \gamma\chi_{c2}$ 2.64 $\pm$ 1.03 $\pm$ 0.14<sup>1</sup> TANENBAUM

78

MRK1

 $\psi(2S) \rightarrow \gamma\chi_{c2}$ 

<sup>1</sup> Rescaled by us using  $B(\psi(2S) \rightarrow \gamma\chi_{c2}) = (8.3 \pm 0.4)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.6 \pm 0.5)\%$ . Multiplied by a factor of 2 to convert from  $K_S^0 K^+ \pi^-$  to  $K^0 K^+ \pi^-$  decay.

NODE=M057R6  
NODE=M057R6

→ UNCHECKED ←

NODE=M057R6;LINKAGE=X3

 **$\Gamma(p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}$**  **$\Gamma_{62}/\Gamma$** 

VALUE (%)

EVTS

DOCUMENT ID

TECN

COMMENT

**0.078 $\pm$ 0.023 $\pm$ 0.002**

29.2

<sup>1</sup> HE

08B

CLEO

 $e^+ e^- \rightarrow \gamma h^+ h^- h^0 h^0$ 

<sup>1</sup> HE 08B reports  $0.08 \pm 0.02 \pm 0.01 \pm 0.01\%$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{p}\pi^0\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R49  
NODE=M057R49

NODE=M057R49;LINKAGE=HE

$\Gamma(p\bar{p}K^+K^- \text{ (non-resonant)})/\Gamma_{\text{total}}$  $\Gamma_{63}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | EVTS     | DOCUMENT ID          | TECN     | COMMENT                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------------|----------|----------------------------------------------|
| <b>1.91±0.32±0.04</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 131 ± 12 | <sup>1</sup> ABLIKIM | 11F BES3 | $\psi(2S) \rightarrow \gamma p\bar{p}K^+K^-$ |
| <sup>1</sup> ABLIKIM 11F reports $(2.08 \pm 0.19 \pm 0.30) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{p}K^+K^- \text{ (non-resonant)})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |          |                      |          |                                              |

NODE=M057R59  
 NODE=M057R59

NODE=M057R59;LINKAGE=AB

 $\Gamma(p\bar{p}K_S^0K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{64}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                         | CL% | DOCUMENT ID          | TECN     | COMMENT                                |
|----------------------------------------------------------------------------------|-----|----------------------|----------|----------------------------------------|
| <b>&lt;7.9</b>                                                                   | 90  | <sup>1</sup> ABLIKIM | 06D BES2 | $\psi(2S) \rightarrow \chi_{c2}\gamma$ |
| <sup>1</sup> Using $B(\psi(2S) \rightarrow \chi_{c2}\gamma) = (9.3 \pm 0.6)\%$ . |     |                      |          |                                        |

NODE=M057R30  
 NODE=M057R30

NODE=M057R;LINKAGE=AB

 $\Gamma(p\bar{n}\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{65}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                         | EVTS | DOCUMENT ID          | TECN     | COMMENT                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b>8.5±0.9 OUR AVERAGE</b>                                                                                                                                                                                                                                                                                                                                                                                                                       |      |                      |          |                                             |
| 8.4±1.0±0.2                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3309 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma p\bar{n}\pi^-$ |
| 10.2±3.4±0.2                                                                                                                                                                                                                                                                                                                                                                                                                                     |      | <sup>2</sup> ABLIKIM | 06I BES2 | $\psi(2S) \rightarrow \gamma p\pi^-X$       |
| <sup>1</sup> ABLIKIM 12J reports $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{n}\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))] = (0.80 \pm 0.02 \pm 0.09) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                             |
| <sup>2</sup> ABLIKIM 06I reports $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{n}\pi^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))] = (0.97 \pm 0.20 \pm 0.26) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                             |

NODE=M057R33  
 NODE=M057R33

NODE=M057R33;LINKAGE=AL

NODE=M057R33;LINKAGE=AB

 $\Gamma(\bar{p}n\pi^+)/\Gamma_{\text{total}}$  $\Gamma_{66}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                         | EVTS | DOCUMENT ID          | TECN     | COMMENT                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------|
| <b>8.9±0.8±0.2</b>                                                                                                                                                                                                                                                                                                                                                                                                                               | 3732 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma\bar{p}n\pi^+$ |
| <sup>1</sup> ABLIKIM 12J reports $[\Gamma(\chi_{c2}(1P) \rightarrow \bar{p}n\pi^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))] = (0.85 \pm 0.02 \pm 0.07) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                            |

NODE=M057R70  
 NODE=M057R70

NODE=M057R70;LINKAGE=AL

 $\Gamma(p\bar{n}\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{67}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                              | EVTS | DOCUMENT ID          | TECN     | COMMENT                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|--------------------------------------------------|
| <b>21.7±1.7±0.5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2128 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma p\bar{n}\pi^-\pi^0$ |
| <sup>1</sup> ABLIKIM 12J reports $[\Gamma(\chi_{c2}(1P) \rightarrow p\bar{n}\pi^-\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))] = (2.07 \pm 0.06 \pm 0.15) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                                  |

NODE=M057R71  
 NODE=M057R71

NODE=M057R71;LINKAGE=AL

 $\Gamma(\bar{p}n\pi^+\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{68}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                              | EVTS | DOCUMENT ID          | TECN     | COMMENT                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|-------------------------------------------------|
| <b>21.1±1.8±0.4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2352 | <sup>1</sup> ABLIKIM | 12J BES3 | $\psi(2S) \rightarrow \gamma\bar{p}n\pi^+\pi^0$ |
| <sup>1</sup> ABLIKIM 12J reports $[\Gamma(\chi_{c2}(1P) \rightarrow \bar{p}n\pi^+\pi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))] = (2.01 \pm 0.06 \pm 0.16) \times 10^{-4}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma\chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                                 |

NODE=M057R72  
 NODE=M057R72

NODE=M057R72;LINKAGE=AL

 $\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$  $\Gamma_{69}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID |
|--------------------------|-------------|
| <b>1.84±0.15 OUR FIT</b> |             |

NODE=M057R25  
 NODE=M057R25

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{70}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                     |
|-------------------------------------------------------------------------------|-----|------|----------------------|----------|-------------------------------------------------------------|
| <b>125±15±3</b>                                                               |     | 371  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma\Lambda\bar{\Lambda}\pi^+\pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                      |          |                                                             |
| <350                                                                          | 90  |      | <sup>2</sup> ABLIKIM | 06D BES2 | $\psi(2S) \rightarrow \chi_{c2}\gamma$                      |

NODE=M057R29  
 NODE=M057R29

<sup>1</sup> ABLIKIM 12I reports  $(137.0 \pm 7.6 \pm 15.7) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Lambda \bar{\Lambda} \pi^+ \pi^-) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.72 \pm 0.34) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Using  $B(\psi(2S) \rightarrow \chi_{c2} \gamma) = (9.3 \pm 0.6)\%$ .

NODE=M057R29;LINKAGE=AL

### $\Gamma(\Lambda \bar{\Lambda} \pi^+ \pi^- (\text{non-resonant})) / \Gamma_{\text{total}}$ $\Gamma_{71} / \Gamma$

| VALUE (units $10^{-5}$ )            | EVTs | DOCUMENT ID          | TECN     | COMMENT                                                         |
|-------------------------------------|------|----------------------|----------|-----------------------------------------------------------------|
| <b><math>66 \pm 15 \pm 1</math></b> | 36   | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda} \pi^+ \pi^-$ |

NODE=M057R65  
NODE=M057R65

<sup>1</sup> ABLIKIM 12I reports  $(71.8 \pm 14.5 \pm 8.2) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Lambda \bar{\Lambda} \pi^+ \pi^- (\text{non-resonant})) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.72 \pm 0.34) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R65;LINKAGE=AL

### $\Gamma(\Sigma(1385)^+ \bar{\Lambda} \pi^- + \text{c.c.}) / \Gamma_{\text{total}}$ $\Gamma_{72} / \Gamma$

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                                          |
|--------------------------|-----|----------------------|----------|------------------------------------------------------------------|
| <b>&lt;40</b>            | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^+ \bar{\Lambda} \pi^-$ |

NODE=M057R66  
NODE=M057R66

<sup>1</sup> ABLIKIM 12I reports  $< 42 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma(1385)^+ \bar{\Lambda} \pi^- + \text{c.c.}) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.72 \pm 0.34) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R66;LINKAGE=AL

### $\Gamma(\Sigma(1385)^- \bar{\Lambda} \pi^+ + \text{c.c.}) / \Gamma_{\text{total}}$ $\Gamma_{73} / \Gamma$

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                                          |
|--------------------------|-----|----------------------|----------|------------------------------------------------------------------|
| <b>&lt;60</b>            | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^- \bar{\Lambda} \pi^+$ |

NODE=M057R67  
NODE=M057R67

<sup>1</sup> ABLIKIM 12I reports  $< 61 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma(1385)^- \bar{\Lambda} \pi^+ + \text{c.c.}) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.72 \pm 0.34) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R67;LINKAGE=AL

### $\Gamma(K^+ \bar{p} \Lambda + \text{c.c.}) / \Gamma_{\text{total}}$ $\Gamma_{74} / \Gamma$

| VALUE (units $10^{-4}$ )                    | EVTs | DOCUMENT ID | TECN | COMMENT |
|---------------------------------------------|------|-------------|------|---------|
| <b><math>7.8 \pm 0.5</math> OUR AVERAGE</b> |      |             |      |         |

NODE=M057R07  
NODE=M057R07

|                       |    |                        |          |                                                   |
|-----------------------|----|------------------------|----------|---------------------------------------------------|
| $7.7 \pm 0.5 \pm 0.2$ | 5k | <sup>1,2</sup> ABLIKIM | 13D BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{p} K^+$ |
| $8.3 \pm 1.6 \pm 0.2$ |    | <sup>3</sup> ATHAR     | 07 CLEO  | $\psi(2S) \rightarrow \gamma h^+ h^- h^0$         |

<sup>1</sup> ABLIKIM 13D reports  $(8.4 \pm 0.3 \pm 0.6) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^+ \bar{p} \Lambda + \text{c.c.}) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.72 \pm 0.34) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R07;LINKAGE=AB

<sup>2</sup> Using  $B(\Lambda \rightarrow p \pi^-) = 63.9\%$ .

NODE=M057R07;LINKAGE=LB  
NODE=M057R07;LINKAGE=AT

<sup>3</sup> ATHAR 07 reports  $(8.5 \pm 1.4 \pm 1.0) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^+ \bar{p} \Lambda + \text{c.c.}) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

### $\Gamma(K^*(892)^+ \bar{p} \Lambda + \text{c.c.}) / \Gamma_{\text{total}}$ $\Gamma_{75} / \Gamma$

| VALUE (units $10^{-4}$ )                | EVTs | DOCUMENT ID          | TECN      | COMMENT                                              |
|-----------------------------------------|------|----------------------|-----------|------------------------------------------------------|
| <b><math>8.2 \pm 1.1 \pm 0.2</math></b> | 476  | <sup>1</sup> ABLIKIM | 19AU BES3 | $\psi(2S) \rightarrow \gamma K^{*+} \bar{p} \Lambda$ |

NODE=M057R98  
NODE=M057R98

<sup>1</sup> ABLIKIM 19AU reports  $[\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^+ \bar{p} \Lambda + \text{c.c.}) / \Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))] = (7.8 \pm 0.9 \pm 0.6) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R98;LINKAGE=F

### $\Gamma(K^+ \bar{p} \Lambda(1520) + \text{c.c.}) / \Gamma_{\text{total}}$ $\Gamma_{76} / \Gamma$

| VALUE (units $10^{-4}$ )                | EVTs        | DOCUMENT ID          | TECN     | COMMENT                                         |
|-----------------------------------------|-------------|----------------------|----------|-------------------------------------------------|
| <b><math>2.8 \pm 0.7 \pm 0.1</math></b> | $79 \pm 13$ | <sup>1</sup> ABLIKIM | 11F BES3 | $\psi(2S) \rightarrow \gamma p \bar{p} K^+ K^-$ |

NODE=M057R60  
NODE=M057R60



<sup>1</sup> ABLIKIM 11F reports  $(3.06 \pm 0.50 \pm 0.54) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow K^+ \bar{p} \Lambda(1520) + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R60;LINKAGE=AB

### $\Gamma(\Lambda(1520)\bar{\Lambda}(1520))/\Gamma_{\text{total}}$ $\Gamma_{77}/\Gamma$

| VALUE (units $10^{-4}$ )                | EVTS       | DOCUMENT ID          | TECN     | COMMENT                                         |
|-----------------------------------------|------------|----------------------|----------|-------------------------------------------------|
| <b><math>4.6 \pm 1.4 \pm 0.1</math></b> | 29 $\pm$ 7 | <sup>1</sup> ABLIKIM | 11F BES3 | $\psi(2S) \rightarrow \gamma p \bar{p} K^+ K^-$ |

NODE=M057R61  
NODE=M057R61

<sup>1</sup> ABLIKIM 11F reports  $(5.05 \pm 1.29 \pm 0.93) \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Lambda(1520)\bar{\Lambda}(1520))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R61;LINKAGE=AB

### $\Gamma(\Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}$ $\Gamma_{78}/\Gamma$

| VALUE (units $10^{-5}$ )                | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                               |
|-----------------------------------------|-----|------|----------------------|----------|-------------------------------------------------------|
| <b><math>3.7 \pm 0.6 \pm 0.1</math></b> |     | 91   | <sup>1</sup> ABLIKIM | 18V BES3 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |

NODE=M057R43  
NODE=M057R43

• • • We do not use the following data for averages, fits, limits, etc. • • •

|    |    |               |                      |          |                                                       |
|----|----|---------------|----------------------|----------|-------------------------------------------------------|
| <6 | 90 |               | <sup>2</sup> ABLIKIM | 13H BES3 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |
| <7 | 90 | 7.5 $\pm$ 3.4 | <sup>3</sup> NAIK    | 08 CLEO  | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{\Sigma}^0$ |

<sup>1</sup> ABLIKIM 18V reports  $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))] = (0.35 \pm 0.05 \pm 0.02) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R43;LINKAGE=A

<sup>2</sup> ABLIKIM 13H reports  $< 0.65 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R43;LINKAGE=AB

<sup>3</sup> NAIK 08 reports  $< 0.75 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R43;LINKAGE=NA

### $\Gamma(\Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}$ $\Gamma_{81}/\Gamma$

| VALUE (units $10^{-5}$ )                | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                               |
|-----------------------------------------|-----|------|----------------------|----------|-------------------------------------------------------|
| <b><math>3.4 \pm 0.7 \pm 0.1</math></b> |     | 55   | <sup>1</sup> ABLIKIM | 18V BES3 | $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{\Sigma}^-$ |

NODE=M057R44  
NODE=M057R44

• • • We do not use the following data for averages, fits, limits, etc. • • •

|    |    |               |                      |          |                                                       |
|----|----|---------------|----------------------|----------|-------------------------------------------------------|
| <8 | 90 |               | <sup>2</sup> ABLIKIM | 13H BES3 | $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{\Sigma}^-$ |
| <7 | 90 | 4.0 $\pm$ 3.5 | <sup>3</sup> NAIK    | 08 CLEO  | $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{\Sigma}^-$ |

<sup>1</sup> ABLIKIM 18V reports  $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))] = (0.32 \pm 0.06 \pm 0.03) \times 10^{-5}$  which we divide by our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M057R44;LINKAGE=A

<sup>2</sup> ABLIKIM 13H reports  $< 0.88 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R44;LINKAGE=AB

<sup>3</sup> NAIK 08 reports  $< 0.67 \times 10^{-4}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R44;LINKAGE=NA

### $\Gamma(\Sigma^- \bar{\Sigma}^+)/\Gamma_{\text{total}}$ $\Gamma_{82}/\Gamma$

| VALUE (units $10^{-5}$ )                | EVTS | DOCUMENT ID          | TECN     | COMMENT                                               |
|-----------------------------------------|------|----------------------|----------|-------------------------------------------------------|
| <b><math>4.4 \pm 1.7 \pm 0.5</math></b> | 131  | <sup>1</sup> ABLIKIM | 20I BES3 | $\psi(2S) \rightarrow \gamma \Sigma^- \bar{\Sigma}^+$ |

NODE=M057R99  
NODE=M057R99

<sup>1</sup> ABLIKIM 20I reports  $(4.4 \pm 1.7 \pm 0.5) \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma^- \bar{\Sigma}^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ .

NODE=M057R99;LINKAGE=A

### $\Gamma(\Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}}$ $\Gamma_{83}/\Gamma$

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                                           |
|--------------------------|-----|----------------------|----------|-------------------------------------------------------------------|
| <b>&lt;16</b>            | 90  | <sup>1</sup> ABLIKIM | 12I BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^+ \bar{\Sigma}(1385)^-$ |

NODE=M057R68  
NODE=M057R68

<sup>1</sup> ABLIKIM 12I reports  $< 17 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.72 \pm 0.34) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

NODE=M057R68;LINKAGE=AL

$\Gamma(\Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}}$  $\Gamma_{84}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                                                                                                                                                 | CL% | DOCUMENT ID              | TECN | COMMENT                                                           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|-------------------------------------------------------------------|
| <b>&lt;8</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | 90  | <sup>1</sup> ABLIKIM 12I | BES3 | $\psi(2S) \rightarrow \gamma \Sigma(1385)^- \bar{\Sigma}(1385)^+$ |
| <sup>1</sup> ABLIKIM 12I reports $< 8.5 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{c2}(1P) \rightarrow \Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.72 \pm 0.34) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ . |     |                          |      |                                                                   |

NODE=M057R69  
 NODE=M057R69

NODE=M057R69;LINKAGE=AL

 $\Gamma(K^- \Lambda \bar{\Xi}^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{85}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EVTS | DOCUMENT ID              | TECN | COMMENT                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------------|------|---------------------------------------------------------------------|
| <b><math>1.76 \pm 0.32 \pm 0.04</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | 51   | <sup>1</sup> ABLIKIM 15I | BES3 | $\psi(2S) \rightarrow \gamma K^- \Lambda \bar{\Xi}^+ + \text{c.c.}$ |
| <sup>1</sup> ABLIKIM 15I reports $[\Gamma(\chi_{c2}(1P) \rightarrow K^- \Lambda \bar{\Xi}^+ + \text{c.c.})/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$ $= (1.68 \pm 0.26 \pm 0.15) \times 10^{-5}$ which we divide by our best value $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                          |      |                                                                     |

NODE=M057R81  
 NODE=M057R81

NODE=M057R81;LINKAGE=A

 $\Gamma(\Xi^0 \Xi^0)/\Gamma_{\text{total}}$  $\Gamma_{86}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                               | CL% | EVTS          | DOCUMENT ID          | TECN | COMMENT                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------|----------------------|------|-------------------------------------------|
| <b>&lt;1.0</b>                                                                                                                                                                                                                                                                                                                                                                                                         | 90  | $2.9 \pm 1.7$ | <sup>1</sup> NAIK 08 | CLEO | $\psi(2S) \rightarrow \gamma \Xi^0 \Xi^0$ |
| <sup>1</sup> NAIK 08 reports $< 1.06 \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c2}(1P) \rightarrow \Xi^0 \Xi^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ . |     |               |                      |      |                                           |

NODE=M057R45  
 NODE=M057R45

NODE=M057R45;LINKAGE=NA

 $\Gamma(\Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}}$  $\Gamma_{87}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CL%        | EVTS | DOCUMENT ID              | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------|--------------------------|------|-------------------------------------------------|
| <b><math>1.42 \pm 0.31 \pm 0.03</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 29 $\pm$ 5 |      | <sup>1</sup> NAIK 08     | CLEO | $\psi(2S) \rightarrow \gamma \Xi^- \bar{\Xi}^+$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |      |                          |      |                                                 |
| <b>&lt; 3.7</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 90         |      | <sup>2</sup> ABLIKIM 06D | BES2 | $\psi(2S) \rightarrow \chi_{c2} \gamma$         |
| <sup>1</sup> NAIK 08 reports $(1.45 \pm 0.30 \pm 0.15) \times 10^{-4}$ from a measurement of $[\Gamma(\chi_{c2}(1P) \rightarrow \Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$ assuming $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.33 \pm 0.14 \pm 0.61) \times 10^{-2}$ , which we rescale to our best value $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |            |      |                          |      |                                                 |
| <sup>2</sup> Using $B(\psi(2S) \rightarrow \chi_{c2} \gamma) = (9.3 \pm 0.6)\%$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |            |      |                          |      |                                                 |

NODE=M057R17  
 NODE=M057R17

NODE=M057R17;LINKAGE=NA

NODE=M057R17;LINKAGE=AB

 $\Gamma(J/\psi(1S) \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{88}/\Gamma$ 

| VALUE            | CL% | DOCUMENT ID | TECN | COMMENT                                         |
|------------------|-----|-------------|------|-------------------------------------------------|
| <b>&lt;0.015</b> | 90  | BARATE 81   | SPEC | 190 GeV $\pi^- \text{Be} \rightarrow 2\pi 2\mu$ |

NODE=M057R13  
 NODE=M057R13

 $\Gamma(\pi^0 \eta_c)/\Gamma_{\text{total}}$  $\Gamma_{89}/\Gamma$ 

| VALUE                                                                                                                                                                               | CL% | DOCUMENT ID              | TECN | COMMENT                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|----------------------------------------------------|
| <b><math>&lt;3.2 \times 10^{-3}</math></b>                                                                                                                                          | 90  | <sup>1</sup> ABLIKIM 15N | BES3 | $\psi(2S) e^+ e^- \rightarrow \gamma \pi^0 \eta_c$ |
| <sup>1</sup> Using $B(\eta_c \rightarrow K_S^0 K^\pm \pi^\mp) \times B(K_S^0 \rightarrow \pi^+ \pi^-) \times B(\pi^0 \rightarrow \gamma \gamma) = (1.66 \pm 0.11) \times 10^{-2}$ . |     |                          |      |                                                    |

NODE=M057R77  
 NODE=M057R77

NODE=M057R77;LINKAGE=A

 $\Gamma(\eta_c(1S) \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{90}/\Gamma$ 

| VALUE                                                                                                                      | CL% | DOCUMENT ID                | TECN | COMMENT                                                     |
|----------------------------------------------------------------------------------------------------------------------------|-----|----------------------------|------|-------------------------------------------------------------|
| <b><math>&lt;0.54 \times 10^{-2}</math></b>                                                                                | 90  | <sup>1,2</sup> ABLIKIM 13B | BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c2}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                              |     |                            |      |                                                             |
| <b><math>&lt;1.2 \times 10^{-2}</math></b>                                                                                 | 90  | <sup>1,3</sup> ABLIKIM 13B | BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c2}$ |
| <sup>1</sup> Using $1.06 \times 10^8 \psi(2S)$ mesons and $B(\psi(2S) \rightarrow \chi_{c2} \gamma) = (8.72 \pm 0.34)\%$ . |     |                            |      |                                                             |
| <sup>2</sup> From the $\eta_c \rightarrow K_S^0 K^\pm \pi^\mp$ decays.                                                     |     |                            |      |                                                             |
| <sup>3</sup> From the $\eta_c \rightarrow K^+ K^- \pi^0$ decays.                                                           |     |                            |      |                                                             |

NODE=M057R76  
 NODE=M057R76

OCCUR=2

NODE=M057R76;LINKAGE=A

NODE=M057R76;LINKAGE=B

NODE=M057R76;LINKAGE=C

 $\Gamma(\eta_c(1S) \pi^+ \pi^-)/\Gamma(K^0 K^+ \pi^- + \text{c.c.})$  $\Gamma_{90}/\Gamma_{42}$ 

| VALUE                                                                                            | CL% | DOCUMENT ID            | TECN | COMMENT                                          |
|--------------------------------------------------------------------------------------------------|-----|------------------------|------|--------------------------------------------------|
| <b>&lt;16.4</b>                                                                                  | 90  | <sup>1</sup> LEES 12AE | BABR | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \eta_c$ |
| <sup>1</sup> We divided the reported limit by 2 to take into account the $K_L^0 K^+ \pi^-$ mode. |     |                        |      |                                                  |

NODE=M057R64  
 NODE=M057R64

NODE=M057R64;LINKAGE=LE

# RADIATIVE DECAYS

 $\Gamma(\gamma J/\psi(1S))/\Gamma_{\text{total}}$ 
 $\Gamma_{91}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**19.0 ± 0.5 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                     |      |                      |          |                                                            |
|---------------------|------|----------------------|----------|------------------------------------------------------------|
| 18.64 ± 0.08 ± 1.69 | 1.0M | <sup>1</sup> ABLIKIM | 17U BES3 | $e^+e^- \rightarrow \gamma X$                              |
| 19.9 ± 0.5 ± 1.2    |      | <sup>2</sup> ADAM    | 05A CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c2}$ |

<sup>1</sup> Not independent from  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))$  and the product  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) \times B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S))$  also measured in ABLIKIM 17U.

<sup>2</sup> Uses  $B(\psi(2S) \rightarrow \gamma \chi_{c2} \rightarrow \gamma \gamma J/\psi)$  from ADAM 05A and  $B(\psi(2S) \rightarrow \gamma \chi_{c2})$  from ATHAR 04.

NODE=M057310

 NODE=M057R7  
 NODE=M057R7

NODE=M057R7;LINKAGE=A

NODE=M057R7;LINKAGE=AD

 $\Gamma(\gamma \rho^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{92}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**<19** 90 13 ± 11 <sup>1</sup> ABLIKIM 11E BES3  $\psi(2S) \rightarrow \gamma \gamma \rho^0$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

**<40** 90 17.2 ± 6.8 <sup>2</sup> BENNETT 08A CLEO  $\psi(2S) \rightarrow \gamma \gamma \rho^0$ 

<sup>1</sup> ABLIKIM 11E reports  $< 20.8 \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \gamma \rho^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

<sup>2</sup> BENNETT 08A reports  $< 50 \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \gamma \rho^0)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.1 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

 NODE=M057R40  
 NODE=M057R40

NODE=M057R40;LINKAGE=AB

NODE=M057R40;LINKAGE=BE

 $\Gamma(\gamma \omega)/\Gamma_{\text{total}}$ 
 $\Gamma_{93}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**<6** 90 1 ± 6 <sup>1</sup> ABLIKIM 11E BES3  $\psi(2S) \rightarrow \gamma \gamma \omega$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

**<6** 90 0.0 ± 1.8 <sup>2</sup> BENNETT 08A CLEO  $\psi(2S) \rightarrow \gamma \gamma \omega$ 

<sup>1</sup> ABLIKIM 11E reports  $< 6.1 \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \gamma \omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

<sup>2</sup> BENNETT 08A reports  $< 7.0 \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \gamma \omega)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.1 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

 NODE=M057R41  
 NODE=M057R41

NODE=M057R41;LINKAGE=AB

NODE=M057R41;LINKAGE=BE

 $\Gamma(\gamma \phi)/\Gamma_{\text{total}}$ 
 $\Gamma_{94}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**< 7** 90 5 ± 5 <sup>1</sup> ABLIKIM 11E BES3  $\psi(2S) \rightarrow \gamma \gamma \phi$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

**<11** 90 1.3 ± 2.5 <sup>2</sup> BENNETT 08A CLEO  $\psi(2S) \rightarrow \gamma \gamma \phi$ 

<sup>1</sup> ABLIKIM 11E reports  $< 8.1 \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \gamma \phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.74 \pm 0.35) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

<sup>2</sup> BENNETT 08A reports  $< 13 \times 10^{-6}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow \gamma \phi)/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.1 \pm 0.4) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = 9.52 \times 10^{-2}$ .

 NODE=M057R42  
 NODE=M057R42

NODE=M057R42;LINKAGE=AB

NODE=M057R42;LINKAGE=BE

 $\Gamma(\gamma \gamma)/\Gamma_{\text{total}}$ 
 $\Gamma_{95}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID |
|--------------------------|-------------|
|--------------------------|-------------|

**2.85 ± 0.10 OUR FIT**

 NODE=M057R1  
 NODE=M057R1

 $\Gamma(e^+e^- J/\psi(1S))/\Gamma_{\text{total}}$ 
 $\Gamma_{96}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

**2.37 ± 0.15 ± 0.05** 1.3k <sup>1,2</sup> ABLIKIM 17I BES3  $\psi(2S) \rightarrow \gamma e^+e^- J/\psi$ 

<sup>1</sup> ABLIKIM 17I reports  $(2.48 \pm 0.08 \pm 0.16) \times 10^{-3}$  from a measurement of  $[\Gamma(\chi_{c2}(1P) \rightarrow e^+e^- J/\psi(1S))/\Gamma_{\text{total}}] \times [B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.11 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (9.52 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Not independent from other measurements reported by ABLIKIM 17I

 NODE=M057R82  
 NODE=M057R82

NODE=M057R82;LINKAGE=B

NODE=M057R82;LINKAGE=C

$\Gamma(e^+e^- J/\psi(1S))/\Gamma(\gamma J/\psi(1S))$  $\Gamma_{96}/\Gamma_{91}$ 

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|--------------------------|------|----------------------|----------|---------------------------------------------|
| <b>11.3±0.4±0.5</b>      | 1.3k | <sup>1</sup> ABLIKIM | 17I BES3 | $\psi(2S) \rightarrow e^+e^- \gamma J/\psi$ |

<sup>1</sup> Uses  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) \times B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)) = (199.6 \pm 0.8 \pm 7.0) \times 10^{-4}$  from ABLIKIM 17N and accounts for common systematic errors.

NODE=M057R83  
NODE=M057R83

NODE=M057R83;LINKAGE=A

 $\Gamma(\mu^+\mu^- J/\psi(1S))/\Gamma(e^+e^- J/\psi(1S))$  $\Gamma_{97}/\Gamma_{96}$ 

| VALUE (units $10^{-2}$ ) | EVTs | DOCUMENT ID | TECN     | COMMENT                                                                    |
|--------------------------|------|-------------|----------|----------------------------------------------------------------------------|
| <b>9.40±0.79±1.15</b>    | 219  | ABLIKIM     | 19Z BES3 | $\psi(2S) \rightarrow \gamma \chi_c \rightarrow \gamma(\mu^+\mu^- J/\psi)$ |

NODE=M057R96  
NODE=M057R96

 $\Gamma(\gamma\gamma)/\Gamma(\gamma J/\psi(1S))$  $\Gamma_{95}/\Gamma_{91}$ 

| VALUE (units $10^{-3}$ ) | DOCUMENT ID                 | TECN | COMMENT                                                                  |
|--------------------------|-----------------------------|------|--------------------------------------------------------------------------|
| <b>1.50±0.05 OUR FIT</b> |                             |      |                                                                          |
| <b>0.99±0.18</b>         | <sup>1</sup> AMBROGIANI 00B | E835 | $\bar{p}p \rightarrow \chi_{c2} \rightarrow \gamma\gamma, \gamma J/\psi$ |

<sup>1</sup> Calculated by us using  $B(J/\psi(1S) \rightarrow e^+e^-) = 0.0593 \pm 0.0010$ .

NODE=M057R23  
NODE=M057R23

NODE=M057R;LINKAGE=7A

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}} \times \Gamma(p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{95}/\Gamma \times \Gamma_{56}/\Gamma$ 

| VALUE (units $10^{-8}$ )    | DOCUMENT ID  | TECN | COMMENT                               |
|-----------------------------|--------------|------|---------------------------------------|
| <b>2.09±0.13 OUR FIT</b>    |              |      |                                       |
| <b>1.7 ±0.4 OUR AVERAGE</b> |              |      |                                       |
| 1.60±0.42                   | ARMSTRONG 93 | E760 | $\bar{p}p \rightarrow \gamma\gamma X$ |
| 9.9 ±4.5                    | BAGLIN 87B   | SPEC | $\bar{p}p \rightarrow \gamma\gamma X$ |

NODE=M057R24  
NODE=M057R24

 $\chi_{c2}(1P)$  CROSS-PARTICLE BRANCHING RATIOS

NODE=M057230

$$\Gamma(\chi_{c2}(1P) \rightarrow K^+K^-\pi^+\pi^-)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$$

$$\Gamma_{14}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-3}$ )    | DOCUMENT ID               | TECN | COMMENT                                 |
|-----------------------------|---------------------------|------|-----------------------------------------|
| <b>2.31±0.26 OUR FIT</b>    |                           |      |                                         |
| <b>2.5 ±0.9 OUR AVERAGE</b> |                           |      | Error includes scale factor of 2.3.     |
| 1.90±0.14±0.44              | BAI 99B                   | BES  | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |
| 3.8 ±0.67                   | <sup>1</sup> TANENBAUM 78 | MRK1 | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |

<sup>1</sup> The reported value is derived using  $B(\psi(2S) \rightarrow \pi^+\pi^- J/\psi) \times B(J/\psi \rightarrow \ell^+\ell^-) = (4.6 \pm 0.7)\%$ . Calculated by us using  $B(J/\psi \rightarrow \ell^+\ell^-) = 0.1181 \pm 0.0020$ .

NODE=M057B18  
NODE=M057B18

NODE=M057B18;LINKAGE=TA

$$\Gamma(\chi_{c2}(1P) \rightarrow K^*(892)^0 \bar{K}^*(892)^0)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{18}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-4}$ ) | DOCUMENT ID | TECN     | COMMENT                                 |
|--------------------------|-------------|----------|-----------------------------------------|
| <b>2.1 ±0.4 OUR FIT</b>  |             |          |                                         |
| <b>3.11±0.36±0.48</b>    | ABLIKIM     | 04H BES2 | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |

NODE=M057B19  
NODE=M057B19

$$\Gamma(\chi_{c2}(1P) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)$$

$$\Gamma_{56}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-5}$ ) | DOCUMENT ID      | TECN    | COMMENT                                                             |
|--------------------------|------------------|---------|---------------------------------------------------------------------|
| <b>2.01±0.09 OUR FIT</b> |                  |         |                                                                     |
| <b>1.4 ±1.1</b>          | <sup>1</sup> BAI | 98I BES | $\psi(2S) \rightarrow \gamma \chi_{c2} \rightarrow \gamma \bar{p}p$ |

<sup>1</sup> Calculated by us. The value for  $B(\chi_{c2} \rightarrow p\bar{p})$  reported in BAI 98I is derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (7.8 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D].

NODE=M057B1  
NODE=M057B1

NODE=M057B;LINKAGE=J8

$$\Gamma(\chi_{c2}(1P) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_{56}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-6}$ )    | EVTs                  | DOCUMENT ID       | TECN     | COMMENT                                                                 |
|-----------------------------|-----------------------|-------------------|----------|-------------------------------------------------------------------------|
| <b>6.98±0.32 OUR FIT</b>    |                       |                   |          |                                                                         |
| <b>7.1 ±0.5 OUR AVERAGE</b> |                       |                   |          | Error includes scale factor of 1.2.                                     |
| 7.3 ±0.4 ±0.3               | 405                   | ABLIKIM           | 13V BES3 | $\psi(2S) \rightarrow \gamma p\bar{p}$                                  |
| 7.2 ±0.7 ±0.4               | 121 ± 12              | <sup>1</sup> NAIK | 08 CLEO  | $\psi(2S) \rightarrow \gamma p\bar{p}$                                  |
| 4.4 $^{+1.6}_{-1.4}$ ±0.6   | 14.3 $^{+5.2}_{-4.7}$ | BAI               | 04F BES  | $\psi(2S) \rightarrow \gamma \chi_{c2}(1P) \rightarrow \gamma \bar{p}p$ |

<sup>1</sup> Calculated by us. NAIK 08 reports  $B(\chi_{c2} \rightarrow p\bar{p}) = (7.7 \pm 0.8 \pm 0.4 \pm 0.5) \times 10^{-5}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (9.33 \pm 0.14 \pm 0.61)\%$ .

NODE=M057B6  
NODE=M057B6

NODE=M057B6;LINKAGE=NA

$$\Gamma(\chi_{c2}(1P) \rightarrow \Lambda \bar{\Lambda}) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{69} / \Gamma \times \Gamma_{153}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

VALUE (units  $10^{-6}$ ) EVTS DOCUMENT ID TECN COMMENT

**17.5±1.3 OUR FIT**

**17.4±1.4 OUR AVERAGE**

18.2±1.4±0.9 207 <sup>1</sup> ABLIKIM 13H BES3  $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda}$   
 15.9±2.1±1.0 71 ± 9 <sup>2</sup> NAIK 08 CLEO  $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda}$

<sup>1</sup> Calculated by us. ABLIKIM 13H reports  $B(\chi_{c2} \rightarrow \Lambda \bar{\Lambda}) = (20.8 \pm 1.6 \pm 2.3) \times 10^{-5}$  from a measurement of  $B(\chi_{c2} \rightarrow \Lambda \bar{\Lambda}) \times B(\psi(2S) \rightarrow \gamma \chi_{c2})$  assuming  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (8.74 \pm 0.35)\%$ .

<sup>2</sup> Calculated by us. NAIK 08 reports  $B(\chi_{c2} \rightarrow \Lambda \bar{\Lambda}) = (17.0 \pm 2.2 \pm 1.1 \pm 1.1) \times 10^{-5}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (9.33 \pm 0.14 \pm 0.61)\%$ .

NODE=M057B10  
 NODE=M057B10

NODE=M057B10;LINKAGE=AB

NODE=M057B10;LINKAGE=NA

$$\Gamma(\chi_{c2}(1P) \rightarrow \Lambda \bar{\Lambda}) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_{69} / \Gamma \times \Gamma_{153}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

VALUE (units  $10^{-5}$ ) EVTS DOCUMENT ID TECN COMMENT

**5.1±0.4 OUR FIT**

**7.1<sup>+3.1</sup><sub>-2.9</sub>±1.3** 8.3<sup>+3.7</sup><sub>-3.4</sub> <sup>1</sup> BAI 03E BES  $\psi(2S) \rightarrow \gamma \Lambda \bar{\Lambda}$

<sup>1</sup> BAI 03E reports  $[B(\chi_{c2} \rightarrow \Lambda \bar{\Lambda}) B(\psi(2S) \rightarrow \gamma \chi_{c2}) / B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-)] \times [B^2(\Lambda \rightarrow \pi^- p) / B(J/\psi \rightarrow p \bar{p})] = (1.33^{+0.59}_{-0.55} \pm 0.25)\%$ . We calculate from this measurement the presented value using  $B(\Lambda \rightarrow \pi^- p) = (63.9 \pm 0.5)\%$  and  $B(J/\psi \rightarrow p \bar{p}) = (2.17 \pm 0.07) \times 10^{-3}$ .

NODE=M057B11  
 NODE=M057B11

NODE=M057B11;LINKAGE=BA

$$\Gamma(\chi_{c2}(1P) \rightarrow \pi \pi) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{25} / \Gamma \times \Gamma_{153}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

VALUE (units  $10^{-4}$ ) EVTS DOCUMENT ID TECN COMMENT

**2.12±0.08 OUR FIT**

**2.17±0.09 OUR AVERAGE**

2.19±0.05±0.15 4.5k <sup>1</sup> ABLIKIM 10A BES3  $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c2}$   
 2.23±0.06±0.10 2.5k <sup>2</sup> ASNER 09 CLEO  $\psi(2S) \rightarrow \gamma \pi^+ \pi^-$   
 1.90±0.08±0.20 0.8k <sup>3</sup> ASNER 09 CLEO  $\psi(2S) \rightarrow \gamma \pi^0 \pi^0$

<sup>1</sup> Calculated by us. ABLIKIM 10A reports  $B(\chi_{c2} \rightarrow \pi^0 \pi^0) = (0.88 \pm 0.02 \pm 0.06 \pm 0.04) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (8.3 \pm 0.4)\%$ . We have multiplied the  $\pi^0 \pi^0$  measurement by 3 to obtain  $\pi \pi$ .

<sup>2</sup> Calculated by us. ASNER 09 reports  $B(\chi_{c2} \rightarrow \pi^+ \pi^-) = (1.59 \pm 0.04 \pm 0.07 \pm 0.10) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (9.33 \pm 0.14 \pm 0.61)\%$ . We have multiplied the  $\pi^+ \pi^-$  measurement by 3/2 to obtain  $\pi \pi$ .

<sup>3</sup> Calculated by us. ASNER 09 reports  $B(\chi_{c2} \rightarrow \pi^0 \pi^0) = (0.68 \pm 0.03 \pm 0.07 \pm 0.04) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (9.33 \pm 0.14 \pm 0.61)\%$ . We have multiplied the  $\pi^0 \pi^0$  measurement by 3 to obtain  $\pi \pi$ .

NODE=M057B02  
 NODE=M057B02

OCCUR=2

NODE=M057B02;LINKAGE=AB

NODE=M057B02;LINKAGE=AS

NODE=M057B02;LINKAGE=AN

$$\Gamma(\chi_{c2}(1P) \rightarrow \pi \pi) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)$$

$$\Gamma_{25} / \Gamma \times \Gamma_{153}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

VALUE (units  $10^{-3}$ ) EVTS DOCUMENT ID TECN COMMENT

**0.612±0.023 OUR FIT**

**0.54 ±0.06 OUR AVERAGE**

0.66 ±0.18 ±0.37 21 ± 6 <sup>1</sup> BAI 03C BES  $\psi(2S) \rightarrow \gamma \pi^0 \pi^0$   
 0.54 ±0.05 ±0.04 185 ± 16 <sup>2</sup> BAI 98I BES  $\psi(2S) \rightarrow \gamma \pi^+ \pi^-$

<sup>1</sup> We have multiplied  $\pi^0 \pi^0$  measurement by 3 to obtain  $\pi \pi$ .

<sup>2</sup> Calculated by us. The value for  $B(\chi_{c2} \rightarrow \pi^+ \pi^-)$  reported by BAI 98I is derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (7.8 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D]. We have multiplied  $\pi^+ \pi^-$  measurement by 3/2 to obtain  $\pi \pi$ .

NODE=M057B9  
 NODE=M057B9

NODE=M057B;LINKAGE=BM

NODE=M057B;LINKAGE=BA

$$\Gamma(\chi_{c2}(1P) \rightarrow \eta \eta) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}}$$

$$\Gamma_{31} / \Gamma \times \Gamma_{153}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

VALUE (units  $10^{-4}$ ) CL% EVTS DOCUMENT ID TECN COMMENT

**0.52±0.04 OUR FIT**

**0.52±0.04 OUR AVERAGE**

0.54±0.03±0.04 386 <sup>1</sup> ABLIKIM 10A BES3  $e^+ e^- \rightarrow \psi(2S) \rightarrow \gamma \chi_{c2}$   
 0.47±0.05±0.05 156 ASNER 09 CLEO  $\psi(2S) \rightarrow \gamma \eta \eta$

NODE=M057B04  
 NODE=M057B04

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |    |                    |     |      |                                                             |
|--------------------------|----|--------------------|-----|------|-------------------------------------------------------------|
| < 0.44                   | 90 | <sup>2</sup> ADAMS | 07  | CLEO | $\psi(2S) \rightarrow \gamma \chi_{c2}$                     |
| < 3                      | 90 | BAI                | 03C | BES  | $\psi(2S) \rightarrow \gamma \eta \eta \rightarrow 5\gamma$ |
| $0.62 \pm 0.31 \pm 0.19$ |    | LEE                | 85  | CBAL | $\psi(2S) \rightarrow \text{photons}$                       |

<sup>1</sup> Calculated by us. ABLIKIM 10A reports  $B(\chi_{c2} \rightarrow \eta \eta) = (0.65 \pm 0.04 \pm 0.05 \pm 0.03) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (8.3 \pm 0.4)\%$ .

<sup>2</sup> Superseded by ASNER 09.

NODE=M057B04;LINKAGE=AB

NODE=M057B04;LINKAGE=AD

$$\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^-) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}} \times \Gamma_{32} / \Gamma \times \Gamma_{153}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID        | TECN | COMMENT                                    |
|--------------------------|------|--------------------|------|--------------------------------------------|
| <b>9.6 ± 0.6 OUR FIT</b> |      |                    |      |                                            |
| <b>10.5 ± 0.3 ± 0.6</b>  | 1.6k | <sup>1</sup> ASNER | 09   | CLEO $\psi(2S) \rightarrow \gamma K^+ K^-$ |

<sup>1</sup> Calculated by us. ASNER 09 reports  $B(\chi_{c2} \rightarrow K^+ K^-) = (1.13 \pm 0.03 \pm 0.06 \pm 0.07) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (9.33 \pm 0.14 \pm 0.61)\%$ .

NODE=M057B03  
NODE=M057B03

NODE=M057B03;LINKAGE=AS

$$\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^-) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) \times \Gamma_{32} / \Gamma \times \Gamma_{153}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-3}$ )     | EVTS     | DOCUMENT ID      | TECN | COMMENT                                   |
|------------------------------|----------|------------------|------|-------------------------------------------|
| <b>0.276 ± 0.017 OUR FIT</b> |          |                  |      |                                           |
| <b>0.190 ± 0.034 ± 0.019</b> | 115 ± 13 | <sup>1</sup> BAI | 98i  | BES $\psi(2S) \rightarrow \gamma K^+ K^-$ |

<sup>1</sup> Calculated by us. The value for  $B(\chi_{c2} \rightarrow K^+ K^-)$  reported by BAI 98i is derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (7.8 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98d].

NODE=M057B8  
NODE=M057B8

NODE=M057B;LINKAGE=BI

$$\Gamma(\chi_{c2}(1P) \rightarrow K_S^0 K_S^0) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}} \times \Gamma_{33} / \Gamma \times \Gamma_{153}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

| VALUE (units $10^{-5}$ )     | EVTS         | DOCUMENT ID        | TECN | COMMENT                                        |
|------------------------------|--------------|--------------------|------|------------------------------------------------|
| <b>5.0 ± 0.4 OUR FIT</b>     |              |                    |      |                                                |
| <b>5.0 ± 0.4 OUR AVERAGE</b> |              |                    |      |                                                |
| $4.9 \pm 0.3 \pm 0.3$        | $373 \pm 20$ | <sup>1</sup> ASNER | 09   | CLEO $\psi(2S) \rightarrow \gamma K_S^0 K_S^0$ |
| $5.72 \pm 0.76 \pm 0.63$     | 65           | ABLIKIM            | 05o  | BES2 $\psi(2S) \rightarrow \gamma K_S^0 K_S^0$ |

<sup>1</sup> Calculated by us. ASNER 09 reports  $B(\chi_{c2} \rightarrow K_S^0 K_S^0) = (0.53 \pm 0.03 \pm 0.03 \pm 0.03) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (9.33 \pm 0.14 \pm 0.61)\%$ .

NODE=M057B12  
NODE=M057B12

NODE=M057B12;LINKAGE=AS

$$\Gamma(\chi_{c2}(1P) \rightarrow K_S^0 K_S^0) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) \times \Gamma_{33} / \Gamma \times \Gamma_{153}^{\psi(2S)} / \Gamma_{11}^{\psi(2S)}$$

| VALUE (units $10^{-5}$ )  | DOCUMENT ID      | TECN | COMMENT                                       |
|---------------------------|------------------|------|-----------------------------------------------|
| <b>14.4 ± 1.1 OUR FIT</b> |                  |      |                                               |
| <b>14.7 ± 4.1 ± 3.3</b>   | <sup>1</sup> BAI | 99B  | BES $\psi(2S) \rightarrow \gamma K_S^0 K_S^0$ |

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c2} \rightarrow K_S^0 K_S^0)$  reported by BAI 99B was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (7.8 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98d].

NODE=M057B13  
NODE=M057B13

NODE=M057B13;LINKAGE=BA

$$\Gamma(\chi_{c2}(1P) \rightarrow \bar{K}^0 K^+ \pi^- + \text{c.c.}) / \Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) / \Gamma_{\text{total}} \times \Gamma_{42} / \Gamma \times \Gamma_{153}^{\psi(2S)} / \Gamma^{\psi(2S)}$$

| VALUE (units $10^{-4}$ )       | EVTS | DOCUMENT ID          | TECN | COMMENT                                                |
|--------------------------------|------|----------------------|------|--------------------------------------------------------|
| <b>1.22 ± 0.17 OUR FIT</b>     |      |                      |      |                                                        |
| <b>1.15 ± 0.18 OUR AVERAGE</b> |      |                      |      |                                                        |
| $1.21 \pm 0.19 \pm 0.09$       | 37   | <sup>1</sup> ATHAR   | 07   | CLEO $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ |
| $0.97 \pm 0.32 \pm 0.13$       | 28   | <sup>2</sup> ABLIKIM | 06R  | BES2 $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp$ |

<sup>1</sup> Calculated by us. ATHAR 07 reports  $B(\chi_{c2} \rightarrow \bar{K}^0 K^+ \pi^- + \text{c.c.}) = (1.3 \pm 0.2 \pm 0.1 \pm 0.1) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (9.33 \pm 0.14 \pm 0.61)\%$ .

<sup>2</sup> Calculated by us. ABLIKIM 06R reports  $B(\chi_{c2} \rightarrow K_S^0 K^\pm \pi^\mp) = (0.6 \pm 0.2 \pm 0.1) \times 10^{-3}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (8.1 \pm 0.6)\%$ . We have multiplied by 2 to obtain  $\bar{K}^0 K^+ \pi^- + \text{c.c.}$  from  $K_S^0 K^\pm \pi^\mp$ .

NODE=M057B05  
NODE=M057B05

NODE=M057B05;LINKAGE=AT

NODE=M057B05;LINKAGE=AB

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow 2(\pi^+ \pi^-))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \times \frac{\Gamma_{51}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

**2.79±0.26 OUR FIT****3.1 ±1.0 OUR AVERAGE** Error includes scale factor of 2.5.

2.3 ±0.1 ±0.5

<sup>1</sup> BAI

99B

BES

 $\psi(2S) \rightarrow \gamma \chi_{c2}$ 

4.3 ±0.6

<sup>2</sup> TANENBAUM

78

MRK1

 $\psi(2S) \rightarrow \gamma \chi_{c2}$ 

<sup>1</sup> Calculated by us. The value for  $B(\chi_{c2} \rightarrow 2\pi^+ 2\pi^-)$  reported in BAI 99B is derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (7.8 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D].

<sup>2</sup> The value for  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) \times B(\chi_{c2} \rightarrow 2\pi^+ \pi^-)$  reported in TANENBAUM 78 is derived using  $B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-) \times B(J/\psi(1S) \ell^+ \ell^-) = (4.6 \pm 0.7)\%$ . Calculated by us using  $B(J/\psi(1S) \rightarrow \ell^+ \ell^-) = 0.1181 \pm 0.0020$ .

NODE=M057B5  
NODE=M057B5

NODE=M057B;LINKAGE=K1

NODE=M057B;LINKAGE=K2

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^- K^+ K^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{51}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.57±0.19 OUR FIT****1.76±0.16±0.24**

160

<sup>1</sup> ABLIKIM

06T

BES2

 $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ 

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c2} \rightarrow 2K^+ 2K^-)$  reported by ABLIKIM 06T was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.1 \pm 0.4)\%$ .

NODE=M057B14  
NODE=M057B14

NODE=M057B14;LINKAGE=AB

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow K^+ K^- K^+ K^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \times \frac{\Gamma_{51}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**4.5±0.5 OUR FIT****3.6±0.6±0.6**<sup>1</sup> BAI

99B

BES

 $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ 

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c2} \rightarrow 2K^+ 2K^-)$  reported by BAI 99B was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (7.8 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D].

NODE=M057B15  
NODE=M057B15

NODE=M057B15;LINKAGE=BA

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \phi \phi)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{20}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.01±0.08 OUR FIT****0.98±0.13 OUR AVERAGE** Error includes scale factor of 1.3.

0.94±0.03±0.10

849

<sup>1</sup> ABLIKIM

11K

BES3

 $\psi(2S) \rightarrow \gamma \text{ hadrons}$ 

1.38±0.24±0.23

41

<sup>2</sup> ABLIKIM

06T

BES2

 $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ 

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c2} \rightarrow \phi \phi)$  reported by ABLIKIM 11K was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.74 \pm 0.35)\%$ .

<sup>2</sup> Calculated by us. The value of  $B(\chi_{c2} \rightarrow \phi \phi)$  reported by ABLIKIM 06T was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (8.1 \pm 0.4)\%$ .

NODE=M057B16  
NODE=M057B16

NODE=M057B16;LINKAGE=AL

NODE=M057B16;LINKAGE=AB

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \phi \phi)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)} \times \frac{\Gamma_{20}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**2.92±0.24 OUR FIT****4.8 ±1.3 ±1.3**<sup>1</sup> BAI

99B

BES

 $\psi(2S) \rightarrow \gamma 2K^+ 2K^-$ 

<sup>1</sup> Calculated by us. The value of  $B(\chi_{c2} \rightarrow \phi \phi)$  reported by BAI 99B was derived using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) = (7.8 \pm 0.8)\%$  and  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = (32.4 \pm 2.6)\%$  [BAI 98D].

NODE=M057B17  
NODE=M057B17

NODE=M057B17;LINKAGE=BA

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \Sigma^+ \bar{p} K_S^0 + \text{c.c.})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{79}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}{\Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

VALUE (units  $10^{-6}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**7.85±0.77±0.44**

129

<sup>1</sup> ABLIKIM

19BB

BES3

 $\psi(2S) \rightarrow \gamma \Sigma^+ \bar{p} K_S^0 + \text{c.c.}$ 

<sup>1</sup> Calculated by us. ABLIKIM 19BB reports  $B(\chi_{c2} \rightarrow \Sigma^+ \bar{p} K_S^0 + \text{c.c.}) = (8.25 \pm 0.83 \pm 0.49) \times 10^{-5}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (9.52 \pm 0.20)\%$  and other branching fractions from PDG 18.

NODE=M057B07  
NODE=M057B07

NODE=M057B07;LINKAGE=A

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \Sigma^0 \bar{p} K^+ + \text{c.c.})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{80}}{\Gamma} \times \frac{\Gamma_{153}^{\psi(2S)}}{\Gamma \psi(2S)}$$

| VALUE (units $10^{-5}$ )                   | EVTS | DOCUMENT ID          | TECN      | COMMENT                                                          |
|--------------------------------------------|------|----------------------|-----------|------------------------------------------------------------------|
| <b><math>0.87 \pm 0.06 \pm 0.04</math></b> | 271  | <sup>1</sup> ABLIKIM | 20AE BES3 | $\psi(2S) \rightarrow \gamma \Sigma^0 \bar{p} K^+ + \text{c.c.}$ |

NODE=M057P00  
NODE=M057P00

<sup>1</sup> Calculated by us. ABLIKIM 20AE reports  $B(\chi_{c2} \rightarrow \Sigma^0 \bar{p} K^+ + \text{c.c.}) = (0.91 \pm 0.06 \pm 0.05) \times 10^{-4}$  using  $B(\psi(2S) \rightarrow \gamma \chi_{c2}) = (9.52 \pm 0.20)\%$  and other branching fractions from PDG 20.

NODE=M057P00;LINKAGE=A

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{91}}{\Gamma} \times \frac{\Gamma_{153}^{\psi(2S)}}{\Gamma \psi(2S)}$$

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**$1.81 \pm 0.04$  OUR FIT**

**$1.69 \pm 0.16$  OUR AVERAGE** Error includes scale factor of 3.4. See the ideogram below.

|                             |      |                        |          |                                             |
|-----------------------------|------|------------------------|----------|---------------------------------------------|
| $1.996 \pm 0.008 \pm 0.070$ | 81k  | <sup>1</sup> ABLIKIM   | 17N BES3 | $\psi(2S) \rightarrow \gamma \gamma J/\psi$ |
| $1.793 \pm 0.008 \pm 0.163$ | 1.0M | ABLIKIM                | 17U BES3 | $e^+ e^- \rightarrow \gamma X$              |
| $1.62 \pm 0.04 \pm 0.12$    | 5.8k | BAI                    | 04I BES2 | $\psi(2S) \rightarrow J/\psi \gamma \gamma$ |
| $0.99 \pm 0.10 \pm 0.08$    |      | GAISER                 | 86 CBAL  | $\psi(2S) \rightarrow \gamma X$             |
| $1.47 \pm 0.17$             |      | <sup>2</sup> OREGLIA   | 82 CBAL  | $\psi(2S) \rightarrow \gamma \chi_{c2}$     |
| $1.8 \pm 0.5$               |      | <sup>3</sup> BRANDELIK | 79B DASP | $\psi(2S) \rightarrow \gamma \chi_{c2}$     |
| $1.2 \pm 0.2$               |      | <sup>3</sup> BARTEL    | 78B CNTR | $\psi(2S) \rightarrow \gamma \chi_{c2}$     |
| $2.2 \pm 1.2$               |      | <sup>4</sup> BIDDICK   | 77 CNTR  | $e^+ e^- \rightarrow \gamma X$              |
| $1.2 \pm 0.7$               |      | <sup>2</sup> WHITAKER  | 76 MRK1  | $e^+ e^-$                                   |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                             |       |                      |          |                                         |
|-----------------------------|-------|----------------------|----------|-----------------------------------------|
| $1.874 \pm 0.007 \pm 0.102$ | 76k   | <sup>5</sup> ABLIKIM | 12O BES3 | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |
| $1.95 \pm 0.02 \pm 0.07$    | 12.4k | <sup>6</sup> MENDEZ  | 08 CLEO  | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |
| $1.85 \pm 0.04 \pm 0.07$    | 1.9k  | <sup>7</sup> ADAM    | 05A CLEO | Repl. by MENDEZ 08                      |

<sup>1</sup> Uses  $B(J/\psi \rightarrow e^+ e^-) = (5.971 \pm 0.032)\%$  and  $B(J/\psi \rightarrow \mu^+ \mu^-) = (5.961 \pm 0.033)\%$ .

<sup>2</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \ell^+ \ell^-) = 0.1181 \pm 0.0020$ .

<sup>3</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \mu^+ \mu^-) = 0.0588 \pm 0.0010$ .

<sup>4</sup> Assumes isotropic gamma distribution.

<sup>5</sup> Superseded by ABLIKIM 17N.

<sup>6</sup> Not independent from other measurements of MENDEZ 08.

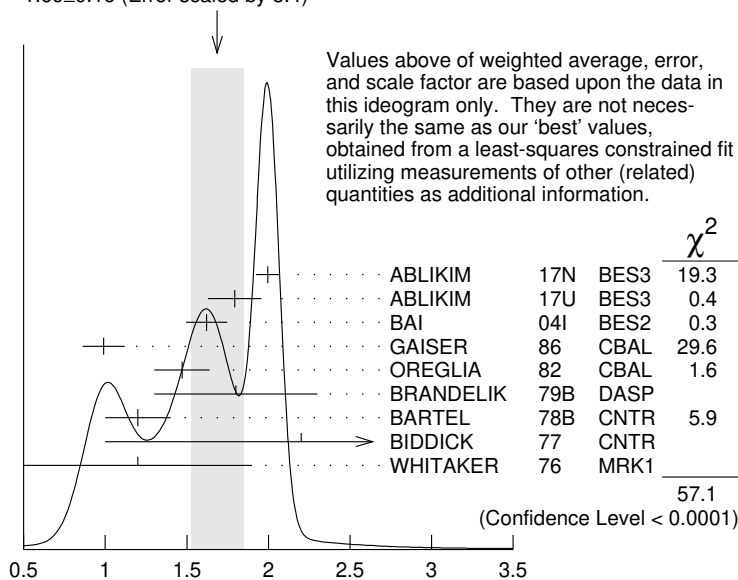
<sup>7</sup> Not independent from other values reported by ADAM 05A.

NODE=M057B2  
NODE=M057B2

NODE=M057B2;LINKAGE=A

NODE=M057B;LINKAGE=3Q  
NODE=M057B;LINKAGE=2Q  
NODE=M057B;LINKAGE=EA  
NODE=M057B2;LINKAGE=B  
NODE=M057B2;LINKAGE=ME  
NODE=M057B;LINKAGE=AD

WEIGHTED AVERAGE  
 $1.69 \pm 0.16$  (Error scaled by 3.4)



$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma_{\text{total}}} \text{ (units } 10^{-2})$$



$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S))}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))}{\Gamma(\psi(2S) \rightarrow J/\psi(1S) \text{ anything})} = \frac{\Gamma_{91}}{\Gamma} \times \frac{\Gamma_{153}^{\psi(2S)}}{\Gamma_9^{\psi(2S)}} + \frac{\Gamma_{12}^{\psi(2S)}}{\Gamma_{11}^{\psi(2S)}} + \frac{\Gamma_{13}^{\psi(2S)}}{\Gamma_{152}^{\psi(2S)}} + \frac{\Gamma_{153}^{\psi(2S)}}{\Gamma_{153}^{\psi(2S)}}$$

NODE=M057B7

NODE=M057B7

| <u>VALUE (units <math>10^{-2}</math>)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|-------------------------------------------|-------------|--------------------|-------------|----------------|
| <b>2.95±0.06 OUR FIT</b>                  |             |                    |             |                |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |       |                     |     |      |                                         |
|--------------------------|-------|---------------------|-----|------|-----------------------------------------|
| $3.12 \pm 0.03 \pm 0.09$ | 12.4k | <sup>1</sup> MENDEZ | 08  | CLEO | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |
| $3.11 \pm 0.07 \pm 0.07$ | 1.9k  | ADAM                | 05A | CLEO | Repl. by MENDEZ 08                      |

<sup>1</sup> Not independent from other measurements of MENDEZ 08.

NODE=M057B7;LINKAGE=ME

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma \chi_{c2}(1P))/\Gamma(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)}{\Gamma_{91}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma_{11}^{\psi(2S)}}$$

NODE=M057B3

| <u>VALUE (units 10<sup>-2</sup>)</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------------------------------|-------------|--------------------|-------------|----------------|
|--------------------------------------|-------------|--------------------|-------------|----------------|

**5.22±0.11 OUR FIT**

**5.53±0.17 OUR AVERAGE**

|                          |       |                      |     |      |                                         |
|--------------------------|-------|----------------------|-----|------|-----------------------------------------|
| $5.56 \pm 0.05 \pm 0.16$ | 12.4k | MENDEZ               | 08  | CLEO | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |
| $6.0 \pm 2.8$            | 1.3k  | <sup>1</sup> ABLIKIM | 04B | BES  | $\psi(2S) \rightarrow J/\psi X$         |
| $3.9 \pm 1.2$            |       | <sup>2</sup> HIMEL   | 80  | MRK2 | $\psi(2S) \rightarrow \gamma \chi_{c2}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

5.52±0.13±0.13      1.9k      <sup>3</sup> ADAM      05A CLEO Repl. by MENDEZ 08

<sup>1</sup>From a fit to the  $J/\psi$  recoil mass spectra.

<sup>2</sup>The value for  $B(\psi(2S) \rightarrow \gamma\chi_{c2}) \times B(\chi_{c2} \rightarrow \gamma J/\psi(1S))$  reported in HIMEL 80 is derived using  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (33 \pm 3)\%$  and  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = 0.138 \pm 0.018$ . Calculated by us using  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = (0.1181 \pm 0.0020)$ .

<sup>3</sup> Not independent from other values reported by ADAM 05A.

NODE=M057B;LINKAGE=H8

NODE=M057B3;LINKAGE=AD

$$\frac{\Gamma(\chi_{c2}(1P) \rightarrow \gamma\gamma)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\chi_{c2}(1P))/\Gamma_{\text{total}}}{\Gamma_{95}/\Gamma \times \Gamma_{153}^{\psi(2S)}/\Gamma^{\psi(2S)}}$$

NODE=M057B4

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.71±0.08 OUR FIT**

**2.82±0.10 OUR AVERAGE**

|                          |      |                      |           |                                                             |
|--------------------------|------|----------------------|-----------|-------------------------------------------------------------|
| $2.83 \pm 0.08 \pm 0.06$ | 5k   | <sup>1</sup> ABLIKIM | 17AE BES3 | $\psi(2S) \rightarrow \gamma \chi_{c2} \rightarrow 3\gamma$ |
| $2.68 \pm 0.28 \pm 0.15$ | 0.3k | ECKLUND              | 08A CLEO  | $\psi(2S) \rightarrow \gamma \chi_{c2} \rightarrow 3\gamma$ |
| $7.0 \pm 2.1 \pm 2.0$    |      | LEE                  | 85 CBAL   | $\psi(2S) \rightarrow \gamma \chi_{c2}$                     |

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

|                          |      |                      |     |      |                                                             |
|--------------------------|------|----------------------|-----|------|-------------------------------------------------------------|
| $2.81 \pm 0.17 \pm 0.15$ | 1.1k | <sup>2</sup> ABLIKIM | 12A | BES3 | $\psi(2S) \rightarrow \gamma \chi_{c2} \rightarrow 3\gamma$ |
|--------------------------|------|----------------------|-----|------|-------------------------------------------------------------|

<sup>1</sup>ABLIKIM 17AE measures the ratio of two-photon partial widths for the helicity  $\lambda = 0$  and helicity  $\lambda = 2$  components to be  $f_{0/2} = \frac{\Gamma^{\lambda=0}}{\Gamma^{\lambda=2}} = 0.000 \pm 0.006 \pm 0.012$ .

NODE=M057B4;LINKAGE=A

<sup>2</sup> ABLIKIM 12A measures the ratio of two-photon partial widths for the helicity  $\lambda = 0$  and helicity  $\lambda = 2$  components to be  $f_{0/2} = \Gamma_{\gamma\gamma}^{\lambda=0} / \Gamma_{\gamma\gamma}^{\lambda=2} = 0.00 \pm 0.02 \pm 0.02$ . Superseded by ABLIKIM 17AE.

NODE=M057B4:LINKAGE=AB

$$\Gamma(\chi_{c2}(1P) \rightarrow \gamma\gamma) / \Gamma(\chi_{c0}(1P) \rightarrow \gamma\gamma) \quad \Gamma_{95} / \Gamma_{95}^{\chi_{c0}(1P)}$$

NODE=M057B06

| <u>VALUE</u> | <u>EVTS</u> | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |
|--------------|-------------|--------------------|-------------|----------------|
|--------------|-------------|--------------------|-------------|----------------|

**0.292±0.028 OUR AVERAGE**

|                             |      |                      |           |                                                             |
|-----------------------------|------|----------------------|-----------|-------------------------------------------------------------|
| $0.295 \pm 0.014 \pm 0.028$ | 8k   | <sup>1</sup> ABLIKIM | 17AE BES3 | $\psi(2S) \rightarrow \gamma \chi_{cJ} \rightarrow 3\gamma$ |
| $0.278 \pm 0.050 \pm 0.036$ | 0.5k | <sup>1</sup> ECKLUND | 08A CLEO  | $\psi(2S) \rightarrow \gamma \chi_{cJ} \rightarrow 3\gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                             |      |                        |     |      |                                                             |
|-----------------------------|------|------------------------|-----|------|-------------------------------------------------------------|
| $0.271 \pm 0.029 \pm 0.030$ | 1.9k | <sup>1,2</sup> ABLIKIM | 12A | BES3 | $\psi(2S) \rightarrow \gamma \chi_{cJ} \rightarrow 3\gamma$ |
|-----------------------------|------|------------------------|-----|------|-------------------------------------------------------------|

<sup>1</sup>Not independent from the values of  $\Gamma(\chi_{c0}, \chi_{c2})$  and  $B(\psi(2S) \rightarrow \chi_{c0}, \chi_{c2})$ .

<sup>2</sup>Superseded by ABLIKIM 17AE.

NODE=M057B06:LINKAGE=AB

NODE=M057B06;LINKAGE=A

MULTIPOLE AMPLITUDES IN  $\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)$  RADIATIVE DECAY

NODE=M057240

$a_2 = M2/\sqrt{E1^2 + M2^2 + E3^2}$  Magnetic quadrupole fractional transition amplitude

NODE=M057A1  
NODE=M057A1

| VALUE (units $10^{-2}$ )                   | EVTS  | DOCUMENT ID             | TECN     | COMMENT                                                               |
|--------------------------------------------|-------|-------------------------|----------|-----------------------------------------------------------------------|
| <b>-11.0 ± 1.0 OUR AVERAGE</b>             |       |                         |          |                                                                       |
| -12.0 ± 1.3 ± 0.4                          | 89k   | <sup>1</sup> ABLIKIM    | 17N BES3 | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$                       |
| -9.3 ± 1.6 ± 0.3                           | 19.8k | <sup>2</sup> ARTUSO     | 09 CLEO  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$                       |
| -9.3 <sup>+</sup> <sub>-4.1</sub> ± 0.6    | 5.9k  | <sup>3</sup> AMBROGIANI | 02 E835  | $p\bar{p} \rightarrow \chi_{c2} \rightarrow J/\psi\gamma$             |
| -14 ± 6                                    | 1.9k  | <sup>3</sup> ARMSTRONG  | 93E E760 | $p\bar{p} \rightarrow \chi_{c2} \rightarrow J/\psi\gamma$             |
| -33.3 <sup>+</sup> <sub>-29.2</sub> ± 11.6 | 441   | <sup>3</sup> OREGLIA    | 82 CBAL  | $\psi(2S) \rightarrow \chi_{c1}\gamma \rightarrow J/\psi\gamma\gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

- 7.9 ± 1.9 ± 0.3 19.8k <sup>4</sup> ARTUSO 09 CLEO  $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$
- <sup>1</sup> Correlated with  $a_3$ ,  $b_2$ , and  $b_3$  with correlation coefficients  $\rho_{a_2 a_3} = 0.733$ ,  $\rho_{a_2 b_2} = -0.605$ , and  $\rho_{a_2 b_3} = -0.095$ .
- <sup>2</sup> From a fit with floating  $M2$  amplitudes  $a_2$  and  $b_2$ , and fixed  $E3$  amplitudes  $a_3 = b_3 = 0$ .
- <sup>3</sup> Assuming  $a_3 = 0$ .
- <sup>4</sup> From a fit with floating  $M2$  and  $E3$  amplitudes  $a_2$ ,  $b_2$ , and  $a_3$ , and  $b_3$ .

OCCUR=2

NODE=M057A1;LINKAGE=B

NODE=M057A1;LINKAGE=AR

NODE=M057A1;LINKAGE=A

NODE=M057A1;LINKAGE=AT

$a_3 = E3/\sqrt{E1^2 + M2^2 + E3^2}$  Electric octupole fractional transition amplitude

NODE=M057A2  
NODE=M057A2

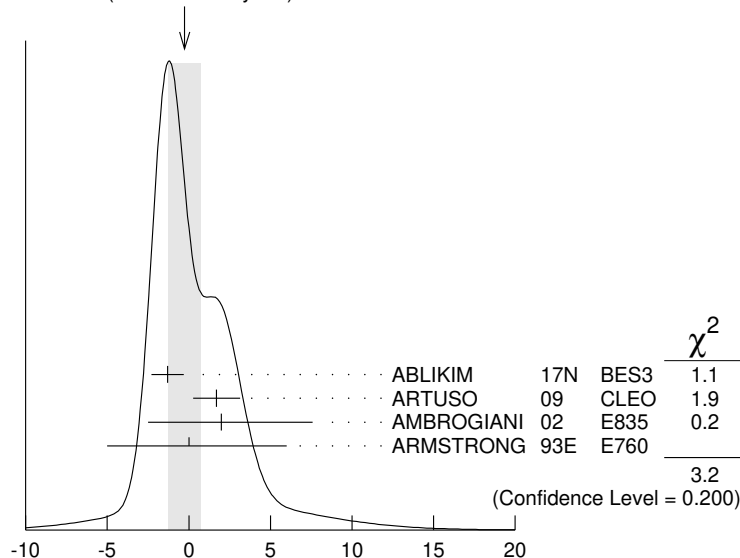
| VALUE (units $10^{-2}$ )                                                                  | EVTS  | DOCUMENT ID          | TECN     | COMMENT                                                   |
|-------------------------------------------------------------------------------------------|-------|----------------------|----------|-----------------------------------------------------------|
| <b>-0.3 ± 1.0 OUR AVERAGE</b> Error includes scale factor of 1.3. See the ideogram below. |       |                      |          |                                                           |
| -1.3 ± 0.9 ± 0.4                                                                          | 89k   | <sup>1</sup> ABLIKIM | 17N BES3 | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$           |
| 1.7 ± 1.4 ± 0.3                                                                           | 19.8k | <sup>2</sup> ARTUSO  | 09 CLEO  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$           |
| 2.0 <sup>+</sup> <sub>-4.4</sub> ± 0.9                                                    | 5908  | AMBROGIANI           | 02 E835  | $p\bar{p} \rightarrow \chi_{c2} \rightarrow J/\psi\gamma$ |
| 0 <sup>+</sup> <sub>-5</sub>                                                              | 1904  | ARMSTRONG            | 93E E760 | $p\bar{p} \rightarrow \chi_{c2} \rightarrow J/\psi\gamma$ |

- <sup>1</sup> Correlated with  $a_2$ ,  $b_2$ , and  $b_3$  with correlation coefficients  $\rho_{a_2 a_3} = 0.733$ ,  $\rho_{a_3 b_2} = -0.422$ , and  $\rho_{a_3 b_3} = -0.024$ .
- <sup>2</sup> From a fit with floating  $M2$  and  $E3$  amplitudes  $a_2$ ,  $b_2$ , and  $a_3$ , and  $b_3$ .

NODE=M057A2;LINKAGE=A

NODE=M057A2;LINKAGE=AR

WEIGHTED AVERAGE  
-0.3 ± 1.0 (Error scaled by 1.3)



$a_3 = E3/\sqrt{E1^2 + M2^2 + E3^2}$  Electric octupole fractional transition amplitude (units  $10^{-2}$ )

# MULTIPOLE AMPLITUDES IN $\psi(2S) \rightarrow \gamma\chi_{c2}(1P)$ RADIATIVE DECAY

NODE=M057250

**$b_2 = M_2/\sqrt{E_1^2 + M_2^2 + E_3^2}$  Magnetic quadrupole fractional transition amplitude**

NODE=M057QB2  
NODE=M057QB2

| VALUE (units $10^{-2}$ )                    | EVTS  | DOCUMENT ID                                                 | TECN     | COMMENT                                                |
|---------------------------------------------|-------|-------------------------------------------------------------|----------|--------------------------------------------------------|
| <b><math>1.9 \pm 0.9</math> OUR AVERAGE</b> |       | Error includes scale factor of 1.4. See the ideogram below. |          |                                                        |
| $1.7 \pm 0.8 \pm 0.2$                       | 89k   | <sup>1</sup> ABLIKIM                                        | 17N BES3 | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |
| $4.6 \pm 1.0 \pm 1.3$                       | 13.8k | <sup>2</sup> ABLIKIM                                        | 11I BES3 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-, \gamma K^+K^-$ |
| $0.2 \pm 1.5 \pm 0.4$                       | 19.8k | <sup>3</sup> ARTUSO                                         | 09 CLEO  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |
| $-5.1^{+5.4}_{-3.6}$                        | 721   | <sup>2</sup> ABLIKIM                                        | 04I BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-, \gamma K^+K^-$ |
| $13.2^{+9.8}_{-7.5}$                        | 441   | <sup>4</sup> OREGLIA                                        | 82 CBAL  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |

OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

$1.0 \pm 1.3 \pm 0.3$  19.8k <sup>4</sup> ARTUSO 09 CLEO  $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$

<sup>1</sup> Correlated with  $a_2$ ,  $a_3$ , and  $b_3$  with correlation coefficients  $\rho_{a_2 b_2} = -0.605$ ,  $\rho_{a_3 b_2} = -0.422$ , and  $\rho_{b_2 b_3} = 0.384$ .

<sup>2</sup> From a fit with floating  $M_2$  and  $E_3$  amplitudes  $b_2$  and  $b_3$ .

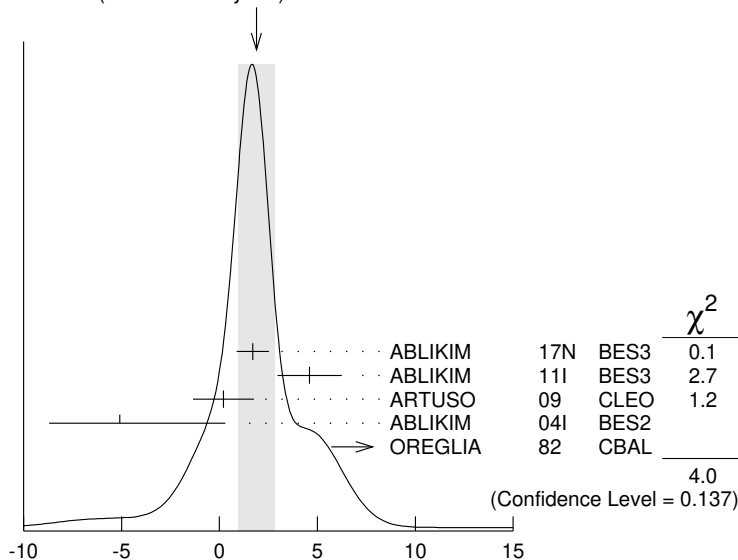
<sup>3</sup> From a fit with floating  $M_2$  and  $E_3$  amplitudes  $a_2$ ,  $b_2$ , and  $a_3$ , and  $b_3$ .

<sup>4</sup> From a fit with floating  $M_2$  amplitudes  $a_2$  and  $b_2$ , and fixed  $E_3$  amplitudes  $a_3 = b_3 = 0$ .

NODE=M057QB2;LINKAGE=A

NODE=M057QB2;LINKAGE=AB  
NODE=M057QB2;LINKAGE=AT  
NODE=M057QB2;LINKAGE=AR

WEIGHTED AVERAGE  
 $1.9 \pm 0.9$  (Error scaled by 1.4)



**$b_2 = M_2/\sqrt{E_1^2 + M_2^2 + E_3^2}$  Magnetic quadrupole fractional transition amplitude (units  $10^{-2}$ )**

**$b_3 = E_3/\sqrt{E_1^2 + M_2^2 + E_3^2}$  Electric octupole fractional transition amplitude**

NODE=M057QB3  
NODE=M057QB3

| VALUE (units $10^{-2}$ )                     | EVTS  | DOCUMENT ID          | TECN     | COMMENT                                                |
|----------------------------------------------|-------|----------------------|----------|--------------------------------------------------------|
| <b><math>-1.0 \pm 0.6</math> OUR AVERAGE</b> |       |                      |          |                                                        |
| $-1.4 \pm 0.7 \pm 0.4$                       | 89k   | <sup>1</sup> ABLIKIM | 17N BES3 | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |
| $1.5 \pm 0.8 \pm 1.8$                        | 13.8k | <sup>2</sup> ABLIKIM | 11I BES3 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-, \gamma K^+K^-$ |
| $-0.8 \pm 1.2 \pm 0.2$                       | 19.8k | ARTUSO               | 09 CLEO  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$        |
| $-2.7^{+4.3}_{-2.9}$                         | 721   | <sup>2</sup> ABLIKIM | 04I BES2 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-, \gamma K^+K^-$ |

<sup>1</sup> Correlated with  $a_2$ ,  $a_3$ , and  $b_2$  with correlation coefficients  $\rho_{a_2 b_3} = -0.095$ ,  $\rho_{a_3 b_3} = -0.024$ , and  $\rho_{b_2 b_3} = 0.384$ .

<sup>2</sup> From a fit with floating  $M_2$  and  $E_3$  amplitudes  $b_2$  and  $b_3$ .

NODE=M057QB3;LINKAGE=A

NODE=M057QB3;LINKAGE=AB

## MULTIPOLE AMPLITUDE RATIOS IN RADIATIVE DECAYS $\psi(2S) \rightarrow \gamma\chi_{c2}(1P)$ and $\chi_{c2} \rightarrow \gamma J/\psi(1S)$

NODE=M057260

**$b_2/a_2$  Magnetic quadrupole transition amplitude ratio**

NODE=M057QAR  
NODE=M057QAR

| VALUE (units $10^{-2}$ )            | EVTS  | DOCUMENT ID         | TECN    | COMMENT                                         |
|-------------------------------------|-------|---------------------|---------|-------------------------------------------------|
| <b><math>-11^{+14}_{-15}</math></b> | 19.8k | <sup>1</sup> ARTUSO | 09 CLEO | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

<sup>1</sup> Statistical and systematic errors combined. From a fit with floating  $M2$  amplitudes  $a_2$  and  $b_2$ , and fixed  $E3$  amplitudes  $a_3=b_3=0$ . Not independent of values for  $a_2(\chi_{c2}(1P))$  and  $b_2(\chi_{c2}(1P))$  from ARTUSO 09.

NODE=M057QAR;LINKAGE=AR

## $\chi_{c2}(1P)$ REFERENCES

NODE=M057

|               |      |                  |                                  |                                 |              |
|---------------|------|------------------|----------------------------------|---------------------------------|--------------|
| ABLIKIM       | 20AE | PR D102 092006   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=60733 |
| ABLIKIM       | 20B  | PR D101 012012   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=60212 |
| ABLIKIM       | 20I  | PR D101 092002   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=60303 |
| PDG           | 20   | PTEP 2020 083C01 | P.A. Zyla <i>et al.</i>          | (PDG Collab.)                   | REF ID=60676 |
| ABLIKIM       | 19AA | PR D99 052008    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=59844 |
| ABLIKIM       | 19AU | PR D100 052010   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=59996 |
| ABLIKIM       | 19BB | PR D100 092006   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=60026 |
| ABLIKIM       | 19J  | PR D99 012015    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=59606 |
| ABLIKIM       | 19Z  | PR D99 051101    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=59837 |
| ABLIKIM       | 18V  | PR D97 052011    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=58990 |
| PDG           | 18   | PR D98 030001    | M. Tanabashi <i>et al.</i>       | (PDG Collab.)                   | REF ID=59304 |
| AAIJ          | 17BB | EPJ C77 609      | R. Aaij <i>et al.</i>            | (LHCb Collab.)                  | REF ID=58191 |
| AAIJ          | 17BI | PRL 119 221801   | R. Aaij <i>et al.</i>            | (LHCb Collab.)                  | REF ID=58278 |
| ABLIKIM       | 17AE | PR D96 092007    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=58310 |
| ABLIKIM       | 17AG | PR D96 111102    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=58316 |
| ABLIKIM       | 17AI | PR D96 112006    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=58321 |
| ABLIKIM       | 17I  | PRL 118 221802   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=57931 |
| ABLIKIM       | 17N  | PR D95 072004    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=57978 |
| ABLIKIM       | 17U  | PR D96 032001    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=58026 |
| PDG           | 16   | CP C40 100001    | C. Patrignani <i>et al.</i>      | (PDG Collab.)                   | REF ID=57140 |
| ABLIKIM       | 15I  | PR D91 092006    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=56774 |
| ABLIKIM       | 15M  | PR D91 112008    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=56778 |
| ABLIKIM       | 15N  | PR D91 112018    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=56779 |
| ABLIKIM       | 14J  | PR D89 074030    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=55901 |
| ABLIKIM       | 13B  | PR D87 012002    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=54877 |
| ABLIKIM       | 13D  | PR D87 012007    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=54879 |
| ABLIKIM       | 13H  | PR D87 032007    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=54953 |
| ABLIKIM       | 13V  | PR D88 112001    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=55583 |
| UEHARA        | 13   | PTEP 2013 123C01 | S. Uehara <i>et al.</i>          | (BELLE Collab.)                 | REF ID=55592 |
| ABLIKIM       | 12A  | PR D85 112008    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=54266 |
| ABLIKIM       | 12I  | PR D86 052004    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=54736 |
| ABLIKIM       | 12J  | PR D86 052011    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=54737 |
| ABLIKIM       | 12O  | PRL 109 172002   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=54742 |
| LEES          | 12AE | PR D86 092005    | J.P. Lees <i>et al.</i>          | (BABAR Collab.)                 | REF ID=54752 |
| LIU           | 12B  | PRL 108 232001   | Z.Q. Liu <i>et al.</i>           | (BELLE Collab.)                 | REF ID=54303 |
| ABLIKIM       | 11A  | PR D83 012006    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=53647 |
| ABLIKIM       | 11E  | PR D83 112005    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=16717 |
| ABLIKIM       | 11F  | PR D83 112009    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=16719 |
| ABLIKIM       | 11I  | PR D84 092006    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=53930 |
| ABLIKIM       | 11K  | PRL 107 092001   | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=53940 |
| DEL-AMO-SA... | 11M  | PR D84 012004    | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)                 | REF ID=16751 |
| ABLIKIM       | 10A  | PR D81 052005    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)                | REF ID=53347 |
| ONYISI        | 10   | PR D82 011103    | P.U.E. Onyisi <i>et al.</i>      | (CLEO Collab.)                  | REF ID=53360 |
| UEHARA        | 10A  | PR D82 114031    | S. Uehara <i>et al.</i>          | (BELLE Collab.)                 | REF ID=53641 |
| ARTUSO        | 09   | PR D80 112003    | M. Artuso <i>et al.</i>          | (CLEO Collab.)                  | REF ID=53206 |
| ASNER         | 09   | PR D79 072007    | D.M. Asner <i>et al.</i>         | (CLEO Collab.)                  | REF ID=52721 |
| UEHARA        | 09   | PR D79 052009    | S. Uehara <i>et al.</i>          | (BELLE Collab.)                 | REF ID=52761 |
| BENNETT       | 08A  | PRL 101 151801   | J.V. Bennett <i>et al.</i>       | (CLEO Collab.)                  | REF ID=52575 |
| ECKLUND       | 08A  | PR D78 091501    | K.M. Ecklund <i>et al.</i>       | (CLEO Collab.)                  | REF ID=52583 |
| HE            | 08B  | PR D78 092004    | Q. He <i>et al.</i>              | (CLEO Collab.)                  | REF ID=52588 |
| MENDEZ        | 08   | PR D78 011102    | H. Mendez <i>et al.</i>          | (CLEO Collab.)                  | REF ID=52684 |
| NAIK          | 08   | PR D78 031101    | P. Naik <i>et al.</i>            | (CLEO Collab.)                  | REF ID=52301 |
| UEHARA        | 08   | EPJ C53 1        | S. Uehara <i>et al.</i>          | (BELLE Collab.)                 | REF ID=52064 |
| ADAMS         | 07   | PR D75 071101    | G.S. Adams <i>et al.</i>         | (CLEO Collab.)                  | REF ID=51651 |
| ATHAR         | 07   | PR D75 032002    | S.B. Athar <i>et al.</i>         | (CLEO Collab.)                  | REF ID=51618 |
| CHEN          | 07B  | PL B651 15       | W.T. Chen <i>et al.</i>          | (BELLE Collab.)                 | REF ID=51710 |
| ABLIKIM       | 06D  | PR D73 052006    | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REF ID=51049 |
| ABLIKIM       | 06I  | PR D74 012004    | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REF ID=51126 |
| ABLIKIM       | 06R  | PR D74 072001    | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REF ID=51447 |
| ABLIKIM       | 06T  | PL B642 197      | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REF ID=51453 |
| DOBBS         | 06   | PR D73 071101    | S. Dobbs <i>et al.</i>           | (CLEO Collab.)                  | REF ID=51062 |
| ABLIKIM       | 05G  | PR D71 092002    | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REF ID=50756 |
| ABLIKIM       | 05N  | PL B630 7        | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REF ID=50847 |
| ABLIKIM       | 05O  | PL B630 21       | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REF ID=50846 |
| ADAM          | 05A  | PRL 94 232002    | N.E. Adam <i>et al.</i>          | (CLEO Collab.)                  | REF ID=50763 |
| ANDREOTTI     | 05A  | NP B717 34       | M. Andreotti <i>et al.</i>       | (FNAL E835 Collab.)             | REF ID=50769 |
| NAKAZAWA      | 05   | PL B615 39       | H. Nakazawa <i>et al.</i>        | (BELLE Collab.)                 | REF ID=50807 |
| ABLIKIM       | 04B  | PR D70 012003    | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REF ID=49741 |
| ABLIKIM       | 04H  | PR D70 092003    | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REF ID=50188 |
| ABLIKIM       | 04I  | PR D70 092004    | M. Ablikim <i>et al.</i>         | (BES Collab.)                   | REF ID=50189 |
| ATHAR         | 04   | PR D70 112002    | S.B. Athar <i>et al.</i>         | (CLEO Collab.)                  | REF ID=50331 |
| BAI           | 04F  | PR D69 092001    | J.Z. Bai <i>et al.</i>           | (BES Collab.)                   | REF ID=49752 |
| BAI           | 04I  | PR D70 012006    | J.Z. Bai <i>et al.</i>           | (BES Collab.)                   | REF ID=49755 |
| AULCHENKO     | 03   | PL B573 63       | V.M. Aulchenko <i>et al.</i>     | (KEDR Collab.)                  | REF ID=49579 |
| BAI           | 03C  | PR D67 032004    | J.Z. Bai <i>et al.</i>           | (BES Collab.)                   | REF ID=49190 |
| BAI           | 03E  | PR D67 112001    | J.Z. Bai <i>et al.</i>           | (BES Collab.)                   | REF ID=49416 |
| ABE           | 02T  | PL B540 33       | K. Abe <i>et al.</i>             | (BELLE Collab.)                 | REF ID=48813 |
| AMBROGIANI    | 02   | PR D65 052002    | M. Ambrogiani <i>et al.</i>      | (FNAL E835 Collab.)             | REF ID=48552 |
| EISENSTEIN    | 01   | PRL 87 061801    | B.I. Eisenstein <i>et al.</i>    | (CLEO Collab.)                  | REF ID=48344 |
| AMBROGIANI    | 00B  | PR D62 052002    | M. Ambrogiani <i>et al.</i>      | (FNAL E835 Collab.)             | REF ID=47940 |
| ACCIARRI      | 99E  | PL B453 73       | M. Acciarri <i>et al.</i>        | (L3 Collab.)                    | REF ID=46943 |
| BAI           | 99B  | PR D60 072001    | J.Z. Bai <i>et al.</i>           | (BES Collab.)                   | REF ID=47385 |
| ACKER.,K...   | 98   | PL B439 197      | K. Ackerstaff <i>et al.</i>      | (OPAL Collab.)                  | REF ID=46324 |
| BAI           | 98D  | PR D58 092006    | J.Z. Bai <i>et al.</i>           | (BES Collab.)                   | REF ID=46338 |
| BAI           | 98I  | PRL 81 3091      | J.Z. Bai <i>et al.</i>           | (BES Collab.)                   | REF ID=46343 |
| DOMINICK      | 94   | PR D50 4265      | J. Dominick <i>et al.</i>        | (CLEO Collab.)                  | REF ID=44077 |
| ARMSTRONG     | 93   | PRL 70 2988      | T.A. Armstrong <i>et al.</i>     | (FNAL E760 Collab.)             | REF ID=43306 |
| ARMSTRONG     | 93E  | PR D48 3037      | T.A. Armstrong <i>et al.</i>     | (FNAL E760 Collab.)             | REF ID=48616 |
| BAUER         | 93   | PL B302 345      | D.A. Bauer <i>et al.</i>         | (TPC Collab.)                   | REF ID=43315 |
| ARMSTRONG     | 92   | NP B373 35       | T.A. Armstrong <i>et al.</i>     | (FNAL, FERR, GENO+)             | REF ID=41865 |
| Also          |      | PRL 68 1468      | T.A. Armstrong <i>et al.</i>     | (FNAL, FERR, GENO+)             | REF ID=41907 |
| BAGLIN        | 87B  | PL B187 191      | C. Baglin <i>et al.</i>          | (R704 Collab.)                  | REF ID=40018 |
| BAGLIN        | 86B  | PL B172 455      | C. Baglin                        | (LAPP, CERN, GENO, LYON, OSLO+) | REF ID=22145 |
| GAISER        | 86   | PR D34 711       | J. Gaiser <i>et al.</i>          | (Crystal Ball Collab.)          | REF ID=22012 |
| LEE           | 85   | SLAC 282         | R.A. Lee                         | (SLAC)                          | REF ID=40589 |
| LEMOIGNE      | 82   | PL 113B 509      | Y. Lemoigne <i>et al.</i>        | (SACL, LOIC, SHMP+)             | REF ID=22084 |
| OREGLIA       | 82   | PR D25 2259      | M.J. Oreglia <i>et al.</i>       | (SLAC, CIT, HARV+)              | REF ID=22120 |
| Also          |      | Private Comm.    | M.J. Oreglia                     | (EFI)                           | REF ID=22143 |
| BARATE        | 81   | PR D24 2994      | R. Barate <i>et al.</i>          | (SACL, LOIC, SHMP, CERN+)       | REF ID=22164 |
| HIMEL         | 80   | PRL 44 920       | T. Himel <i>et al.</i>           | (LBL, SLAC)                     | REF ID=22119 |
| Also          |      | Private Comm.    | G. Trilling                      | (LBL, UCB)                      | REF ID=22113 |
| BRANDELIK     | 79B  | NP B160 426      | R. Brandelik <i>et al.</i>       | (DASP Collab.)                  | REF ID=22115 |
| BARTL         | 78B  | PL 79B 492       | W. Bartel <i>et al.</i>          | (DESY, HEIDP)                   | REF ID=22111 |
| TANENBAUM     | 78   | PR D17 1731      | W.M. Tanenbaum <i>et al.</i>     | (SLAC, LBL)                     | REF ID=22112 |
| Also          |      | Private Comm.    | G. Trilling                      | (LBL, UCB)                      | REF ID=22113 |
| BIDDICK       | 77   | PRL 38 1324      | C.J. Biddick <i>et al.</i>       | (UCSD, UMD, PAVI+)              | REF ID=22059 |
| WHITAKER      | 76   | PRL 37 1596      | J.S. Whitaker <i>et al.</i>      | (SLAC, LBL)                     | REF ID=22151 |

$$J^{PC} = 0^{+}(0^{-+})$$

Quantum numbers are quark model predictions.

NODE=M059

NODE=M059

NODE=M059M

NODE=M059M

### $\eta_c(2S)$ MASS

| VALUE (MeV)                                                                      | EVTS         | DOCUMENT ID                  | TECN     | COMMENT                                                           |
|----------------------------------------------------------------------------------|--------------|------------------------------|----------|-------------------------------------------------------------------|
| <b>3637.5<math>\pm</math>1.1 OUR AVERAGE</b> Error includes scale factor of 1.2. |              |                              |          |                                                                   |
| 3635.1 $\pm$ 3.7 $\pm$ 2.9                                                       | 106          | XU                           | 18 BELL  | $e^+e^- \rightarrow e^+e^-\eta'\pi^+\pi^-$                        |
| 3633.6 $\pm$ 1.7 $\pm$ 0.6                                                       | 106          | <sup>1</sup> AAIJ            | 17ADLHCB | $pp \rightarrow B^+X \rightarrow p\bar{p}K^+X$                    |
| 3636.4 $\pm$ 4.1 $\pm$ 0.7                                                       | 365          | <sup>2</sup> AAIJ            | 17BBLHCB | $pp \rightarrow b\bar{b}X \rightarrow 2(K^+K^-)X$                 |
| 3637.0 $\pm$ 5.7 $\pm$ 3.4                                                       | 178          | <sup>3,4</sup> LEES          | 14E BABR | $\gamma\gamma \rightarrow K^+K^-\pi^0$                            |
| 3635.1 $\pm$ 5.8 $\pm$ 2.1                                                       | 47           | <sup>3,5</sup> LEES          | 14E BABR | $\gamma\gamma \rightarrow K^+K^-\eta$                             |
| 3646.9 $\pm$ 1.6 $\pm$ 3.6                                                       | 57 $\pm$ 17  | ABLIKIM                      | 13K BES3 | $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$     |
| 3637.6 $\pm$ 2.9 $\pm$ 1.6                                                       | 127 $\pm$ 18 | <sup>6</sup> ABLIKIM         | 12G BES3 | $\psi(2S) \rightarrow \gamma K^0 K\pi, KK\pi^0$                   |
| 3638.5 $\pm$ 1.5 $\pm$ 0.8                                                       | 624          | <sup>3</sup> DEL-AMO-SA..11M | BABR     | $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$                    |
| 3640.5 $\pm$ 3.2 $\pm$ 2.5                                                       | 1201         | <sup>3</sup> DEL-AMO-SA..11M | BABR     | $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$                  |
| 3636.1 $^{+3.9+0.7}_{-4.2-2.0}$                                                  | 128          | <sup>7</sup> VINOKUROVA      | 11 BELL  | $B^\pm \rightarrow K^\pm(K_S^0 K^\pm \pi^\mp)$                    |
| 3626 $\pm 5 \pm 6$                                                               | 311          | <sup>8</sup> ABE             | 07 BELL  | $e^+e^- \rightarrow J/\psi(c\bar{c})$                             |
| 3645.0 $\pm$ 5.5 $^{+4.9}_{-7.8}$                                                | 121 $\pm$ 27 | AUBERT                       | 05C BABR | $e^+e^- \rightarrow J/\psi c\bar{c}$                              |
| 3642.9 $\pm$ 3.1 $\pm$ 1.5                                                       | 61           | ASNER                        | 04 CLEO  | $\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •    |              |                              |          |                                                                   |
| 3639 $\pm 7$                                                                     | 98 $\pm$ 52  | <sup>9</sup> AUBERT          | 06E BABR | $B^\pm \rightarrow K^\pm X_{c\bar{c}}$                            |
| 3630.8 $\pm$ 3.4 $\pm$ 1.0                                                       | 112 $\pm$ 24 | <sup>10</sup> AUBERT         | 04D BABR | $\gamma\gamma \rightarrow \eta_c(2S) \rightarrow K\bar{K}\pi$     |
| 3654 $\pm 6 \pm 8$                                                               | 39 $\pm$ 11  | <sup>11</sup> CHOI           | 02 BELL  | $B \rightarrow K K_S K^-\pi^+$                                    |
| 3594 $\pm 5$                                                                     |              | <sup>12</sup> EDWARDS        | 82C CBAL | $e^+e^- \rightarrow \gamma X$                                     |

OCCUR=2

OCCUR=2

<sup>1</sup>AAIJ 17AD report  $m_{\psi(2S)} - m_{\eta_c(2S)} = 52.5 \pm 1.7 \pm 0.6$  MeV. We use the current value  $m_{\psi(2S)} = 3686.097 \pm 0.025$  MeV to obtain the quoted mass.

<sup>2</sup>From a fit of the  $\phi\phi$  invariant mass with the width of  $\eta_c(2S)$  fixed to the PDG 16 value.

<sup>3</sup>Ignoring possible interference with continuum.

<sup>4</sup>With a width fixed to 11.3 MeV.

<sup>5</sup>With a width fixed to 11.3 MeV. Using both  $\eta \rightarrow \gamma\gamma$  and  $\eta \rightarrow \pi^+\pi^-\pi^0$  decays.

<sup>6</sup>From a simultaneous fit to  $K_S^0 K^\pm \pi^\mp$  and  $K^+K^-\pi^0$  decay modes.

<sup>7</sup>Accounts for interference with non-resonant continuum.

<sup>8</sup>From a fit of the  $J/\psi$  recoil mass spectrum. Supersedes ABE,K 02 and ABE 04G.

<sup>9</sup>From the fit of the kaon momentum spectrum. Systematic errors not evaluated.

<sup>10</sup>Superseded by DEL-AMO-SANCHEZ 11M.

<sup>11</sup>Superseded by VINOKUROVA 11.

<sup>12</sup>Assuming mass of  $\psi(2S) = 3686$  MeV.

NODE=M059M;LINKAGE=B

NODE=M059M;LINKAGE=C  
 NODE=M059M;LINKAGE=DE  
 NODE=M059M;LINKAGE=LE  
 NODE=M059M;LINKAGE=LS  
 NODE=M059M;LINKAGE=AB  
 NODE=M059M;LINKAGE=VA  
 NODE=M059M;LINKAGE=EB  
 NODE=M059M;LINKAGE=AU  
 NODE=M059M;LINKAGE=AR  
 NODE=M059M;LINKAGE=CH  
 NODE=M059M;LINKAGE=A

### $\eta_c(2S)$ WIDTH

| VALUE (MeV)                                                                   | CL% | EVTS         | DOCUMENT ID                   | TECN     | COMMENT                                                           |
|-------------------------------------------------------------------------------|-----|--------------|-------------------------------|----------|-------------------------------------------------------------------|
| <b>11.3<math>^{+3.2}_{-2.9}</math> OUR AVERAGE</b>                            |     |              |                               |          |                                                                   |
| 9.9 $\pm$ 4.8 $\pm$ 2.9                                                       |     | 57 $\pm$ 17  | ABLIKIM                       | 13K BES3 | $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$     |
| 16.9 $\pm$ 6.4 $\pm$ 4.8                                                      |     | 127 $\pm$ 18 | <sup>13</sup> ABLIKIM         | 12G BES3 | $\psi(2S) \rightarrow \gamma K^0 K\pi, KK\pi^0$                   |
| 13.4 $\pm$ 4.6 $\pm$ 3.2                                                      |     | 624          | <sup>14</sup> DEL-AMO-SA..11M | BABR     | $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$                    |
| 6.6 $^{+8.4+2.6}_{-5.1-0.9}$                                                  |     | 128          | <sup>15</sup> VINOKUROVA      | 11 BELL  | $B^\pm \rightarrow K^\pm(K_S^0 K^\pm \pi^\mp)$                    |
| 6.3 $\pm$ 12.4 $\pm$ 4.0                                                      |     | 61           | ASNER                         | 04 CLEO  | $\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |              |                               |          |                                                                   |
| < 23                                                                          | 90  | 98 $\pm$ 52  | <sup>16</sup> AUBERT          | 06E BABR | $B^\pm \rightarrow K^\pm X_{c\bar{c}}$                            |
| 22 $\pm$ 14                                                                   |     | 121 $\pm$ 27 | AUBERT                        | 05C BABR | $e^+e^- \rightarrow J/\psi c\bar{c}$                              |
| 17.0 $\pm$ 8.3 $\pm$ 2.5                                                      |     | 112 $\pm$ 24 | <sup>17</sup> AUBERT          | 04D BABR | $\gamma\gamma \rightarrow \eta_c(2S) \rightarrow K\bar{K}\pi$     |
| <55                                                                           | 90  | 39 $\pm$ 11  | <sup>18</sup> CHOI            | 02 BELL  | $B \rightarrow K K_S K^-\pi^+$                                    |
| <8.0                                                                          | 95  |              | <sup>19</sup> EDWARDS         | 82C CBAL | $e^+e^- \rightarrow \gamma X$                                     |

NODE=M059W

NODE=M059W

<sup>13</sup> From a simultaneous fit to  $K_S^0 K^\pm \pi^\mp$  and  $K^+ K^- \pi^0$  decay modes.

<sup>14</sup> Ignoring possible interference with continuum.

<sup>15</sup> Accounts for interference with non-resonant continuum.

<sup>16</sup> From the fit of the kaon momentum spectrum. Systematic errors not evaluated.

<sup>17</sup> Superseded by DEL-AMO-SANCHEZ 11M.

<sup>18</sup> For a mass value of  $3654 \pm 6$  MeV. Superseded by VINOKUROVA 11.

<sup>19</sup> For a mass value of  $3594 \pm 5$  MeV

NODE=M059W;LINKAGE=AB  
 NODE=M059W;LINKAGE=DE  
 NODE=M059W;LINKAGE=VA  
 NODE=M059W;LINKAGE=AU  
 NODE=M059W;LINKAGE=AR  
 NODE=M059W;LINKAGE=W2  
 NODE=M059W;LINKAGE=W

## $\eta_c(2S)$ DECAY MODES

NODE=M059215;NODE=M059

| Mode                                                 | Fraction ( $\Gamma_i/\Gamma$ )     | Confidence level |
|------------------------------------------------------|------------------------------------|------------------|
| $\Gamma_1$ hadrons                                   | not seen                           |                  |
| $\Gamma_2$ $K \bar{K} \pi$                           | ( $1.9 \pm 1.2$ ) %                |                  |
| $\Gamma_3$ $K \bar{K} \eta$                          | ( $5 \pm 4$ ) $\times 10^{-3}$     |                  |
| $\Gamma_4$ $2\pi^+ 2\pi^-$                           | not seen                           |                  |
| $\Gamma_5$ $\rho^0 \rho^0$                           | not seen                           |                  |
| $\Gamma_6$ $3\pi^+ 3\pi^-$                           | not seen                           |                  |
| $\Gamma_7$ $K^+ K^- \pi^+ \pi^-$                     | not seen                           |                  |
| $\Gamma_8$ $K^{*0} \bar{K}^{*0}$                     | not seen                           |                  |
| $\Gamma_9$ $K^+ K^- \pi^+ \pi^- \pi^0$               | ( $1.4 \pm 1.0$ ) %                |                  |
| $\Gamma_{10}$ $K^+ K^- 2\pi^+ 2\pi^-$                | not seen                           |                  |
| $\Gamma_{11}$ $K_S^0 K^- 2\pi^+ \pi^- + \text{c.c.}$ | seen                               |                  |
| $\Gamma_{12}$ $2K^+ 2K^-$                            | not seen                           |                  |
| $\Gamma_{13}$ $\phi \phi$                            | not seen                           |                  |
| $\Gamma_{14}$ $p \bar{p}$                            | seen                               |                  |
| $\Gamma_{15}$ $p \bar{p} \pi^+ \pi^-$                | seen                               |                  |
| $\Gamma_{16}$ $\gamma \gamma$                        | ( $1.9 \pm 1.3$ ) $\times 10^{-4}$ |                  |
| $\Gamma_{17}$ $\gamma J/\psi(1S)$                    | < 1.4 %                            | 90%              |
| $\Gamma_{18}$ $\pi^+ \pi^- \eta$                     | not seen                           |                  |
| $\Gamma_{19}$ $\pi^+ \pi^- \eta'$                    | not seen                           |                  |
| $\Gamma_{20}$ $\pi^+ \pi^- \eta_c(1S)$               | < 25 %                             | 90%              |

DESIG=1  
 DESIG=4  
 DESIG=20  
 DESIG=5  
 DESIG=16  
 DESIG=8;OUR EVAL;→ UNCHECKED ←  
 DESIG=6  
 DESIG=17  
 DESIG=9  
 DESIG=10;OUR EVAL;→ UNCHECKED ←  
 DESIG=11  
 DESIG=7  
 DESIG=18  
 DESIG=3  
 DESIG=22  
 DESIG=2  
 DESIG=21  
 DESIG=12;OUR EVAL;→ UNCHECKED ←  
 DESIG=13;OUR EVAL;→ UNCHECKED ←  
 DESIG=15

## $\eta_c(2S)$ PARTIAL WIDTHS

NODE=M059216

$\Gamma(\gamma\gamma)$   $\Gamma_{16}$

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |     |                     |    |      |                                                                   |
|-------------|-----|---------------------|----|------|-------------------------------------------------------------------|
| 0.44 ± 0.14 | 106 | <sup>20</sup> XU    | 18 | BELL | $e^+ e^- \rightarrow e^+ e^- \eta' \pi^+ \pi^-$                   |
| 1.3 ± 0.6   |     | <sup>21</sup> ASNER | 04 | CLEO | $\gamma\gamma \rightarrow \eta_c \rightarrow K_S^0 K^\pm \pi^\mp$ |

<sup>20</sup> Assuming that the branching fraction into  $\eta' \pi^+ \pi^-$  is the same as for  $\eta_c(1S)$ .

<sup>21</sup> They measure  $\Gamma(\eta_c(2S) \gamma\gamma) / B(\eta_c(2S) \rightarrow K \bar{K} \pi) = (0.18 \pm 0.05 \pm 0.02) \Gamma(\eta_c(1S) \gamma\gamma) / B(\eta_c(1S) \rightarrow K \bar{K} \pi)$ . The value for  $\Gamma(\eta_c(2S) \rightarrow \gamma\gamma)$  is derived assuming that the branching fractions for  $\eta_c(2S)$  and  $\eta_c(1S)$  decays to  $K_S K \pi$  are equal and using  $\Gamma(\eta_c(1S) \rightarrow \gamma\gamma) = 7.4 \pm 0.4 \pm 2.3$  keV.

NODE=M059W1;LINKAGE=A  
 NODE=M059W1;LINKAGE=AS

$\Gamma(\gamma\gamma) \times \Gamma(\pi^+ \pi^- \eta') / \Gamma_{\text{total}}$   $\Gamma_{16} \Gamma_{19} / \Gamma$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                             |     |    |    |      |                                                 |
|-----------------------------|-----|----|----|------|-------------------------------------------------|
| $5.6^{+1.2}_{-1.1} \pm 1.1$ | 106 | XU | 18 | BELL | $e^+ e^- \rightarrow e^+ e^- \eta' \pi^+ \pi^-$ |
|-----------------------------|-----|----|----|------|-------------------------------------------------|

NODE=M059R29  
 NODE=M059R29

## $\eta_c(2S) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$

NODE=M059218

$\Gamma(2\pi^+ 2\pi^-) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_4 \Gamma_{16} / \Gamma$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|       |    |        |    |      |                                                                  |
|-------|----|--------|----|------|------------------------------------------------------------------|
| < 6.5 | 90 | UEHARA | 08 | BELL | $\gamma\gamma \rightarrow \eta_c(2S) \rightarrow 2(\pi^+ \pi^-)$ |
|-------|----|--------|----|------|------------------------------------------------------------------|

NODE=M059G01  
 NODE=M059G01

$\Gamma(K \bar{K} \pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$   $\Gamma_2 \Gamma_{16} / \Gamma$

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                  |     |                               |      |                                                |
|------------------|-----|-------------------------------|------|------------------------------------------------|
| $41 \pm 4 \pm 6$ | 624 | <sup>22</sup> DEL-AMO-SA..11M | BABR | $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$ |
|------------------|-----|-------------------------------|------|------------------------------------------------|

NODE=M059G04  
 NODE=M059G04

<sup>22</sup> Not independent from other measurements reported in DEL-AMO-SANCHEZ 11M.

NODE=M059G04;LINKAGE=DE

$$\Gamma(K^+K^-\pi^+\pi^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_7\Gamma_{16}/\Gamma$$

| VALUE (eV)     | CL% | DOCUMENT ID | TECN | COMMENT                                                                 |
|----------------|-----|-------------|------|-------------------------------------------------------------------------|
| <b>&lt;5.0</b> | 90  | UEHARA      | 08   | BELL $\gamma\gamma \rightarrow \eta_c(2S) \rightarrow K^+K^-\pi^+\pi^-$ |

NODE=M059G02  
NODE=M059G02

$$\Gamma(K^+K^-\pi^+\pi^-\pi^0) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_9\Gamma_{16}/\Gamma$$

| VALUE (eV)    | EVTS | DOCUMENT ID                   | TECN | COMMENT                                          |
|---------------|------|-------------------------------|------|--------------------------------------------------|
| <b>30±6±5</b> | 1201 | <sup>23</sup> DEL-AMO-SA..11M | BABR | $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$ |

NODE=M059G05  
NODE=M059G05

<sup>23</sup> Not independent from other measurements reported in DEL-AMO-SANCHEZ 11M.

NODE=M059G05;LINKAGE=DE

$$\Gamma(2K^+2K^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{12}\Gamma_{16}/\Gamma$$

| VALUE (eV)     | CL% | DOCUMENT ID | TECN | COMMENT                                                          |
|----------------|-----|-------------|------|------------------------------------------------------------------|
| <b>&lt;2.9</b> | 90  | UEHARA      | 08   | BELL $\gamma\gamma \rightarrow \eta_c(2S) \rightarrow 2(K^+K^-)$ |

NODE=M059G03  
NODE=M059G03

$$\Gamma(\pi^+\pi^-\eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{20}\Gamma_{16}/\Gamma$$

| VALUE (eV)     | CL% | DOCUMENT ID | TECN      | COMMENT                                     |
|----------------|-----|-------------|-----------|---------------------------------------------|
| <b>&lt;133</b> | 90  | LEES        | 12AE BABR | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\eta_c$ |

NODE=M059G06  
NODE=M059G06

$$\eta_c(2S) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma^2(\text{total})$$

NODE=M059217

$$\Gamma(p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}} \quad \Gamma_{14}/\Gamma \times \Gamma_{16}/\Gamma$$

| VALUE (units 10 <sup>-8</sup> ) | CL%                    | DOCUMENT ID | TECN | COMMENT                                  |
|---------------------------------|------------------------|-------------|------|------------------------------------------|
| <b>&lt; 5.6</b>                 | 90 <sup>24,25,26</sup> | AMBROGIANI  | 01   | E835 $\bar{p}p \rightarrow \gamma\gamma$ |

NODE=M059G1  
NODE=M059G1

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |                        |                             |    |                                          |
|-------|------------------------|-----------------------------|----|------------------------------------------|
| < 8.0 | 90 <sup>24,25,27</sup> | AMBROGIANI                  | 01 | E835 $\bar{p}p \rightarrow \gamma\gamma$ |
| <12.0 | 90                     | <sup>25,27</sup> AMBROGIANI | 01 | E835 $\bar{p}p \rightarrow \gamma\gamma$ |

OCCUR=2  
OCCUR=3

<sup>24</sup> Including the measurements of of ARMSTRONG 95F in the AMBROGIANI 01 analysis.

<sup>25</sup> For a total width  $\Gamma=5$  MeV.

<sup>26</sup> For the resonance mass region 3589–3599 MeV/ $c^2$ .

<sup>27</sup> For the resonance mass region 3575–3660 MeV/ $c^2$ .

NODE=M059G1;LINKAGE=A  
NODE=M059G1;LINKAGE=B  
NODE=M059G1;LINKAGE=C1  
NODE=M059G1;LINKAGE=C2

## $\eta_c(2S)$ BRANCHING RATIOS

NODE=M059220

$$\Gamma(\text{hadrons})/\Gamma_{\text{total}} \quad \Gamma_1/\Gamma$$

| VALUE           | DOCUMENT ID | TECN | COMMENT                                           |
|-----------------|-------------|------|---------------------------------------------------|
| <b>not seen</b> | ABREU       | 98o  | DLPH $e^+e^- \rightarrow e^+e^- + \text{hadrons}$ |

NODE=M059R1  
NODE=M059R1

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |                       |     |                                    |
|------|-----------------------|-----|------------------------------------|
| seen | <sup>28</sup> EDWARDS | 82c | CBAL $e^+e^- \rightarrow \gamma X$ |
|------|-----------------------|-----|------------------------------------|

<sup>28</sup> For a mass value of 3594 ± 5 MeV

NODE=M059R;LINKAGE=W

$$\Gamma(K\bar{K}\pi)/\Gamma_{\text{total}} \quad \Gamma_2/\Gamma$$

| VALUE (units 10 <sup>-2</sup> ) | EVTS    | DOCUMENT ID          | TECN | COMMENT                                                    |
|---------------------------------|---------|----------------------|------|------------------------------------------------------------|
| <b>1.9±0.4±1.1</b>              | 59 ± 12 | <sup>29</sup> AUBERT | 08AB | BABR $B \rightarrow \eta_c(2S)K \rightarrow K\bar{K}\pi K$ |

NODE=M059R3  
NODE=M059R3

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |          |                    |     |                                                |
|------|----------|--------------------|-----|------------------------------------------------|
| seen | 127 ± 18 | ABLIKIM            | 13K | BES3 $\psi(2S) \rightarrow \gamma K\bar{K}\pi$ |
| seen | 39 ± 11  | <sup>30</sup> CHOI | 02  | BELL $B \rightarrow K K_S K^-\pi^+$            |

<sup>29</sup> Derived from a measurement of  $[B(B^+ \rightarrow \eta_c(2S)K^+) \times B(\eta_c(2S) \rightarrow K\bar{K}\pi)] / [B(B^+ \rightarrow \eta_c K^+) \times B(\eta_c \rightarrow K\bar{K}\pi)] = (9.6^{+2.0}_{-1.9} \pm 2.5)\%$  and using  $B(B^+ \rightarrow \eta_c(2S)K^+) = (3.4 \pm 1.8) \times 10^{-4}$ , and  $[B(B^+ \rightarrow \eta_c K^+) \times B(\eta_c \rightarrow K\bar{K}\pi)] = (6.88 \pm 0.77^{+0.55}_{-0.66}) \times 10^{-5}$ .

NODE=M059R3;LINKAGE=AU

<sup>30</sup> For a mass value of 3654 ± 6 MeV

NODE=M059R;LINKAGE=W2

$$\Gamma(K\bar{K}\eta)/\Gamma(K\bar{K}\pi) \quad \Gamma_3/\Gamma_2$$

| VALUE (units 10 <sup>-2</sup> ) | EVTS | DOCUMENT ID        | TECN | COMMENT                                            |
|---------------------------------|------|--------------------|------|----------------------------------------------------|
| <b>27.3±7.0±9.0</b>             | 225  | <sup>31</sup> LEES | 14E  | BABR $\gamma\gamma \rightarrow K^+K^-\gamma\gamma$ |

NODE=M059R26  
NODE=M059R26

<sup>31</sup> LEES 14E reports  $B(\eta_c(2S) \rightarrow K^+K^-\eta)/B(\eta_c(2S) \rightarrow K^+K^-\pi^0) = 0.82 \pm 0.21 \pm 0.27$ , which we divide by 3 to account for isospin symmetry.

NODE=M059R26;LINKAGE=LE

$$\Gamma(2\pi^+2\pi^-)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$$

| VALUE           | DOCUMENT ID | TECN | COMMENT                                    |
|-----------------|-------------|------|--------------------------------------------|
| <b>not seen</b> | UEHARA      | 08   | BELL $\gamma\gamma \rightarrow \eta_c(2S)$ |

NODE=M059R01  
NODE=M059R01

$\Gamma(\rho^0\rho^0)/\Gamma_{\text{total}}$   $\Gamma_5/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN     | COMMENT                                     |
|----------|-------------|----------|---------------------------------------------|
| not seen | ABLIKIM     | 11H BES3 | $\psi(2S) \rightarrow \gamma 2\pi^+ 2\pi^-$ |

NODE=M059R15  
NODE=M059R15

 $\Gamma(K^+K^-\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_7/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN    | COMMENT                               |
|----------|-------------|---------|---------------------------------------|
| not seen | UEHARA      | 08 BELL | $\gamma\gamma \rightarrow \eta_c(2S)$ |

NODE=M059R02  
NODE=M059R02

 $\Gamma(K^+K^-\pi^+\pi^-\pi^0)/\Gamma(K\bar{K}\pi)$   $\Gamma_9/\Gamma_2$ 

| VALUE                    | EVTS | DOCUMENT ID                   | TECN | COMMENT                                          |
|--------------------------|------|-------------------------------|------|--------------------------------------------------|
| $0.73 \pm 0.17 \pm 0.17$ | 1201 | <sup>32</sup> DEL-AMO-SA..11M | BABR | $\gamma\gamma \rightarrow K^+K^-\pi^+\pi^-\pi^0$ |

NODE=M059R21  
NODE=M059R21

<sup>32</sup>We have multiplied the value of  $\Gamma(K^+K^-\pi^+\pi^-\pi^0)/\Gamma(K_S^0 K^\pm \pi^\mp)$  reported in DEL-AMO-SANCHEZ 11M by a factor 1/3 to obtain  $\Gamma(K^+K^-\pi^+\pi^-\pi^0)/\Gamma(K\bar{K}\pi)$ . Not independent from other measurements reported in DEL-AMO-SANCHEZ 11M.

NODE=M059R21;LINKAGE=DE

 $\Gamma(K^{*0}\bar{K}^{*0})/\Gamma_{\text{total}}$   $\Gamma_8/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN     | COMMENT                                        |
|----------|-------------|----------|------------------------------------------------|
| not seen | ABLIKIM     | 11H BES3 | $\psi(2S) \rightarrow \gamma K^+K^-\pi^+\pi^-$ |

NODE=M059R16  
NODE=M059R16

 $\Gamma(K_S^0 K^- 2\pi^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{11}/\Gamma$ 

| VALUE | EVTS        | DOCUMENT ID | TECN     | COMMENT                                                       |
|-------|-------------|-------------|----------|---------------------------------------------------------------|
| seen  | $57 \pm 17$ | ABLIKIM     | 13K BES3 | $\psi(2S) \rightarrow \gamma K_S^0 K^\pm \pi^\mp \pi^+ \pi^-$ |

NODE=M059R22  
NODE=M059R22

 $\Gamma(2K^+2K^-)/\Gamma_{\text{total}}$   $\Gamma_{12}/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN    | COMMENT                               |
|----------|-------------|---------|---------------------------------------|
| not seen | UEHARA      | 08 BELL | $\gamma\gamma \rightarrow \eta_c(2S)$ |

NODE=M059R03  
NODE=M059R03

 $\Gamma(\phi\phi)/\Gamma_{\text{total}}$   $\Gamma_{13}/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN     | COMMENT                                    |
|----------|-------------|----------|--------------------------------------------|
| not seen | ABLIKIM     | 11H BES3 | $\psi(2S) \rightarrow \gamma K^+K^-K^+K^-$ |

NODE=M059R17  
NODE=M059R17

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$   $\Gamma_{14}/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID        | TECN      | COMMENT                                              |
|-------|------|--------------------|-----------|------------------------------------------------------|
| seen  | 106  | <sup>33</sup> AAIJ | 17AD LHCb | $p\bar{p} \rightarrow B^+X \rightarrow p\bar{p}K^+X$ |

NODE=M059R04  
NODE=M059R04  
OCCUR=2

<sup>33</sup>AAIJ 17AD report a 6.4 standard deviation signal, with  $B(B^+ \rightarrow \eta_c(2S)K^+ \rightarrow p\bar{p}K^+)/B(B^+ \rightarrow J/\psi K^+ \rightarrow p\bar{p}K^+) = (1.58 \pm 0.33 \pm 0.09) \times 10^{-2}$ .

NODE=M059R04;LINKAGE=A

 $\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{15}/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID            | TECN    | COMMENT                           |
|-------|------|------------------------|---------|-----------------------------------|
| seen  | 110  | <sup>34</sup> CHILIKIN | 19 BELL | $e^+e^- \rightarrow \Upsilon(4S)$ |

NODE=M059R30  
NODE=M059R30

<sup>34</sup>CHILIKIN 19 reports signals in  $B^+ \rightarrow \eta_c(2S)K^+$  and  $B^0 \rightarrow \eta_c(2S)K_S^0$  with 12.3 and 5.9 standard deviations, respectively.

NODE=M059R30;LINKAGE=A

 $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$   $\Gamma_{16}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------------------------------------------|-----|-------------|------|---------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |         |

NODE=M059R2  
NODE=M059R2

|                     |    |                     |         |                                        |
|---------------------|----|---------------------|---------|----------------------------------------|
| $<4 \times 10^{-4}$ | 90 | <sup>35</sup> WICHT | 08 BELL | $B^\pm \rightarrow K^\pm \gamma\gamma$ |
| not seen            |    | AMBROGIANI          | 01 E835 | $\bar{p}p \rightarrow \gamma\gamma$    |
| $<0.01$             | 90 | LEE                 | 85 CBAL | $\psi' \rightarrow \text{photons}$     |

<sup>35</sup>WICHT 08 reports  $[\Gamma(\eta_c(2S) \rightarrow \gamma\gamma)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \eta_c(2S)K^+)] < 0.18 \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \eta_c(2S)K^+) = 4.4 \times 10^{-4}$ .

NODE=M059R2;LINKAGE=WI

 $\Gamma(\pi^+\pi^-\eta_c(1S))/\Gamma(K\bar{K}\pi)$   $\Gamma_{20}/\Gamma_2$ 

| VALUE   | CL% | DOCUMENT ID        | TECN      | COMMENT                                     |
|---------|-----|--------------------|-----------|---------------------------------------------|
| $<3.33$ | 90  | <sup>36</sup> LEES | 12AE BABR | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\eta_c$ |

NODE=M059R23  
NODE=M059R23

<sup>36</sup>We divided the reported limit by 3 to take into account isospin relations.

NODE=M059R23;LINKAGE=LE

## $\eta_c(2S)$ CROSS-PARTICLE BRANCHING RATIOS

NODE=M059230

 $\Gamma(\eta_c(2S) \rightarrow K\bar{K}\eta)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$   $\Gamma_3/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma_{\psi(2S)}$ 

| VALUE                                                                         | CL% | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------------------------------------------|-----|-------------|------|---------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |         |

NODE=M059R25  
NODE=M059R25

|                        |    |                              |      |                                          |
|------------------------|----|------------------------------|------|------------------------------------------|
| $<11.8 \times 10^{-6}$ | 90 | <sup>37</sup> CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma K^+K^-\eta$ |
|------------------------|----|------------------------------|------|------------------------------------------|



<sup>37</sup> CRONIN-HENNESSY 10 reports a limit of  $< 5.9 \times 10^{-6}$  for the decay  $\eta_c(2S) \rightarrow K^+ K^- \eta$  which we multiply by 2 account for isospin symmetry. It assumes  $\Gamma(\eta_c(2S)) = 14$  MeV. It also gives the analytic dependence of limits on width.

NODE=M059R25;LINKAGE=CR

$$\frac{\Gamma(\eta_c(2S) \rightarrow 2\pi^+ 2\pi^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))}{\Gamma_{\text{total}}} \times \frac{\Gamma_4/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma\psi(2S)}$$

| VALUE                  | CL% | DOCUMENT ID                  | TECN | COMMENT                                     |
|------------------------|-----|------------------------------|------|---------------------------------------------|
| $<14.6 \times 10^{-6}$ | 90  | <sup>38</sup> CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma 2\pi^+ 2\pi^-$ |

NODE=M059R05  
NODE=M059R05

<sup>38</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R05;LINKAGE=CR

$$\frac{\Gamma(\eta_c(2S) \rightarrow \rho^0 \rho^0)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))}{\Gamma_{\text{total}}} \times \frac{\Gamma_5/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma\psi(2S)}$$

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                                     |
|------------------------|-----|-------------|----------|---------------------------------------------|
| $<12.7 \times 10^{-7}$ | 90  | ABLIKIM     | 11H BES3 | $\psi(2S) \rightarrow \gamma 2\pi^+ 2\pi^-$ |

NODE=M059R18  
NODE=M059R18

$$\frac{\Gamma(\eta_c(2S) \rightarrow 3\pi^+ 3\pi^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))}{\Gamma_{\text{total}}} \times \frac{\Gamma_6/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma\psi(2S)}$$

| VALUE                  | CL% | DOCUMENT ID                  | TECN | COMMENT                                     |
|------------------------|-----|------------------------------|------|---------------------------------------------|
| $<13.2 \times 10^{-6}$ | 90  | <sup>39</sup> CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma 3\pi^+ 3\pi^-$ |

NODE=M059R06  
NODE=M059R06

<sup>39</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R06;LINKAGE=CR

$$\frac{\Gamma(\eta_c(2S) \rightarrow K^+ K^- \pi^+ \pi^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))}{\Gamma_{\text{total}}} \times \frac{\Gamma_7/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma\psi(2S)}$$

| VALUE                 | CL% | DOCUMENT ID                  | TECN | COMMENT                                           |
|-----------------------|-----|------------------------------|------|---------------------------------------------------|
| $<9.6 \times 10^{-6}$ | 90  | <sup>40</sup> CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma K^+ K^- \pi^+ \pi^-$ |

NODE=M059R07  
NODE=M059R07

<sup>40</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R07;LINKAGE=CR

$$\frac{\Gamma(\eta_c(2S) \rightarrow K^{*0} \bar{K}^{*0})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))}{\Gamma_{\text{total}}} \times \frac{\Gamma_8/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma\psi(2S)}$$

| VALUE                  | CL% | DOCUMENT ID | TECN     | COMMENT                                           |
|------------------------|-----|-------------|----------|---------------------------------------------------|
| $<19.6 \times 10^{-7}$ | 90  | ABLIKIM     | 11H BES3 | $\psi(2S) \rightarrow \gamma K^+ K^- \pi^+ \pi^-$ |

NODE=M059R19  
NODE=M059R19

$$\frac{\Gamma(\eta_c(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))}{\Gamma_{\text{total}}} \times \frac{\Gamma_9/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma\psi(2S)}$$

| VALUE                  | CL% | DOCUMENT ID                  | TECN | COMMENT                                                 |
|------------------------|-----|------------------------------|------|---------------------------------------------------------|
| $<43.0 \times 10^{-6}$ | 90  | <sup>41</sup> CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma K^+ K^- \pi^+ \pi^- \pi^0$ |

NODE=M059R08  
NODE=M059R08

<sup>41</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R08;LINKAGE=CR

$$\frac{\Gamma(\eta_c(2S) \rightarrow K^+ K^- 2\pi^+ 2\pi^-)}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{10}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma\psi(2S)}$$

| VALUE                 | CL% | DOCUMENT ID                  | TECN | COMMENT                                             |
|-----------------------|-----|------------------------------|------|-----------------------------------------------------|
| $<9.7 \times 10^{-6}$ | 90  | <sup>42</sup> CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma K^+ K^- 2\pi^+ 2\pi^-$ |

NODE=M059R09  
NODE=M059R09

<sup>42</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R09;LINKAGE=CR

$$\frac{\Gamma(\eta_c(2S) \rightarrow K_S^0 K^- 2\pi^+ \pi^- + \text{c.c.})}{\Gamma_{\text{total}}} \times \frac{\Gamma(\psi(2S) \rightarrow \gamma \eta_c(2S))}{\Gamma_{\text{total}}} \times \frac{\Gamma_{11}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma\psi(2S)}$$

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                            |
|--------------------------|-----|-------------|----------|--------------------------------------------------------------------|
| $7.03 \pm 2.10 \pm 0.7$  | 60  | ABLIKIM     | 13K BES3 | $\psi(2S) \rightarrow \gamma K_S^0 K^- 2\pi^+ \pi^- + \text{c.c.}$ |

NODE=M059R10  
NODE=M059R10

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |    |                              |      |                                                                    |
|----------|----|------------------------------|------|--------------------------------------------------------------------|
| $< 15.2$ | 90 | <sup>43</sup> CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma K_S^0 K^- 2\pi^+ \pi^- + \text{c.c.}$ |
|----------|----|------------------------------|------|--------------------------------------------------------------------|

<sup>43</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R10;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow \phi\phi)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{13}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma_{\psi(2S)}$$

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                                       |
|-----------------------|-----|-------------|----------|-----------------------------------------------|
| $<7.8 \times 10^{-7}$ | 90  | ABLIKIM     | 11H BES3 | $\psi(2S) \rightarrow \gamma K^+ K^- K^+ K^-$ |

NODE=M059R20  
NODE=M059R20

$$\Gamma(\eta_c(2S) \rightarrow p\bar{p})/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{14}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma_{\psi(2S)}$$

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                                |
|-----------------------|-----|-------------|----------|----------------------------------------|
| $<1.4 \times 10^{-6}$ | 90  | ABLIKIM     | 13V BES3 | $\psi(2S) \rightarrow \gamma p\bar{p}$ |

NODE=M059R24  
NODE=M059R24

$$\Gamma(\eta_c(2S) \rightarrow \gamma J/\psi(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{17}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma_{\psi(2S)}$$

| VALUE                 | CL% | EVTS | DOCUMENT ID | TECN     | COMMENT                                    |
|-----------------------|-----|------|-------------|----------|--------------------------------------------|
| $<9.7 \times 10^{-6}$ | 90  | 33   | 44 ABLIKIM  | 17N BES3 | $\psi(2S) \rightarrow \gamma\gamma J/\psi$ |

NODE=M059R27  
NODE=M059R27

<sup>44</sup> Uses  $B(J/\psi \rightarrow e^+e^-) = (5.971 \pm 0.032)\%$  and  $B(J/\psi \rightarrow \mu^+\mu^-) = (5.961 \pm 0.033)\%$ .

NODE=M059R27;LINKAGE=A

$$\Gamma(\eta_c(2S) \rightarrow \pi^+\pi^-\eta)/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{18}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma_{\psi(2S)}$$

| VALUE                 | CL% | DOCUMENT ID                  | TECN | COMMENT                                     |
|-----------------------|-----|------------------------------|------|---------------------------------------------|
| $<4.3 \times 10^{-6}$ | 90  | <sup>45</sup> CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma\pi^+\pi^-\eta$ |

NODE=M059R11  
NODE=M059R11

<sup>45</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R11;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow \pi^+\pi^-\eta')/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{19}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma_{\psi(2S)}$$

| VALUE                  | CL% | DOCUMENT ID                  | TECN | COMMENT                                      |
|------------------------|-----|------------------------------|------|----------------------------------------------|
| $<14.2 \times 10^{-6}$ | 90  | <sup>46</sup> CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma\pi^+\pi^-\eta'$ |

NODE=M059R12  
NODE=M059R12

<sup>46</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M059R12;LINKAGE=CR

$$\Gamma(\eta_c(2S) \rightarrow \pi^+\pi^-\eta_c(1S))/\Gamma_{\text{total}} \times \Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}$$

$$\Gamma_{20}/\Gamma \times \Gamma_{155}^{\psi(2S)}/\Gamma_{\psi(2S)}$$

| VALUE                 | CL% | DOCUMENT ID                  | TECN | COMMENT                                           |
|-----------------------|-----|------------------------------|------|---------------------------------------------------|
| $<1.7 \times 10^{-4}$ | 90  | <sup>47</sup> CRONIN-HEN..10 | CLEO | $\psi(2S) \rightarrow \gamma\pi^+\pi^-\eta_c(1S)$ |

NODE=M059R14  
NODE=M059R14

<sup>47</sup> Assuming  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

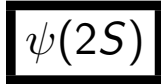
NODE=M059R14;LINKAGE=CR

## $\eta_c(2S)$ REFERENCES

|               |      |                |                                   |                     |
|---------------|------|----------------|-----------------------------------|---------------------|
| CHILIKIN      | 19   | PR D100 012001 | K. Chilikin <i>et al.</i>         | (BELLE Collab.)     |
| XU            | 18   | PR D98 072001  | Q.N. Xu <i>et al.</i>             | (BELLE Collab.)     |
| AAIJ          | 17AD | PL B769 305    | R. Aaij <i>et al.</i>             | (LHCb Collab.)      |
| AAIJ          | 17BB | EPJ C77 609    | R. Aaij <i>et al.</i>             | (LHCb Collab.)      |
| ABLIKIM       | 17N  | PR D95 072004  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    |
| PDG           | 16   | CP C40 100001  | C. Patrignani <i>et al.</i>       | (PDG Collab.)       |
| LEES          | 14E  | PR D89 112004  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     |
| ABLIKIM       | 13K  | PR D87 052005  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    |
| ABLIKIM       | 13V  | PR D88 112001  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    |
| ABLIKIM       | 12G  | PRL 109 042003 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    |
| LEES          | 12AE | PR D86 092005  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     |
| ABLIKIM       | 11H  | PR D84 091102  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    |
| DEL-AMO-SA... | 11M  | PR D84 012004  | P. del Amo Sanchez <i>et al.</i>  | (BABAR Collab.)     |
| VINOKUROVA    | 11   | PL B706 139    | A. Vinokurova <i>et al.</i>       | (BELLE Collab.)     |
| CRONIN-HEN... | 10   | PR D81 052002  | D. Cronin-Hennessey <i>et al.</i> | (CLEO Collab.)      |
| AUBERT        | 08AB | PR D78 012006  | B. Aubert <i>et al.</i>           | (BABAR Collab.)     |
| UEHARA        | 08   | EPJ C53 1      | S. Uehara <i>et al.</i>           | (BELLE Collab.)     |
| WICHT         | 08   | PL B662 323    | J. Wicht <i>et al.</i>            | (BELLE Collab.)     |
| ABE           | 07   | PRL 98 082001  | K. Abe <i>et al.</i>              | (BELLE Collab.)     |
| AUBERT        | 06E  | PRL 96 052002  | B. Aubert <i>et al.</i>           | (BABAR Collab.)     |
| AUBERT        | 05C  | PR D72 031101  | B. Aubert <i>et al.</i>           | (BABAR Collab.)     |
| ABE           | 04G  | PR D70 071102  | K. Abe <i>et al.</i>              | (BELLE Collab.)     |
| ASNER         | 04   | PRL 92 142001  | D.M. Asner <i>et al.</i>          | (CLEO Collab.)      |
| AUBERT        | 04D  | PRL 92 142002  | B. Aubert <i>et al.</i>           | (BABAR Collab.)     |
| ABE,K         | 02   | PRL 89 142001  | K. Abe <i>et al.</i>              | (BELLE Collab.)     |
| CHOI          | 02   | PRL 89 102001  | S.-K. Choi <i>et al.</i>          | (BELLE Collab.)     |
| AMBROGIANI    | 01   | PR D64 052003  | M. Ambrogiani <i>et al.</i>       | (FNAL E835 Collab.) |
| ABREU         | 98O  | PL B441 479    | P. Abreu <i>et al.</i>            | (DELPHI Collab.)    |
| ARMSTRONG     | 95F  | PR D52 4839    | T.A. Armstrong <i>et al.</i>      | (FNAL, FERR, GENO+) |
| LEE           | 85   | SLAC 282       | R.A. Lee                          | (SLAC)              |
| EDWARDS       | 82C  | PRL 48 70      | C. Edwards <i>et al.</i>          | (CIT, HARV, PRIN+)  |

NODE=M059

REFID=59899  
REFID=59453  
REFID=57896  
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REFID=57978  
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REFID=48340  
REFID=46553  
REFID=44623  
REFID=40589  
REFID=22173



$$I^G(J^{PC}) = 0^-(1^{--})$$

See the Review on " $\psi(2S)$  and  $\chi_c$  branching ratios" before the  $\chi_{c0}(1P)$  Listings.

### $\psi(2S)$ MASS

OUR FIT includes measurements of  $m_{\psi(2S)}$ ,  $m_{\psi(3770)}$ , and  $m_{\psi(3770)} - m_{\psi(2S)}$ .

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                         | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|------|-------------------------------------|------|---------------------------------------------|
| <b>3686.10 <math>\pm 0.06</math> OUR FIT</b>                                  |      | Error includes scale factor of 5.9. |      |                                             |
| <b>3686.097 <math>\pm 0.010</math> OUR AVERAGE</b>                            |      |                                     |      |                                             |
| 3686.099 $\pm 0.004 \pm 0.009$                                                |      | <sup>1</sup> ANASHIN 15             | KEDR | $e^+e^- \rightarrow \text{hadrons}$         |
| 3686.12 $\pm 0.06 \pm 0.10$                                                   | 4k   | AAIJ 12H                            | LHCB | $p\bar{p} \rightarrow J/\psi \pi^+ \pi^- X$ |
| 3685.95 $\pm 0.10$                                                            | 413  | <sup>2</sup> ARTAMONOV 00           | OLYA | $e^+e^- \rightarrow \text{hadrons}$         |
| 3685.98 $\pm 0.09 \pm 0.04$                                                   |      | <sup>3</sup> ARMSTRONG 93B          | E760 | $\bar{p}p \rightarrow e^+e^-$               |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                     |      |                                             |
| 3686.114 $\pm 0.007^{+0.011}_{-0.016}$                                        |      | <sup>4</sup> ANASHIN 12             | KEDR | $e^+e^- \rightarrow \text{hadrons}$         |
| 3686.111 $\pm 0.025 \pm 0.009$                                                |      | AULCHENKO 03                        | KEDR | $e^+e^- \rightarrow \text{hadrons}$         |
| 3686.00 $\pm 0.10$                                                            | 413  | <sup>5</sup> ZHOLENTZ 80            | OLYA | $e^+e^-$                                    |

<sup>1</sup>Supersedes AULCHENKO 03 and ANASHIN 12.

<sup>2</sup>Reanalysis of ZHOLENTZ 80 using new electron mass (COHEN 87) and radiative corrections (KURAEV 85).

<sup>3</sup>Mass central value and systematic error recalculated by us according to Eq.(16) in ARMSTRONG 93B, using the value for the  $J/\psi(1S)$  mass from AULCHENKO 03.

<sup>4</sup>From the scans in 2004 and 2006. ANASHIN 12 reports the value  $3686.114 \pm 0.007 \pm 0.011^{+0.002}_{-0.012}$  MeV, where the third uncertainty is due to assumptions on the interference between the resonance and hadronic continuum. We combined the two systematic uncertainties.

<sup>5</sup>Superseded by ARTAMONOV 00.

### $m_{\psi(2S)} - m_{J/\psi(1S)}$

| VALUE (MeV)                                                                   | DOCUMENT ID               | TECN | COMMENT                                                |
|-------------------------------------------------------------------------------|---------------------------|------|--------------------------------------------------------|
| <b>589.188 <math>\pm 0.028</math> OUR AVERAGE</b>                             |                           |      |                                                        |
| 589.194 $\pm 0.027 \pm 0.011$                                                 | <sup>1</sup> AULCHENKO 03 | KEDR | $e^+e^- \rightarrow \text{hadrons}$                    |
| 589.7 $\pm 1.2$                                                               | LEMOIGNE 82               | GOLI | $185 \pi^- \text{Be} \rightarrow \gamma \mu^+ \mu^- A$ |
| 589.07 $\pm 0.13$                                                             | <sup>1</sup> ZHOLENTZ 80  | OLYA | $e^+e^-$                                               |
| 588.7 $\pm 0.8$                                                               | LUTH 75                   | MRK1 |                                                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                           |      |                                                        |
| 588 $\pm 1$                                                                   | <sup>2</sup> BAI 98E      | BES  | $e^+e^-$                                               |

<sup>1</sup>Redundant with data in mass above.

<sup>2</sup>Systematic errors not evaluated.

### $\psi(2S)$ WIDTH

| VALUE (keV)                                | EVTS | DOCUMENT ID                | TECN | COMMENT                                 |
|--------------------------------------------|------|----------------------------|------|-----------------------------------------|
| <b>294 <math>\pm 8</math> OUR FIT</b>      |      |                            |      |                                         |
| <b>286 <math>\pm 16</math> OUR AVERAGE</b> |      |                            |      |                                         |
| 358 $\pm 88 \pm 4$                         |      | ABLIKIM 08B                | BES2 | $e^+e^- \rightarrow \text{hadrons}$     |
| 290 $\pm 25 \pm 4$                         | 2.7k | ANDREOTTI 07               | E835 | $p\bar{p} \rightarrow e^+e^-, J/\psi X$ |
| 331 $\pm 58 \pm 2$                         |      | ABLIKIM 06L                | BES2 | $e^+e^- \rightarrow \text{hadrons}$     |
| 264 $\pm 27$                               |      | <sup>1</sup> BAI 02B       | BES2 | $e^+e^-$                                |
| 287 $\pm 37 \pm 16$                        |      | <sup>2</sup> ARMSTRONG 93B | E760 | $\bar{p}p \rightarrow e^+e^-$           |

<sup>1</sup>From a simultaneous fit to the hadronic and  $\mu^+\mu^-$  cross section, assuming  $\Gamma = \Gamma_h + \Gamma_e + \Gamma_\mu + \Gamma_\tau$  and lepton universality. Does not include vacuum polarization correction.

<sup>2</sup>The initial-state radiation correction reevaluated by ANDREOTTI 07 in its Ref. [4].

NODE=M071

NODE=M071

NODE=M071M

NODE=M071M

NODE=M071M

NODE=M071M;LINKAGE=A  
NODE=M071M;LINKAGE=AR

NODE=M071M;LINKAGE=NW

NODE=M071M;LINKAGE=AN

NODE=M071M;LINKAGE=RZ

NODE=M071DM

NODE=M071DM

NODE=M071DM;LINKAGE=R  
NODE=M071DM;LINKAGE=BD

NODE=M071W

NODE=M071W

NODE=M071W;LINKAGE=BC

NODE=M071W;LINKAGE=AN

$\psi(2S)$  DECAY MODES

NODE=M071220;NODE=M071

| Mode                                            | Fraction ( $\Gamma_i/\Gamma$ )       | Scale factor/<br>Confidence level |
|-------------------------------------------------|--------------------------------------|-----------------------------------|
| $\Gamma_1$ hadrons                              | (97.85 $\pm$ 0.13 ) %                |                                   |
| $\Gamma_2$ virtual $\gamma \rightarrow$ hadrons | ( 1.73 $\pm$ 0.14 ) %                | S=1.5                             |
| $\Gamma_3$ $g g g$                              | (10.6 $\pm$ 1.6 ) %                  |                                   |
| $\Gamma_4$ $\gamma g g$                         | ( 1.03 $\pm$ 0.29 ) %                |                                   |
| $\Gamma_5$ light hadrons                        | (15.4 $\pm$ 1.5 ) %                  |                                   |
| $\Gamma_6$ $e^+ e^-$                            | ( 7.93 $\pm$ 0.17 ) $\times 10^{-3}$ |                                   |
| $\Gamma_7$ $\mu^+ \mu^-$                        | ( 8.0 $\pm$ 0.6 ) $\times 10^{-3}$   |                                   |
| $\Gamma_8$ $\tau^+ \tau^-$                      | ( 3.1 $\pm$ 0.4 ) $\times 10^{-3}$   |                                   |

DESIG=3  
DESIG=4  
DESIG=255  
DESIG=256  
DESIG=226  
DESIG=1  
DESIG=2  
DESIG=68

Decays into  $J/\psi(1S)$  and anything

|                                        |                                        |
|----------------------------------------|----------------------------------------|
| $\Gamma_9$ $J/\psi(1S)$ anything       | (61.4 $\pm$ 0.6 ) %                    |
| $\Gamma_{10}$ $J/\psi(1S)$ neutrals    | (25.38 $\pm$ 0.32 ) %                  |
| $\Gamma_{11}$ $J/\psi(1S) \pi^+ \pi^-$ | (34.68 $\pm$ 0.30 ) %                  |
| $\Gamma_{12}$ $J/\psi(1S) \pi^0 \pi^0$ | (18.24 $\pm$ 0.31 ) %                  |
| $\Gamma_{13}$ $J/\psi(1S) \eta$        | ( 3.37 $\pm$ 0.05 ) %                  |
| $\Gamma_{14}$ $J/\psi(1S) \pi^0$       | ( 1.268 $\pm$ 0.032 ) $\times 10^{-3}$ |

NODE=M071;CLUMP=A  
DESIG=11  
DESIG=12  
DESIG=13  
DESIG=14  
DESIG=15  
DESIG=18

## Hadronic decays

|                                                                               |                                              |        |
|-------------------------------------------------------------------------------|----------------------------------------------|--------|
| $\Gamma_{15}$ $\pi^0 h_c(1P)$                                                 | ( 8.6 $\pm$ 1.3 ) $\times 10^{-4}$           |        |
| $\Gamma_{16}$ $3(\pi^+ \pi^-) \pi^0$                                          | ( 3.5 $\pm$ 1.6 ) $\times 10^{-3}$           |        |
| $\Gamma_{17}$ $2(\pi^+ \pi^-) \pi^0$                                          | ( 2.9 $\pm$ 1.0 ) $\times 10^{-3}$           | S=4.7  |
| $\Gamma_{18}$ $\rho a_2(1320)$                                                | ( 2.6 $\pm$ 0.9 ) $\times 10^{-4}$           |        |
| $\Gamma_{19}$ $\pi^+ \pi^- \pi^0 \pi^0 \pi^0$                                 | ( 5.3 $\pm$ 0.9 ) $\times 10^{-3}$           |        |
| $\Gamma_{20}$ $\rho^\pm \pi^\mp \pi^0 \pi^0$                                  | < 2.7 $\times 10^{-3}$                       | CL=90% |
| $\Gamma_{21}$ $p \bar{p}$                                                     | ( 2.94 $\pm$ 0.08 ) $\times 10^{-4}$         |        |
| $\Gamma_{22}$ $n \bar{n}$                                                     | ( 3.06 $\pm$ 0.15 ) $\times 10^{-4}$         |        |
| $\Gamma_{23}$ $\Delta^{++} \bar{\Delta}^{--}$                                 | ( 1.28 $\pm$ 0.35 ) $\times 10^{-4}$         |        |
| $\Gamma_{24}$ $\Lambda \bar{\Lambda} \pi^0$                                   | < 2.9 $\times 10^{-6}$                       | CL=90% |
| $\Gamma_{25}$ $\Lambda \bar{\Lambda} \eta$                                    | ( 2.5 $\pm$ 0.4 ) $\times 10^{-5}$           |        |
| $\Gamma_{26}$ $\Lambda \bar{p} K^+$                                           | ( 1.00 $\pm$ 0.14 ) $\times 10^{-4}$         |        |
| $\Gamma_{27}$ $K^*(892)^+ \bar{p} \Lambda + \text{c.c.}$                      | ( 6.3 $\pm$ 0.7 ) $\times 10^{-5}$           |        |
| $\Gamma_{28}$ $\Lambda \bar{p} K^+ \pi^+ \pi^-$                               | ( 1.8 $\pm$ 0.4 ) $\times 10^{-4}$           |        |
| $\Gamma_{29}$ $\Lambda \bar{\Lambda} \pi^+ \pi^-$                             | ( 2.8 $\pm$ 0.6 ) $\times 10^{-4}$           |        |
| $\Gamma_{30}$ $\Lambda \bar{\Lambda}$                                         | ( 3.81 $\pm$ 0.13 ) $\times 10^{-4}$         | S=1.4  |
| $\Gamma_{31}$ $\Lambda \bar{\Sigma}^+ \pi^- + \text{c.c.}$                    | ( 1.40 $\pm$ 0.13 ) $\times 10^{-4}$         |        |
| $\Gamma_{32}$ $\Lambda \bar{\Sigma}^- \pi^+ + \text{c.c.}$                    | ( 1.54 $\pm$ 0.14 ) $\times 10^{-4}$         |        |
| $\Gamma_{33}$ $\Lambda \bar{\Sigma}^0$                                        | ( 1.23 $\pm$ 0.24 ) $\times 10^{-5}$         |        |
| $\Gamma_{34}$ $\Sigma^0 \bar{p} K^+ + \text{c.c.}$                            | ( 1.67 $\pm$ 0.18 ) $\times 10^{-5}$         |        |
| $\Gamma_{35}$ $\Sigma^+ \bar{\Sigma}^-$                                       | ( 2.32 $\pm$ 0.12 ) $\times 10^{-4}$         |        |
| $\Gamma_{36}$ $\Sigma^0 \bar{\Sigma}^0$                                       | ( 2.35 $\pm$ 0.09 ) $\times 10^{-4}$         | S=1.1  |
| $\Gamma_{37}$ $\Sigma(1385)^+ \bar{\Sigma}(1385)^-$                           | ( 8.5 $\pm$ 0.7 ) $\times 10^{-5}$           |        |
| $\Gamma_{38}$ $\Sigma(1385)^- \bar{\Sigma}(1385)^+$                           | ( 8.5 $\pm$ 0.8 ) $\times 10^{-5}$           |        |
| $\Gamma_{39}$ $\Sigma(1385)^0 \bar{\Sigma}(1385)^0$                           | ( 6.9 $\pm$ 0.7 ) $\times 10^{-5}$           |        |
| $\Gamma_{40}$ $\Xi^- \Xi^+$                                                   | ( 2.87 $\pm$ 0.11 ) $\times 10^{-4}$         | S=1.1  |
| $\Gamma_{41}$ $\Xi^0 \Xi^0$                                                   | ( 2.3 $\pm$ 0.4 ) $\times 10^{-4}$           | S=4.2  |
| $\Gamma_{42}$ $\Xi(1530)^0 \Xi(1530)^0$                                       | ( 5.2 $\pm$ 3.2 $\pm$ 1.2 ) $\times 10^{-5}$ |        |
| $\Gamma_{43}$ $K^- \Lambda \Xi^+ + \text{c.c.}$                               | ( 3.9 $\pm$ 0.4 ) $\times 10^{-5}$           |        |
| $\Gamma_{44}$ $\Xi(1530)^- \Xi(1530)^+$                                       | ( 1.15 $\pm$ 0.07 ) $\times 10^{-4}$         |        |
| $\Gamma_{45}$ $\Xi(1530)^- \Xi^+$                                             | ( 7.0 $\pm$ 1.2 ) $\times 10^{-6}$           |        |
| $\Gamma_{46}$ $\Xi(1690)^- \Xi^+ \rightarrow K^- \Lambda \Xi^+ + \text{c.c.}$ | ( 5.2 $\pm$ 1.6 ) $\times 10^{-6}$           |        |
| $\Gamma_{47}$ $\Xi(1820)^- \Xi^+ \rightarrow K^- \Lambda \Xi^+ + \text{c.c.}$ | ( 1.20 $\pm$ 0.32 ) $\times 10^{-5}$         |        |
| $\Gamma_{48}$ $K^- \Sigma^0 \Xi^+ + \text{c.c.}$                              | ( 3.7 $\pm$ 0.4 ) $\times 10^{-5}$           |        |
| $\Gamma_{49}$ $\Omega^- \bar{\Omega}^+$                                       | ( 5.66 $\pm$ 0.30 ) $\times 10^{-5}$         | S=1.3  |
| $\Gamma_{50}$ $\pi^0 p \bar{p}$                                               | ( 1.53 $\pm$ 0.07 ) $\times 10^{-4}$         |        |
| $\Gamma_{51}$ $N(940) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$      | ( 6.4 $\pm$ 1.8 $\pm$ 1.3 ) $\times 10^{-5}$ |        |

NODE=M071;CLUMP=B  
DESIG=254  
DESIG=37  
DESIG=25  
DESIG=65  
DESIG=312  
DESIG=315  
DESIG=27  
DESIG=309  
DESIG=70  
DESIG=238  
DESIG=239  
DESIG=214  
DESIG=321  
DESIG=215  
DESIG=213  
DESIG=28  
DESIG=280  
DESIG=281  
DESIG=307  
DESIG=274  
DESIG=223  
DESIG=71  
DESIG=72  
DESIG=297  
DESIG=299  
DESIG=29  
DESIG=224  
DESIG=73  
DESIG=293  
DESIG=322  
DESIG=323  
DESIG=294  
DESIG=295  
DESIG=296  
DESIG=74  
DESIG=35  
DESIG=267

|                  |                                                                   |                                         |        |           |
|------------------|-------------------------------------------------------------------|-----------------------------------------|--------|-----------|
| Г <sub>52</sub>  | $N(1440)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$        | $(7.3^{+1.7}_{-1.5}) \times 10^{-5}$    | S=2.5  | DESIG=261 |
| Г <sub>53</sub>  | $N(1520)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$        | $(6.4^{+2.3}_{-1.8}) \times 10^{-6}$    |        | DESIG=268 |
| Г <sub>54</sub>  | $N(1535)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$        | $(2.5 \pm 1.0) \times 10^{-5}$          |        | DESIG=269 |
| Г <sub>55</sub>  | $N(1650)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$        | $(3.8^{+1.4}_{-1.7}) \times 10^{-5}$    |        | DESIG=270 |
| Г <sub>56</sub>  | $N(1720)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$        | $(1.79^{+0.26}_{-0.70}) \times 10^{-5}$ |        | DESIG=271 |
| Г <sub>57</sub>  | $N(2300)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$        | $(2.6^{+1.2}_{-0.7}) \times 10^{-5}$    |        | DESIG=272 |
| Г <sub>58</sub>  | $N(2570)\bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p}$        | $(2.13^{+0.40}_{-0.31}) \times 10^{-5}$ |        | DESIG=273 |
| Г <sub>59</sub>  | $\eta p \bar{p}$                                                  | $(6.0 \pm 0.4) \times 10^{-5}$          |        | DESIG=200 |
| Г <sub>60</sub>  | $N(1535)\bar{p} + \text{c.c.} \rightarrow \eta p \bar{p}$         | $(4.4 \pm 0.7) \times 10^{-5}$          |        | DESIG=264 |
| Г <sub>61</sub>  | $\omega p \bar{p}$                                                | $(6.9 \pm 2.1) \times 10^{-5}$          |        | DESIG=77  |
| Г <sub>62</sub>  | $\eta' p \bar{p}$                                                 | $(1.10 \pm 0.13) \times 10^{-5}$        |        | DESIG=317 |
| Г <sub>63</sub>  | $\phi p \bar{p}$                                                  | $(6.1 \pm 0.6) \times 10^{-6}$          |        | DESIG=80  |
| Г <sub>64</sub>  | $\phi X(1835) \rightarrow \phi p \bar{p}$                         | $< 1.82 \times 10^{-7}$                 | CL=90% | DESIG=318 |
| Г <sub>65</sub>  | $\pi^+ \pi^- p \bar{p}$                                           | $(6.0 \pm 0.4) \times 10^{-4}$          |        | DESIG=31  |
| Г <sub>66</sub>  | $p \bar{n} \pi^- \text{ or c.c.}$                                 | $(2.48 \pm 0.17) \times 10^{-4}$        |        | DESIG=227 |
| Г <sub>67</sub>  | $p \bar{n} \pi^- \pi^0$                                           | $(3.2 \pm 0.7) \times 10^{-4}$          |        | DESIG=228 |
| Г <sub>68</sub>  | $2(\pi^+ \pi^- \pi^0)$                                            | $(4.8 \pm 1.5) \times 10^{-3}$          |        | DESIG=221 |
| Г <sub>69</sub>  | $\eta \pi^+ \pi^-$                                                | $< 1.6 \times 10^{-4}$                  | CL=90% | DESIG=202 |
| Г <sub>70</sub>  | $\eta \pi^+ \pi^- \pi^0$                                          | $(9.5 \pm 1.7) \times 10^{-4}$          |        | DESIG=203 |
| Г <sub>71</sub>  | $2(\pi^+ \pi^-) \eta$                                             | $(1.2 \pm 0.6) \times 10^{-3}$          |        | DESIG=251 |
| Г <sub>72</sub>  | $\pi^+ \pi^- \pi^0 \pi^0 \eta$                                    | $< 4 \times 10^{-4}$                    | CL=90% | DESIG=313 |
| Г <sub>73</sub>  | $\eta' \pi^+ \pi^- \pi^0$                                         | $(4.5 \pm 2.1) \times 10^{-4}$          |        | DESIG=204 |
| Г <sub>74</sub>  | $\omega \pi^+ \pi^-$                                              | $(7.3 \pm 1.2) \times 10^{-4}$          | S=2.1  | DESIG=75  |
| Г <sub>75</sub>  | $b_1^\pm \pi^\mp$                                                 | $(4.0 \pm 0.6) \times 10^{-4}$          | S=1.1  | DESIG=40  |
| Г <sub>76</sub>  | $b_1^0 \pi^0$                                                     | $(2.4 \pm 0.6) \times 10^{-4}$          |        | DESIG=193 |
| Г <sub>77</sub>  | $\omega f_2(1270)$                                                | $(2.2 \pm 0.4) \times 10^{-4}$          |        | DESIG=64  |
| Г <sub>78</sub>  | $\omega \pi^0 \pi^0$                                              | $(1.11 \pm 0.35) \times 10^{-3}$        |        | DESIG=314 |
| Г <sub>79</sub>  | $\pi^0 \pi^0 K^+ K^-$                                             | $(2.6 \pm 1.3) \times 10^{-4}$          |        | DESIG=298 |
| Г <sub>80</sub>  | $\pi^+ \pi^- K^+ K^-$                                             | $(7.3 \pm 0.5) \times 10^{-4}$          |        | DESIG=26  |
| Г <sub>81</sub>  | $\pi^0 \pi^0 K_S^0 K_L^0$                                         | $(1.3 \pm 0.6) \times 10^{-3}$          |        | DESIG=304 |
| Г <sub>82</sub>  | $\rho^0 K^+ K^-$                                                  | $(2.2 \pm 0.4) \times 10^{-4}$          |        | DESIG=205 |
| Г <sub>83</sub>  | $K^*(892)^0 \bar{K}_2^*(1430)^0$                                  | $(1.9 \pm 0.5) \times 10^{-4}$          |        | DESIG=66  |
| Г <sub>84</sub>  | $K^+ K^- \pi^+ \pi^- \eta$                                        | $(1.3 \pm 0.7) \times 10^{-3}$          |        | DESIG=252 |
| Г <sub>85</sub>  | $K^+ K^- 2(\pi^+ \pi^-) \pi^0$                                    | $(1.00 \pm 0.31) \times 10^{-3}$        |        | DESIG=240 |
| Г <sub>86</sub>  | $K^+ K^- 2(\pi^+ \pi^-)$                                          | $(1.9 \pm 0.9) \times 10^{-3}$          |        | DESIG=222 |
| Г <sub>87</sub>  | $K_1(1270)^\pm K^\mp$                                             | $(1.00 \pm 0.28) \times 10^{-3}$        |        | DESIG=41  |
| Г <sub>88</sub>  | $K_S^0 K_S^0 \pi^+ \pi^-$                                         | $(2.2 \pm 0.4) \times 10^{-4}$          |        | DESIG=225 |
| Г <sub>89</sub>  | $\rho^0 p \bar{p}$                                                | $(5.0 \pm 2.2) \times 10^{-5}$          |        | DESIG=210 |
| Г <sub>90</sub>  | $K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.}$                        | $(6.7 \pm 2.5) \times 10^{-4}$          |        | DESIG=34  |
| Г <sub>91</sub>  | $2(\pi^+ \pi^-)$                                                  | $(2.4 \pm 0.6) \times 10^{-4}$          | S=2.2  | DESIG=24  |
| Г <sub>92</sub>  | $\rho^0 \pi^+ \pi^-$                                              | $(2.2 \pm 0.6) \times 10^{-4}$          | S=1.4  | DESIG=33  |
| Г <sub>93</sub>  | $K^+ K^- \pi^+ \pi^- \pi^0$                                       | $(1.26 \pm 0.09) \times 10^{-3}$        |        | DESIG=206 |
| Г <sub>94</sub>  | $\omega f_0(1710) \rightarrow \omega K^+ K^-$                     | $(5.9 \pm 2.2) \times 10^{-5}$          |        | DESIG=216 |
| Г <sub>95</sub>  | $K^*(892)^0 K^- \pi^+ \pi^0 + \text{c.c.}$                        | $(8.6 \pm 2.2) \times 10^{-4}$          |        | DESIG=217 |
| Г <sub>96</sub>  | $K^*(892)^+ K^- \pi^+ \pi^- + \text{c.c.}$                        | $(9.6 \pm 2.8) \times 10^{-4}$          |        | DESIG=218 |
| Г <sub>97</sub>  | $K^*(892)^+ K^- \rho^0 + \text{c.c.}$                             | $(7.3 \pm 2.6) \times 10^{-4}$          |        | DESIG=219 |
| Г <sub>98</sub>  | $K^*(892)^0 K^- \rho^+ + \text{c.c.}$                             | $(6.1 \pm 1.8) \times 10^{-4}$          |        | DESIG=220 |
| Г <sub>99</sub>  | $\eta K^+ K^-$ , no $\eta \phi$                                   | $(3.49 \pm 0.17) \times 10^{-5}$        |        | DESIG=207 |
| Г <sub>100</sub> | $\omega K^+ K^-$                                                  | $(1.62 \pm 0.11) \times 10^{-4}$        | S=1.1  | DESIG=76  |
| Г <sub>101</sub> | $\omega K^*(892)^+ K^- + \text{c.c.}$                             | $(2.07 \pm 0.26) \times 10^{-4}$        |        | DESIG=276 |
| Г <sub>102</sub> | $\omega K_2^*(1430)^+ K^- + \text{c.c.}$                          | $(6.1 \pm 1.2) \times 10^{-5}$          |        | DESIG=277 |
| Г <sub>103</sub> | $\omega \bar{K}^*(892)^0 K^0$                                     | $(1.68 \pm 0.30) \times 10^{-4}$        |        | DESIG=278 |
| Г <sub>104</sub> | $\omega \bar{K}_2^*(1430)^0 K^0$                                  | $(5.8 \pm 2.2) \times 10^{-5}$          |        | DESIG=279 |
| Г <sub>105</sub> | $\omega X(1440) \rightarrow \omega K_S^0 K^- \pi^+ + \text{c.c.}$ | $(1.6 \pm 0.4) \times 10^{-5}$          |        | DESIG=282 |
| Г <sub>106</sub> | $\omega X(1440) \rightarrow \omega K^+ K^- \pi^0$                 | $(1.09 \pm 0.26) \times 10^{-5}$        |        | DESIG=283 |

|                  |                                                                                           |                                       |        |           |
|------------------|-------------------------------------------------------------------------------------------|---------------------------------------|--------|-----------|
| Г <sub>107</sub> | $\omega f_1(1285) \rightarrow \omega K_S^0 K^- \pi^+ +$<br>c.c.                           | $(3.0 \pm 1.0) \times 10^{-6}$        |        | DESIG=284 |
| Г <sub>108</sub> | $\omega f_1(1285) \rightarrow \omega K^+ K^- \pi^0$                                       | $(1.2 \pm 0.7) \times 10^{-6}$        |        | DESIG=285 |
| Г <sub>109</sub> | $3(\pi^+ \pi^-)$                                                                          | $(3.5 \pm 2.0) \times 10^{-4}$        | S=2.8  | DESIG=32  |
| Г <sub>110</sub> | $p\bar{p} \pi^+ \pi^- \pi^0$                                                              | $(7.3 \pm 0.7) \times 10^{-4}$        |        | DESIG=211 |
| Г <sub>111</sub> | $K^+ K^-$                                                                                 | $(7.5 \pm 0.5) \times 10^{-5}$        |        | DESIG=23  |
| Г <sub>112</sub> | $K_S^0 K_L^0$                                                                             | $(5.34 \pm 0.33) \times 10^{-5}$      |        | DESIG=85  |
| Г <sub>113</sub> | $\pi^+ \pi^- \pi^0$                                                                       | $(2.01 \pm 0.17) \times 10^{-4}$      | S=1.7  | DESIG=36  |
| Г <sub>114</sub> | $\rho(2150) \pi \rightarrow \pi^+ \pi^- \pi^0$                                            | $(1.9 \pm 1.2_{-0.4}) \times 10^{-4}$ |        | DESIG=201 |
| Г <sub>115</sub> | $\rho(770) \pi \rightarrow \pi^+ \pi^- \pi^0$                                             | $(3.2 \pm 1.2) \times 10^{-5}$        | S=1.8  | DESIG=22  |
| Г <sub>116</sub> | $\pi^+ \pi^-$                                                                             | $(7.8 \pm 2.6) \times 10^{-6}$        |        | DESIG=21  |
| Г <sub>117</sub> | $K_1(1400)^\pm K^\mp$                                                                     | $< 3.1 \times 10^{-4}$                | CL=90% | DESIG=42  |
| Г <sub>118</sub> | $K_2^*(1430)^\pm K^\mp$                                                                   | $(7.1 \pm 1.3_{-0.9}) \times 10^{-5}$ |        | DESIG=265 |
| Г <sub>119</sub> | $K^+ K^- \pi^0$                                                                           | $(4.07 \pm 0.31) \times 10^{-5}$      |        | DESIG=38  |
| Г <sub>120</sub> | $K_S^0 K_L^0 \pi^0$                                                                       | $< 3.0 \times 10^{-4}$                | CL=90% | DESIG=303 |
| Г <sub>121</sub> | $K_S^0 K_L^0 \eta$                                                                        | $(1.3 \pm 0.5) \times 10^{-3}$        |        | DESIG=305 |
| Г <sub>122</sub> | $K^+ K^*(892)^- + \text{c.c.}$                                                            | $(2.9 \pm 0.4) \times 10^{-5}$        | S=1.2  | DESIG=39  |
| Г <sub>123</sub> | $K^*(892)^0 \bar{K}^0 + \text{c.c.}$                                                      | $(1.09 \pm 0.20) \times 10^{-4}$      |        | DESIG=194 |
| Г <sub>124</sub> | $\phi \pi^+ \pi^-$                                                                        | $(1.18 \pm 0.26) \times 10^{-4}$      | S=1.5  | DESIG=78  |
| Г <sub>125</sub> | $\phi f_0(980) \rightarrow \pi^+ \pi^-$                                                   | $(7.5 \pm 3.3) \times 10^{-5}$        | S=1.6  | DESIG=81  |
| Г <sub>126</sub> | $2(K^+ K^-)$                                                                              | $(6.3 \pm 1.3) \times 10^{-5}$        |        | DESIG=208 |
| Г <sub>127</sub> | $\phi K^+ K^-$                                                                            | $(7.0 \pm 1.6) \times 10^{-5}$        |        | DESIG=79  |
| Г <sub>128</sub> | $2(K^+ K^-) \pi^0$                                                                        | $(1.10 \pm 0.28) \times 10^{-4}$      |        | DESIG=209 |
| Г <sub>129</sub> | $\phi \eta$                                                                               | $(3.10 \pm 0.31) \times 10^{-5}$      |        | DESIG=89  |
| Г <sub>130</sub> | $\eta \phi(2170), \phi(2170) \rightarrow$<br>$\phi f_0(980), f_0 \rightarrow \pi^+ \pi^-$ | $< 2.2 \times 10^{-6}$                | CL=90% | DESIG=316 |
| Г <sub>131</sub> | $\phi \eta'$                                                                              | $(1.54 \pm 0.20) \times 10^{-5}$      |        | DESIG=90  |
| Г <sub>132</sub> | $\phi f_1(1285)$                                                                          | $(3.0 \pm 1.3) \times 10^{-5}$        |        | DESIG=319 |
| Г <sub>133</sub> | $\phi \eta(1405) \rightarrow \phi \pi^+ \pi^- \eta$                                       | $(8.5 \pm 1.7) \times 10^{-6}$        |        | DESIG=320 |
| Г <sub>134</sub> | $\omega \eta'$                                                                            | $(3.2 \pm 2.5_{-2.1}) \times 10^{-5}$ |        | DESIG=91  |
| Г <sub>135</sub> | $\omega \pi^0$                                                                            | $(2.1 \pm 0.6) \times 10^{-5}$        |        | DESIG=92  |
| Г <sub>136</sub> | $\rho \eta'$                                                                              | $(1.9 \pm 1.7_{-1.2}) \times 10^{-5}$ |        | DESIG=93  |
| Г <sub>137</sub> | $\rho \eta$                                                                               | $(2.2 \pm 0.6) \times 10^{-5}$        | S=1.1  | DESIG=94  |
| Г <sub>138</sub> | $\omega \eta$                                                                             | $< 1.1 \times 10^{-5}$                | CL=90% | DESIG=95  |
| Г <sub>139</sub> | $\phi \pi^0$                                                                              | $< 4 \times 10^{-7}$                  | CL=90% | DESIG=96  |
| Г <sub>140</sub> | $\eta_c \pi^+ \pi^- \pi^0$                                                                | $< 1.0 \times 10^{-3}$                | CL=90% | DESIG=229 |
| Г <sub>141</sub> | $p\bar{p} K^+ K^-$                                                                        | $(2.7 \pm 0.7) \times 10^{-5}$        |        | DESIG=212 |
| Г <sub>142</sub> | $\bar{\Lambda} n K_S^0 + \text{c.c.}$                                                     | $(8.1 \pm 1.8) \times 10^{-5}$        |        | DESIG=237 |
| Г <sub>143</sub> | $\phi f_2'(1525)$                                                                         | $(4.4 \pm 1.6) \times 10^{-5}$        |        | DESIG=67  |
| Г <sub>144</sub> | $\Theta(1540) \bar{\Theta}(1540) \rightarrow$<br>$K_S^0 p K^- \bar{n} + \text{c.c.}$      | $< 8.8 \times 10^{-6}$                | CL=90% | DESIG=195 |
| Г <sub>145</sub> | $\Theta(1540) K^- \bar{n} \rightarrow K_S^0 p K^- \bar{n}$                                | $< 1.0 \times 10^{-5}$                | CL=90% | DESIG=196 |
| Г <sub>146</sub> | $\Theta(1540) K_S^0 \bar{p} \rightarrow K_S^0 \bar{p} K^+ n$                              | $< 7.0 \times 10^{-6}$                | CL=90% | DESIG=197 |
| Г <sub>147</sub> | $\bar{\Theta}(1540) K^+ n \rightarrow K_S^0 \bar{p} K^+ n$                                | $< 2.6 \times 10^{-5}$                | CL=90% | DESIG=198 |
| Г <sub>148</sub> | $\bar{\Theta}(1540) K_S^0 p \rightarrow K_S^0 p K^- \bar{n}$                              | $< 6.0 \times 10^{-6}$                | CL=90% | DESIG=199 |
| Г <sub>149</sub> | $K_S^0 K_S^0$                                                                             | $< 4.6 \times 10^{-6}$                |        | DESIG=86  |
| Г <sub>150</sub> | $\Lambda_c^+ \bar{p} e^+ e^- + \text{c.c.}$                                               | $< 1.7 \times 10^{-6}$                | CL=90% | DESIG=310 |

**Radiative decays**

NODE=M071;CLUMP=C

|                  |                                                                                       |                                                               |        |           |
|------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------|--------|-----------|
| Γ <sub>151</sub> | $\gamma\chi_{c0}(1P)$                                                                 | ( 9.79 ± 0.20 ) %                                             |        | DESIG=56  |
| Γ <sub>152</sub> | $\gamma\chi_{c1}(1P)$                                                                 | ( 9.75 ± 0.24 ) %                                             |        | DESIG=58  |
| Γ <sub>153</sub> | $\gamma\chi_{c2}(1P)$                                                                 | ( 9.52 ± 0.20 ) %                                             |        | DESIG=59  |
| Γ <sub>154</sub> | $\gamma\eta_c(1S)$                                                                    | ( 3.4 ± 0.5 ) × 10 <sup>-3</sup>                              | S=1.3  | DESIG=61  |
| Γ <sub>155</sub> | $\gamma\eta_c(2S)$                                                                    | ( 7 ± 5 ) × 10 <sup>-4</sup>                                  |        | DESIG=63  |
| Γ <sub>156</sub> | $\gamma\pi^0$                                                                         | ( 1.04 ± 0.22 ) × 10 <sup>-6</sup>                            | S=1.4  | DESIG=52  |
| Γ <sub>157</sub> | $\gamma\eta'(958)$                                                                    | ( 1.24 ± 0.04 ) × 10 <sup>-4</sup>                            |        | DESIG=54  |
| Γ <sub>158</sub> | $\gamma f_2(1270)$                                                                    | ( 2.73 <sup>+0.29</sup> <sub>-0.25</sub> ) × 10 <sup>-4</sup> | S=1.8  | DESIG=82  |
| Γ <sub>159</sub> | $\gamma f_0(1370) \rightarrow \gamma K \bar{K}$                                       | ( 3.1 ± 1.7 ) × 10 <sup>-5</sup>                              |        | DESIG=286 |
| Γ <sub>160</sub> | $\gamma f_0(1500)$                                                                    | ( 9.3 ± 1.9 ) × 10 <sup>-5</sup>                              |        | DESIG=287 |
| Γ <sub>161</sub> | $\gamma f'_2(1525)$                                                                   | ( 3.3 ± 0.8 ) × 10 <sup>-5</sup>                              |        | DESIG=288 |
| Γ <sub>162</sub> | $\gamma f_0(1710)$                                                                    |                                                               |        | DESIG=236 |
| Γ <sub>163</sub> | $\gamma f_0(1710) \rightarrow \gamma \pi \pi$                                         | ( 3.5 ± 0.6 ) × 10 <sup>-5</sup>                              |        | DESIG=83  |
| Γ <sub>164</sub> | $\gamma f_0(1710) \rightarrow \gamma K \bar{K}$                                       | ( 6.6 ± 0.7 ) × 10 <sup>-5</sup>                              |        | DESIG=84  |
| Γ <sub>165</sub> | $\gamma f_0(2100) \rightarrow \gamma \pi \pi$                                         | ( 4.8 ± 1.0 ) × 10 <sup>-6</sup>                              |        | DESIG=289 |
| Γ <sub>166</sub> | $\gamma f_0(2200) \rightarrow \gamma K \bar{K}$                                       | ( 3.2 ± 1.0 ) × 10 <sup>-6</sup>                              |        | DESIG=290 |
| Γ <sub>167</sub> | $\gamma f_J(2220) \rightarrow \gamma \pi \pi$                                         | < 5.8 × 10 <sup>-6</sup>                                      | CL=90% | DESIG=291 |
| Γ <sub>168</sub> | $\gamma f_J(2220) \rightarrow \gamma K \bar{K}$                                       | < 9.5 × 10 <sup>-6</sup>                                      | CL=90% | DESIG=292 |
| Γ <sub>169</sub> | $\gamma\gamma$                                                                        | < 1.5 × 10 <sup>-4</sup>                                      | CL=90% | DESIG=51  |
| Γ <sub>170</sub> | $\gamma\eta$                                                                          | ( 9.2 ± 1.8 ) × 10 <sup>-7</sup>                              |        | DESIG=53  |
| Γ <sub>171</sub> | $\gamma\eta\pi^+\pi^-$                                                                | ( 8.7 ± 2.1 ) × 10 <sup>-4</sup>                              |        | DESIG=230 |
| Γ <sub>172</sub> | $\gamma\eta(1405)$                                                                    |                                                               |        | DESIG=231 |
| Γ <sub>173</sub> | $\gamma\eta(1405) \rightarrow \gamma K \bar{K} \pi$                                   | < 9 × 10 <sup>-5</sup>                                        | CL=90% | DESIG=62  |
| Γ <sub>174</sub> | $\gamma\eta(1405) \rightarrow \eta\pi^+\pi^-$                                         | ( 3.6 ± 2.5 ) × 10 <sup>-5</sup>                              |        | DESIG=232 |
| Γ <sub>175</sub> | $\gamma\eta(1405) \rightarrow \gamma f_0(980)\pi^0 \rightarrow \gamma\pi^+\pi^-\pi^0$ | < 5.0 × 10 <sup>-7</sup>                                      | CL=90% | DESIG=308 |
| Γ <sub>176</sub> | $\gamma\eta(1475)$                                                                    |                                                               |        | DESIG=233 |
| Γ <sub>177</sub> | $\gamma\eta(1475) \rightarrow K \bar{K} \pi$                                          | < 1.4 × 10 <sup>-4</sup>                                      | CL=90% | DESIG=234 |
| Γ <sub>178</sub> | $\gamma\eta(1475) \rightarrow \eta\pi^+\pi^-$                                         | < 8.8 × 10 <sup>-5</sup>                                      | CL=90% | DESIG=235 |
| Γ <sub>179</sub> | $\gamma 2(\pi^+\pi^-)$                                                                | ( 4.0 ± 0.6 ) × 10 <sup>-4</sup>                              |        | DESIG=241 |
| Γ <sub>180</sub> | $\gamma K^{*0} K^+\pi^- + \text{c.c.}$                                                | ( 3.7 ± 0.9 ) × 10 <sup>-4</sup>                              |        | DESIG=242 |
| Γ <sub>181</sub> | $\gamma K^{*0} \bar{K}^{*0}$                                                          | ( 2.4 ± 0.7 ) × 10 <sup>-4</sup>                              |        | DESIG=243 |
| Γ <sub>182</sub> | $\gamma K_S^0 K^+\pi^- + \text{c.c.}$                                                 | ( 2.6 ± 0.5 ) × 10 <sup>-4</sup>                              |        | DESIG=244 |
| Γ <sub>183</sub> | $\gamma K^+ K^- \pi^+ \pi^-$                                                          | ( 1.9 ± 0.5 ) × 10 <sup>-4</sup>                              |        | DESIG=245 |
| Γ <sub>184</sub> | $\gamma p \bar{p}$                                                                    | ( 3.9 ± 0.5 ) × 10 <sup>-5</sup>                              | S=2.0  | DESIG=246 |
| Γ <sub>185</sub> | $\gamma f_2(1950) \rightarrow \gamma p \bar{p}$                                       | ( 1.20 ± 0.22 ) × 10 <sup>-5</sup>                            |        | DESIG=257 |
| Γ <sub>186</sub> | $\gamma f_2(2150) \rightarrow \gamma p \bar{p}$                                       | ( 7.2 ± 1.8 ) × 10 <sup>-6</sup>                              |        | DESIG=258 |
| Γ <sub>187</sub> | $\gamma X(1835) \rightarrow \gamma p \bar{p}$                                         | ( 4.6 <sup>+1.8</sup> <sub>-4.0</sub> ) × 10 <sup>-6</sup>    |        | DESIG=259 |
| Γ <sub>188</sub> | $\gamma X \rightarrow \gamma p \bar{p}$                                               | [a] < 2 × 10 <sup>-6</sup>                                    | CL=90% | DESIG=260 |
| Γ <sub>189</sub> | $\gamma\pi^+\pi^- p \bar{p}$                                                          | ( 2.8 ± 1.4 ) × 10 <sup>-5</sup>                              |        | DESIG=247 |
| Γ <sub>190</sub> | $\gamma 2(\pi^+\pi^-) K^+ K^-$                                                        | < 2.2 × 10 <sup>-4</sup>                                      | CL=90% | DESIG=248 |
| Γ <sub>191</sub> | $\gamma 3(\pi^+\pi^-)$                                                                | < 1.7 × 10 <sup>-4</sup>                                      | CL=90% | DESIG=249 |
| Γ <sub>192</sub> | $\gamma K^+ K^- K^+ K^-$                                                              | < 4 × 10 <sup>-5</sup>                                        | CL=90% | DESIG=250 |
| Γ <sub>193</sub> | $\gamma\gamma J/\psi$                                                                 | ( 3.1 <sup>+1.0</sup> <sub>-1.2</sub> ) × 10 <sup>-4</sup>    |        | DESIG=266 |
| Γ <sub>194</sub> | $e^+ e^- \eta'$                                                                       | ( 1.90 ± 0.26 ) × 10 <sup>-6</sup>                            |        | DESIG=311 |
| Γ <sub>195</sub> | $e^+ e^- \chi_{c0}(1P)$                                                               | ( 1.06 ± 0.24 ) × 10 <sup>-3</sup>                            |        | DESIG=300 |
| Γ <sub>196</sub> | $e^+ e^- \chi_{c1}(1P)$                                                               | ( 8.5 ± 0.6 ) × 10 <sup>-4</sup>                              |        | DESIG=301 |
| Γ <sub>197</sub> | $e^+ e^- \chi_{c2}(1P)$                                                               | ( 7.0 ± 0.8 ) × 10 <sup>-4</sup>                              |        | DESIG=302 |

**Weak decays**NODE=M071;CLUMP=E  
DESIG=306

|                  |                             |                          |        |
|------------------|-----------------------------|--------------------------|--------|
| Γ <sub>198</sub> | $D^0 e^+ e^- + \text{c.c.}$ | < 1.4 × 10 <sup>-7</sup> | CL=90% |
|------------------|-----------------------------|--------------------------|--------|

**Other decays**NODE=M071;CLUMP=D  
DESIG=275

|                  |           |         |        |
|------------------|-----------|---------|--------|
| Γ <sub>199</sub> | invisible | < 1.6 % | CL=90% |
|------------------|-----------|---------|--------|

[a] For a narrow resonance in the range  $2.2 < M(X) < 2.8$  GeV.

LINKAGE=NMR

## CONSTRAINED FIT INFORMATION

A multiparticle fit to  $\chi_{c1}(1P)$ ,  $\chi_{c0}(1P)$ ,  $\chi_{c2}(1P)$ , and  $\psi(2S)$  with 4 total widths, a partial width, 25 combinations of partial widths obtained from integrated cross section, and 84 branching ratios uses 248 measurements to determine 49 parameters. The overall fit has a  $\chi^2 = 378.1$  for 199 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ .

|           |       |       |       |          |          |          |          |           |           |           |
|-----------|-------|-------|-------|----------|----------|----------|----------|-----------|-----------|-----------|
| $x_7$     | 3     |       |       |          |          |          |          |           |           |           |
| $x_8$     | 1     | 0     |       |          |          |          |          |           |           |           |
| $x_{11}$  | 29    | 11    | 2     |          |          |          |          |           |           |           |
| $x_{12}$  | 28    | 6     | 1     | 48       |          |          |          |           |           |           |
| $x_{13}$  | 13    | 4     | 1     | 36       | 15       |          |          |           |           |           |
| $x_{21}$  | 0     | 0     | 0     | 4        | 3        | 2        |          |           |           |           |
| $x_{151}$ | 1     | 0     | 0     | 2        | 1        | 1        | 0        |           |           |           |
| $x_{152}$ | 1     | 0     | 0     | 2        | 1        | 1        | 0        | 0         |           |           |
| $x_{153}$ | 1     | 0     | 0     | 3        | 1        | 1        | 0        | 0         | 0         |           |
| $\Gamma$  | -81   | -4    | -1    | -38      | -34      | -16      | -7       | -1        | -1        | -1        |
|           | $x_6$ | $x_7$ | $x_8$ | $x_{11}$ | $x_{12}$ | $x_{13}$ | $x_{21}$ | $x_{151}$ | $x_{152}$ | $x_{153}$ |

### $\psi(2S)$ PARTIAL WIDTHS

NODE=M071225

#### $\Gamma(\text{hadrons})$

 $\Gamma_1$ 

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |      |     |               |
|--------------|------|-----|---------------|
| $258 \pm 26$ | BAI  | 02B | BES2 $e^+e^-$ |
| $224 \pm 56$ | LUTH | 75  | MRK1 $e^+e^-$ |

NODE=M071W3  
NODE=M071W3

#### $\Gamma(e^+e^-)$

 $\Gamma_6$ 

| VALUE (keV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**2.33  $\pm 0.04$  OUR FIT****2.29  $\pm 0.06$  OUR AVERAGE**

|                             |                      |     |      |                                                        |
|-----------------------------|----------------------|-----|------|--------------------------------------------------------|
| $2.23 \pm 0.10 \pm 0.02$    | <sup>1</sup> ABLIKIM | 15V | BES3 | $4.0\text{--}4.4 e^+e^- \rightarrow \pi^+\pi^- J/\psi$ |
| $2.338 \pm 0.037 \pm 0.096$ | ABLIKIM              | 08B | BES2 | $e^+e^- \rightarrow \text{hadrons}$                    |
| $2.330 \pm 0.036 \pm 0.110$ | ABLIKIM              | 06L | BES2 | $e^+e^- \rightarrow \text{hadrons}$                    |
| $2.44 \pm 0.21$             | <sup>2</sup> BAI     | 02B | BES2 | $e^+e^-$                                               |
| $2.14 \pm 0.21$             | ALEXANDER            | 89  | RVUE | See $\Upsilon$ mini-review                             |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                             |                      |     |      |          |
|-----------------------------|----------------------|-----|------|----------|
| $2.279 \pm 0.015 \pm 0.042$ | <sup>3</sup> ANASHIN | 18  | KEDR | $e^+e^-$ |
| $2.282 \pm 0.015 \pm 0.042$ | <sup>4</sup> ANASHIN | 18  | KEDR | $e^+e^-$ |
| $2.0 \pm 0.3$               | BRANDELIK            | 79C | DASP | $e^+e^-$ |
| $2.1 \pm 0.3$               | <sup>5</sup> LUTH    | 75  | MRK1 | $e^+e^-$ |

OCCUR=2

<sup>1</sup> ABLIKIM 15V reports  $2.213 \pm 0.018 \pm 0.099$  keV from a measurement of  $[\Gamma(\psi(2S) \rightarrow e^+e^-)] \times [B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-)]$  assuming  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (34.95 \pm 0.45) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (34.68 \pm 0.30) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071W1;LINKAGE=A

<sup>2</sup> From a simultaneous fit to  $e^+e^-$ ,  $\mu^+\mu^-$ , and hadronic channel, assuming  $\Gamma_e = \Gamma_\mu = \Gamma_\tau/0.38847$ .

NODE=M071W;LINKAGE=BB

<sup>3</sup> Combining  $\Gamma_{e^+e^-} \cdot B(\mu^+\mu^-)$  from ANASHIN 18 with  $\Gamma_{e^+e^-} \cdot B(\text{hadrons})$  from ANASHIN 12 and assuming lepton universality.

NODE=M071W1;LINKAGE=B

<sup>4</sup> From the sum of  $\Gamma_{e^+e^-} \cdot B(\text{hadrons})$  from ANASHIN 12,  $\Gamma_{e^+e^-} \cdot B(e^+e^-)$  and  $\Gamma_{e^+e^-} \cdot B(\mu^+\mu^-)$  from ANASHIN 18, and  $\Gamma_{e^+e^-} \cdot B(\tau^+\tau^-)$  from ANASHIN 07.

NODE=M071W1;LINKAGE=C

<sup>5</sup> From a simultaneous fit to  $e^+e^-$ ,  $\mu^+\mu^-$ , and hadronic channels assuming  $\Gamma(e^+e^-) = \Gamma(\mu^+\mu^-)$ .

NODE=M071W1;LINKAGE=F



$\Gamma(\gamma\gamma)$  $\Gamma_{169}$ 

| VALUE (eV) | CL% | DOCUMENT ID | TECN     | COMMENT  |
|------------|-----|-------------|----------|----------|
| <43        | 90  | BRANDELIK   | 79C DASP | $e^+e^-$ |

NODE=M071W51  
 NODE=M071W51

 $\psi(2S) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$ 

NODE=M071230

This combination of a partial width with the partial width into  $e^+e^-$  and with the total width is obtained from the integrated cross section into channel(i) in the  $e^+e^-$  annihilation. We list only data that have not been used to determine the partial width  $\Gamma(i)$  or the branching ratio  $\Gamma(i)/\text{total}$ .

NODE=M071230

 $\Gamma(\text{hadrons}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_1\Gamma_6/\Gamma$ 

| VALUE (keV)              | DOCUMENT ID          | TECN    | COMMENT                             |
|--------------------------|----------------------|---------|-------------------------------------|
| <b>2.233±0.015±0.042</b> | <sup>1</sup> ANASHIN | 12 KEDR | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M071G3  
 NODE=M071G3

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.2 ± 0.4 ABRAMS 75 MRK1  $e^+e^-$

<sup>1</sup> ANASHIN 12 reports the value  $2.233 \pm 0.015 \pm 0.037 \pm 0.020$  keV, where the third uncertainty is due to assumptions on the interference between the resonance and hadronic continuum. We combined the two systematic uncertainties.

NODE=M071G3;LINKAGE=AN

 $\Gamma(e^+e^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_6\Gamma_6/\Gamma$ 

| VALUE (eV)          | DOCUMENT ID          | TECN    | COMMENT  |
|---------------------|----------------------|---------|----------|
| <b>21.2±0.7±1.2</b> | <sup>1</sup> ANASHIN | 18 KEDR | $e^+e^-$ |

NODE=M071P14  
 NODE=M071P14

<sup>1</sup> From the average of nine scans of the  $\psi(2S)$ .

NODE=M071P14;LINKAGE=A

 $\Gamma(\mu^+\mu^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_7\Gamma_6/\Gamma$ 

| VALUE (eV)          | DOCUMENT ID          | TECN    | COMMENT                           |
|---------------------|----------------------|---------|-----------------------------------|
| <b>19.3±0.3±0.5</b> | <sup>1</sup> ANASHIN | 18 KEDR | $\psi(2S) \rightarrow \mu^+\mu^-$ |

NODE=M071P13  
 NODE=M071P13

<sup>1</sup> From the average of nine scans of the  $\psi(2S)$ .

NODE=M071P13;LINKAGE=A

 $\Gamma(\tau^+\tau^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_8\Gamma_6/\Gamma$ 

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

NODE=M071G9  
 NODE=M071G9

• • • We do not use the following data for averages, fits, limits, etc. • • •

9.0±2.6 79 <sup>1</sup> ANASHIN 07 KEDR  $e^+e^- \rightarrow \psi(2S) \rightarrow \tau^+\tau^-$

<sup>1</sup> Using  $\psi(2S)$  total width of  $337 \pm 13$  keV. Systematic errors not evaluated.

NODE=M071G9;LINKAGE=AN

 $\Gamma(J/\psi(1S)\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{11}\Gamma_6/\Gamma$ 

| VALUE (keV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

NODE=M071G1  
 NODE=M071G1

**0.808±0.013 OUR FIT****0.837±0.025 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

0.837±0.028±0.005 <sup>1</sup> LEES 12E BABR 10.6  $e^+e^- \rightarrow 2\pi^+2\pi^-\gamma$

0.852±0.010±0.026 19.5k ADAM 06 CLEO 3.773  $e^+e^- \rightarrow \gamma\psi(2S)$

0.68 ± 0.09 <sup>2</sup> BAI 98E BES  $e^+e^-$

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.88 ± 0.08 ± 0.03 256 <sup>3</sup> AUBERT 07AU BABR 10.6  $e^+e^- \rightarrow J/\psi\pi^+\pi^-\gamma$

0.755±0.048±0.004 544 <sup>4</sup> AUBERT 05D BABR 10.6  $e^+e^- \rightarrow \pi^+\pi^-\mu^+\mu^-\gamma$

<sup>1</sup> LEES 12E reports  $[\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \mu^+\mu^-)] = (49.9 \pm 1.3 \pm 1.0) \times 10^{-3}$  keV which we divide by our best value  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = (5.961 \pm 0.033) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G1;LINKAGE=LE

<sup>2</sup> The value of  $\Gamma(e^+e^-)$  quoted in BAI 98E is derived using  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (32.4 \pm 2.6) \times 10^{-2}$  and  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = 0.1203 \pm 0.0038$ . Recalculated by us using  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = 0.1181 \pm 0.0020$ .

NODE=M071G1;LINKAGE=A

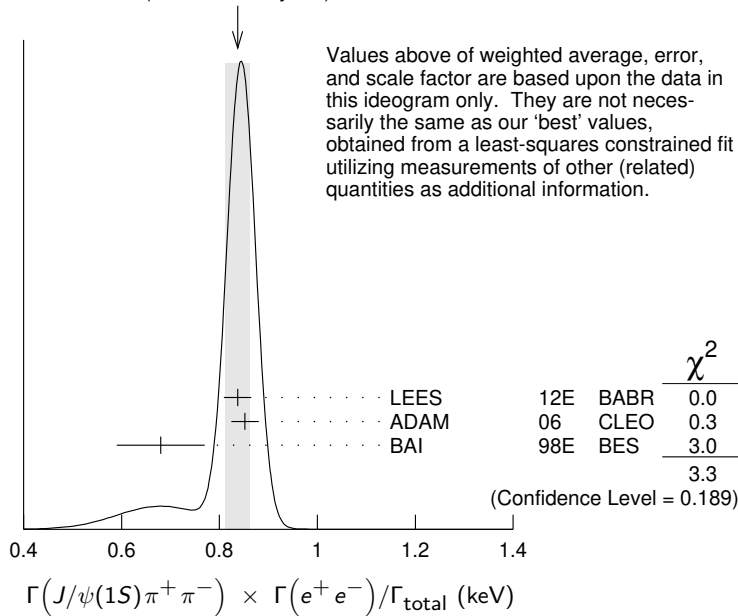
<sup>3</sup> AUBERT 07AU reports  $[\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \pi^+\pi^-\pi^0)] = 0.0186 \pm 0.0012 \pm 0.0011$  keV which we divide by our best value  $B(J/\psi(1S) \rightarrow \pi^+\pi^-\pi^0) = (2.10 \pm 0.08) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G1;LINKAGE=UB

<sup>4</sup> AUBERT 05D reports  $[\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \mu^+\mu^-)] = 0.0450 \pm 0.0018 \pm 0.0022$  keV which we divide by our best value  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = (5.961 \pm 0.033) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. Superseded by LEES 12E.

NODE=M071G1;LINKAGE=AU

WEIGHTED AVERAGE  
0.837±0.025 (Error scaled by 1.3)



$\Gamma(J/\psi(1S)\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{12}\Gamma_6/\Gamma$

| VALUE (keV)                | EVTS | DOCUMENT ID | TECN | COMMENT                                        |
|----------------------------|------|-------------|------|------------------------------------------------|
| <b>0.425±0.009 OUR FIT</b> |      |             |      |                                                |
| <b>0.411±0.008±0.018</b>   | 3.6k | ADAM        | 06   | CLEO 3.773 $e^+e^- \rightarrow \gamma\psi(2S)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                  |     |                   |          |                                                  |
|------------------|-----|-------------------|----------|--------------------------------------------------|
| 0.48 ±0.09 ±0.02 | 142 | <sup>1</sup> LEES | 18E BABR | 10.6 $e^+e^- \rightarrow J/\psi\pi^0\pi^0\gamma$ |
|------------------|-----|-------------------|----------|--------------------------------------------------|

<sup>1</sup> LEES 18E reports  $[\Gamma(\psi(2S) \rightarrow J/\psi(1S)\pi^0\pi^0) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(J/\psi(1S) \rightarrow \pi^+\pi^-\pi^0)] = 0.0101 \pm 0.0015 \pm 0.0011 \text{ keV}$  which we divide by our best value  $B(J/\psi(1S) \rightarrow \pi^+\pi^-\pi^0) = (2.10 \pm 0.08) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G6  
NODE=M071G6

NODE=M071G6;LINKAGE=A

$\Gamma(J/\psi(1S)\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{13}\Gamma_6/\Gamma$

| VALUE (eV)                | EVTS     | DOCUMENT ID         | TECN      | COMMENT                                               |
|---------------------------|----------|---------------------|-----------|-------------------------------------------------------|
| <b>78.6± 1.6 OUR FIT</b>  |          |                     |           |                                                       |
| <b>87 ± 9 OUR AVERAGE</b> |          |                     |           |                                                       |
| 83 ±25 ±5                 | 14       | <sup>1</sup> AUBERT | 07AU BABR | 10.6 $e^+e^- \rightarrow J/\psi\pi^+\pi^-\pi^0\gamma$ |
| 88 ± 6 ±7                 | 291 ± 24 | ADAM                | 06        | CLEO 3.773 $e^+e^- \rightarrow \gamma\psi(2S)$        |

<sup>1</sup> AUBERT 07AU quotes  $\Gamma_{ee}^{\psi(2S)} \cdot B(\psi(2S) \rightarrow J/\psi\eta) \cdot B(J/\psi \rightarrow \mu^+\mu^-) \cdot B(\eta \rightarrow \pi^+\pi^-\pi^0) = 1.11 \pm 0.33 \pm 0.07 \text{ eV}$ .

NODE=M071G7  
NODE=M071G7

NODE=M071G7;LINKAGE=UB

$\Gamma(J/\psi(1S)\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{14}\Gamma_6/\Gamma$

| VALUE (eV)   | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                                        |
|--------------|-----|------|-------------|------|------------------------------------------------|
| <b>&lt;8</b> | 90  | <37  | ADAM        | 06   | CLEO 3.773 $e^+e^- \rightarrow \gamma\psi(2S)$ |

NODE=M071G8  
NODE=M071G8

$\Gamma(p\bar{p}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{21}\Gamma_6/\Gamma$

| VALUE (eV)                    | EVTS | DOCUMENT ID       | TECN     | COMMENT                                 |
|-------------------------------|------|-------------------|----------|-----------------------------------------|
| <b>0.686±0.019 OUR FIT</b>    |      |                   |          |                                         |
| <b>0.63 ±0.05 OUR AVERAGE</b> |      |                   |          | Error includes scale factor of 1.2.     |
| 0.67 ±0.12 ±0.02              | 43   | <sup>1</sup> LEES | 130 BABR | $e^+e^- \rightarrow p\bar{p}\gamma$     |
| 0.74 ±0.07 ±0.04              | 142  | <sup>2</sup> LEES | 13Y BABR | $e^+e^- \rightarrow p\bar{p}\gamma$     |
| 0.579±0.038±0.036             | 2.7k | ANDREOTTI         | 07 E835  | $p\bar{p} \rightarrow e^+e^-, J/\psi X$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                  |    |                     |          |                                     |
|------------------|----|---------------------|----------|-------------------------------------|
| 0.70 ±0.17 ±0.03 | 22 | <sup>3</sup> AUBERT | 06B BABR | $e^+e^- \rightarrow p\bar{p}\gamma$ |
|------------------|----|---------------------|----------|-------------------------------------|

<sup>1</sup> ISR photon reconstructed in the detector

<sup>2</sup> ISR photon undetected

<sup>3</sup> Superseded by LEES 130

NODE=M071G2  
NODE=M071G2

NODE=M071G2;LINKAGE=C  
NODE=M071G2;LINKAGE=B  
NODE=M071G2;LINKAGE=A

$\Gamma(\Lambda\bar{\Lambda}) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_{30}\Gamma_6/\Gamma$

| VALUE (eV)         | DOCUMENT ID | TECN      | COMMENT                                              |
|--------------------|-------------|-----------|------------------------------------------------------|
| <b>1.5±0.4±0.1</b> | AUBERT      | 07BD BABR | 10.6 $e^+e^- \rightarrow \Lambda\bar{\Lambda}\gamma$ |

NODE=M071G11  
NODE=M071G11

$$\Gamma(2(\pi^+\pi^-\pi^0)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{68}\Gamma_6/\Gamma$$

| VALUE (eV)          | EVTs | DOCUMENT ID | TECN     | COMMENT                                            |
|---------------------|------|-------------|----------|----------------------------------------------------|
| <b>11.2±3.3±1.3</b> | 43   | AUBERT      | 06D BABR | 10.6 $e^+e^- \rightarrow 2(\pi^+\pi^-\pi^0)\gamma$ |

NODE=M071G4  
NODE=M071G4

$$\Gamma(\pi^0\pi^0K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{79}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTs | DOCUMENT ID | TECN     | COMMENT                                          |
|-----------------------|------|-------------|----------|--------------------------------------------------|
| <b>0.60±0.31±0.03</b> | 17   | LEES        | 12F BABR | 10.6 $e^+e^- \rightarrow \pi^0\pi^0K^+K^-\gamma$ |

NODE=M071G08  
NODE=M071G08

$$\Gamma(K^+K^-2(\pi^+\pi^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{86}\Gamma_6/\Gamma$$

| VALUE (eV)         | EVTs | DOCUMENT ID | TECN     | COMMENT                                             |
|--------------------|------|-------------|----------|-----------------------------------------------------|
| <b>4.4±2.1±0.3</b> | 26   | AUBERT      | 06D BABR | 10.6 $e^+e^- \rightarrow K^+K^-2(\pi^+\pi^-)\gamma$ |

NODE=M071G5  
NODE=M071G5

$$\Gamma(\pi^+\pi^-K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{80}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTs | DOCUMENT ID | TECN     | COMMENT                                          |
|-----------------------|------|-------------|----------|--------------------------------------------------|
| <b>1.92±0.30±0.06</b> | 133  | LEES        | 12F BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-K^+K^-\gamma$ |

NODE=M071G12  
NODE=M071G12

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |    |                     |           |                                                  |
|----------------|----|---------------------|-----------|--------------------------------------------------|
| 2.56±0.42±0.16 | 85 | <sup>1</sup> AUBERT | 07AK BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-K^+K^-\gamma$ |
|----------------|----|---------------------|-----------|--------------------------------------------------|

<sup>1</sup> Superseded by LEES 12F.

NODE=M071G12;LINKAGE=A

$$\Gamma(\pi^0\pi^0K_S^0K_L^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{81}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTs | DOCUMENT ID | TECN     | COMMENT                                         |
|-----------------------|------|-------------|----------|-------------------------------------------------|
| <b>2.92±1.27±0.15</b> | 14   | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0K_L^0\pi^0\pi^0\gamma$ |

NODE=M071G14  
NODE=M071G14

$$\Gamma(K_S^0K_L^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{120}\Gamma_6/\Gamma$$

| VALUE (eV)     | CL% | EVTs | DOCUMENT ID | TECN     | COMMENT                                    |
|----------------|-----|------|-------------|----------|--------------------------------------------|
| <b>&lt;0.7</b> | 90  | 8    | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0K_L^0\pi^0\gamma$ |

NODE=M071G15  
NODE=M071G15

$$\Gamma(K_S^0K_L^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{121}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTs | DOCUMENT ID | TECN     | COMMENT                                   |
|-----------------------|------|-------------|----------|-------------------------------------------|
| <b>3.14±1.08±0.16</b> | 16   | LEES        | 17A BABR | $e^+e^- \rightarrow K_S^0K_L^0\eta\gamma$ |

NODE=M071G16  
NODE=M071G16

$$\Gamma(\phi f_0(980) \rightarrow \pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{125}\Gamma_6/\Gamma$$

| VALUE (eV)               | EVTs | DOCUMENT ID       | TECN     | COMMENT                                          |
|--------------------------|------|-------------------|----------|--------------------------------------------------|
| <b>0.345±0.128±0.004</b> | 12   | <sup>1</sup> LEES | 12F BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-K^+K^-\gamma$ |

NODE=M071G13  
NODE=M071G13

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |     |                     |           |                                                  |
|-------------------|-----|---------------------|-----------|--------------------------------------------------|
| 0.345±0.168±0.004 | 6±3 | <sup>2</sup> AUBERT | 07AK BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-K^+K^-\gamma$ |
|-------------------|-----|---------------------|-----------|--------------------------------------------------|

<sup>1</sup> LEES 12F reports  $[\Gamma(\psi(2S) \rightarrow \phi f_0(980) \rightarrow \pi^+\pi^-) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] = 0.17 \pm 0.06 \pm 0.02$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G13;LINKAGE=A

<sup>2</sup> Superseded by LEES 12F. AUBERT 07AK reports  $[\Gamma(\psi(2S) \rightarrow \phi f_0(980) \rightarrow \pi^+\pi^-) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] = 0.17 \pm 0.08 \pm 0.02$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G13;LINKAGE=AU

$$\Gamma(2(K^+K^-)) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{126}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTs | DOCUMENT ID | TECN     | COMMENT                                      |
|-----------------------|------|-------------|----------|----------------------------------------------|
| <b>0.22±0.10±0.02</b> | 13   | LEES        | 12F BABR | 10.6 $e^+e^- \rightarrow K^+K^-K^+K^-\gamma$ |

NODE=M071G07  
NODE=M071G07

$$\Gamma(\phi\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{124}\Gamma_6/\Gamma$$

| VALUE (eV)            | EVTs | DOCUMENT ID       | TECN     | COMMENT                                          |
|-----------------------|------|-------------------|----------|--------------------------------------------------|
| <b>0.55±0.19±0.01</b> | 19   | <sup>1</sup> LEES | 12F BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |

NODE=M071G10  
NODE=M071G10

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |    |                         |          |                                                  |
|----------------|----|-------------------------|----------|--------------------------------------------------|
| 0.57±0.23±0.01 | 10 | <sup>2</sup> AUBERT, BE | 06D BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |
|----------------|----|-------------------------|----------|--------------------------------------------------|

<sup>1</sup> LEES 12F reports  $[\Gamma(\psi(2S) \rightarrow \phi\pi^+\pi^-) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] = 0.27 \pm 0.09 \pm 0.02 \text{ eV}$  which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G10;LINKAGE=A

<sup>2</sup> Superseded by LEES 12F. AUBERT,BE 06D reports  $[\Gamma(\psi(2S) \rightarrow \phi\pi^+\pi^-) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] = 0.28 \pm 0.11 \pm 0.02 \text{ eV}$  which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = (49.2 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G10;LINKAGE=AU

$\Gamma(2(\pi^+\pi^-)\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{17}\Gamma_6/\Gamma$

| VALUE (eV)          | EVTS | DOCUMENT ID | TECN      | COMMENT                                            |
|---------------------|------|-------------|-----------|----------------------------------------------------|
| <b>29.7±2.2±1.8</b> | 410  | AUBERT      | 07AU BABR | 10.6 $e^+e^- \rightarrow 2(\pi^+\pi^-)\pi^0\gamma$ |

NODE=M071G01  
NODE=M071G01

$\Gamma(\pi^+\pi^-\pi^0\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{19}\Gamma_6/\Gamma$

| VALUE (eV)          | EVTS | DOCUMENT ID | TECN     | COMMENT                                              |
|---------------------|------|-------------|----------|------------------------------------------------------|
| <b>12.4±1.8±1.2</b> | 177  | LEES        | 18E BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0\gamma$ |

NODE=M071P16  
NODE=M071P16

$\Gamma(\rho^\pm\pi^\mp\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{20}\Gamma_6/\Gamma$

| VALUE (eV)     | CL% | DOCUMENT ID | TECN     | COMMENT                                         |
|----------------|-----|-------------|----------|-------------------------------------------------|
| <b>&lt;6.2</b> | 90  | LEES        | 18E BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$ |

NODE=M071P18  
NODE=M071P18

$\Gamma(\omega\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{74}\Gamma_6/\Gamma$

| VALUE (eV)            | EVTS | DOCUMENT ID         | TECN      | COMMENT                                          |
|-----------------------|------|---------------------|-----------|--------------------------------------------------|
| <b>3.01±0.84±0.02</b> | 37   | <sup>1</sup> AUBERT | 07AU BABR | 10.6 $e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$ |

NODE=M071G02  
NODE=M071G02

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(\psi(2S) \rightarrow \omega\pi^+\pi^-) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow \pi^+\pi^-\pi^0)] = 2.69 \pm 0.73 \pm 0.16 \text{ eV}$  which we divide by our best value  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G02;LINKAGE=UB

$\Gamma(\omega\pi^0\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{78}\Gamma_6/\Gamma$

| VALUE (eV)            | EVTS | DOCUMENT ID       | TECN     | COMMENT                                         |
|-----------------------|------|-------------------|----------|-------------------------------------------------|
| <b>2.58±0.82±0.02</b> | 33   | <sup>1</sup> LEES | 18E BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\gamma$ |

NODE=M071P17  
NODE=M071P17

<sup>1</sup> LEES 18E reports  $[\Gamma(\psi(2S) \rightarrow \omega\pi^0\pi^0) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\omega(782) \rightarrow \pi^+\pi^-\pi^0)] = 2.3 \pm 0.7 \pm 0.2 \text{ eV}$  which we divide by our best value  $B(\omega(782) \rightarrow \pi^+\pi^-\pi^0) = (89.2 \pm 0.7) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071P17;LINKAGE=A

$\Gamma(2(\pi^+\pi^-)\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{71}\Gamma_6/\Gamma$

| VALUE (eV)            | EVTS | DOCUMENT ID         | TECN      | COMMENT                                           |
|-----------------------|------|---------------------|-----------|---------------------------------------------------|
| <b>2.87±1.41±0.01</b> | 16   | <sup>1</sup> AUBERT | 07AU BABR | 10.6 $e^+e^- \rightarrow 2(\pi^+\pi^-)\eta\gamma$ |

NODE=M071G03  
NODE=M071G03

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(\psi(2S) \rightarrow 2(\pi^+\pi^-)\eta) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\eta \rightarrow 2\gamma)] = 1.13 \pm 0.55 \pm 0.08 \text{ eV}$  which we divide by our best value  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G03;LINKAGE=UB

$\Gamma(\pi^+\pi^-\pi^0\pi^0\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{72}\Gamma_6/\Gamma$

| VALUE (eV)      | CL% | DOCUMENT ID | TECN     | COMMENT                                                  |
|-----------------|-----|-------------|----------|----------------------------------------------------------|
| <b>&lt;0.85</b> | 90  | LEES        | 18E BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-\pi^0\pi^0\eta\gamma$ |

NODE=M071P15  
NODE=M071P15

$\Gamma(K^+K^-\pi^+\pi^-\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{93}\Gamma_6/\Gamma$

| VALUE (eV)         | EVTS | DOCUMENT ID | TECN      | COMMENT                                               |
|--------------------|------|-------------|-----------|-------------------------------------------------------|
| <b>4.4±1.3±0.3</b> | 32   | AUBERT      | 07AU BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\pi^0\gamma$ |

NODE=M071G04  
NODE=M071G04

$\Gamma(K^+K^-\pi^+\pi^-\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{84}\Gamma_6/\Gamma$

| VALUE (eV)            | EVTS | DOCUMENT ID         | TECN      | COMMENT                                              |
|-----------------------|------|---------------------|-----------|------------------------------------------------------|
| <b>3.04±1.79±0.02</b> | 7    | <sup>1</sup> AUBERT | 07AU BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\eta\gamma$ |

NODE=M071G05  
NODE=M071G05

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(\psi(2S) \rightarrow K^+K^-\pi^+\pi^-\eta) \times \Gamma(\psi(2S) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\eta \rightarrow 2\gamma)] = 1.2 \pm 0.7 \pm 0.1 \text{ eV}$  which we divide by our best value  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071G05;LINKAGE=UB

$\Gamma(K^+K^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{111}\Gamma_6/\Gamma$ 

| VALUE (eV)                    | EVTS | DOCUMENT ID       | TECN     | COMMENT                           |
|-------------------------------|------|-------------------|----------|-----------------------------------|
| 0.147 $\pm$ 0.035 $\pm$ 0.005 | 66   | <sup>1</sup> LEES | 15J BABR | $e^+e^- \rightarrow K^+K^-\gamma$ |
| 0.197 $\pm$ 0.035 $\pm$ 0.005 | 66   | <sup>2</sup> LEES | 15J BABR | $e^+e^- \rightarrow K^+K^-\gamma$ |
| 0.35 $\pm$ 0.14 $\pm$ 0.03    | 11   | <sup>3</sup> LEES | 13Q BABR | $e^+e^- \rightarrow K^+K^-\gamma$ |

- • • We do not use the following data for averages, fits, limits, etc. • • •
- <sup>1</sup>  $\sin\phi > 0$ .  
<sup>2</sup>  $\sin\phi < 0$ .  
<sup>3</sup> Interference with non-resonant  $K^+K^-$  production not taken into account.

NODE=M071G06  
 NODE=M071G06

OCCUR=2

NODE=M071G06;LINKAGE=A  
 NODE=M071G06;LINKAGE=B  
 NODE=M071G06;LINKAGE=BA

 $\psi(2S)$  BRANCHING RATIOS

NODE=M071235

 $\Gamma(\text{hadrons})/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

| VALUE                                           | DOCUMENT ID       | TECN     | COMMENT  |
|-------------------------------------------------|-------------------|----------|----------|
| <b>0.9785<math>\pm</math>0.0013 OUR AVERAGE</b> |                   |          |          |
| 0.9779 $\pm$ 0.0015                             | <sup>1</sup> BAI  | 02B BES2 | $e^+e^-$ |
| 0.981 $\pm$ 0.003                               | <sup>1</sup> LUTH | 75 MRK1  | $e^+e^-$ |

- <sup>1</sup> Includes cascade decay into  $J/\psi(1S)$ .

NODE=M071R3  
 NODE=M071R3

NODE=M071R;LINKAGE=P

 $\Gamma(\text{virtual}\gamma \rightarrow \text{hadrons})/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE                                           | DOCUMENT ID                         | TECN     | COMMENT  |
|-------------------------------------------------|-------------------------------------|----------|----------|
| <b>0.0173<math>\pm</math>0.0014 OUR AVERAGE</b> | Error includes scale factor of 1.5. |          |          |
| 0.0166 $\pm$ 0.0010                             | <sup>1,2</sup> SETH                 | 04 RVUE  | $e^+e^-$ |
| 0.0199 $\pm$ 0.0019                             | <sup>1</sup> BAI                    | 02B BES2 | $e^+e^-$ |
| 0.029 $\pm$ 0.004                               | <sup>1</sup> LUTH                   | 75 MRK1  | $e^+e^-$ |

- • • We do not use the following data for averages, fits, limits, etc. • • •

- <sup>1</sup> Included in  $\Gamma(\text{hadrons})/\Gamma_{\text{total}}$ .

- <sup>2</sup> Using  $B(\psi(2S) \rightarrow \ell^+\ell^-) = (0.73 \pm 0.04)\%$  from RPP-2002 and  $R = 2.28 \pm 0.04$  determined by a fit to data from BAI 00 and BAI 02C.

NODE=M071R5  
 NODE=M071R5

NODE=M071R;LINKAGE=Z  
 NODE=M071R5;LINKAGE=SE

 $\Gamma(ggg)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE (units $10^{-2}$ )         | EVTS  | DOCUMENT ID        | TECN    | COMMENT                               |
|----------------------------------|-------|--------------------|---------|---------------------------------------|
| <b>10.58<math>\pm</math>1.62</b> | 2.9 M | <sup>1</sup> LIBBY | 09 CLEO | $\psi(2S) \rightarrow \text{hadrons}$ |

- <sup>1</sup> Calculated using  $\Gamma(\gamma gg)/\Gamma(ggg) = 0.097 \pm 0.026 \pm 0.016$  from LIBBY 09,  $B(\psi(2S) \rightarrow X J/\psi)$  relative and absolute branching fractions from MENDEZ 08,  $B(\psi(2S) \rightarrow \gamma \eta_c)$  from MITCHELL 09, and  $B(\psi(2S) \rightarrow \text{virtual } \gamma \rightarrow \text{hadrons})$ ,  $B(\psi(2S) \rightarrow \gamma \chi_{cJ})$ , and  $B(\psi(2S) \rightarrow \ell^+\ell^-)$  from PDG 08. The statistical error is negligible and the systematic error is largely uncorrelated with that of  $\Gamma(\gamma gg)/\Gamma_{\text{total}}$  LIBBY 09 measurement.

NODE=M071S43  
 NODE=M071S43

NODE=M071S43;LINKAGE=LI

 $\Gamma(\gamma gg)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE (units $10^{-2}$ )          | EVTS  | DOCUMENT ID        | TECN    | COMMENT                                        |
|-----------------------------------|-------|--------------------|---------|------------------------------------------------|
| <b>1.025<math>\pm</math>0.288</b> | 200 k | <sup>1</sup> LIBBY | 09 CLEO | $\psi(2S) \rightarrow \gamma + \text{hadrons}$ |

- <sup>1</sup> Calculated using  $\Gamma(\gamma gg)/\Gamma(ggg) = 0.097 \pm 0.026 \pm 0.016$  from LIBBY 09. The statistical error is negligible and the systematic error is largely uncorrelated with that of  $\Gamma(ggg)/\Gamma_{\text{total}}$  LIBBY 09 measurement.

NODE=M071S44  
 NODE=M071S44

NODE=M071S44;LINKAGE=LI

 $\Gamma(\gamma gg)/\Gamma(ggg)$  $\Gamma_4/\Gamma_3$ 

| VALUE (units $10^{-2}$ )                         | EVTS  | DOCUMENT ID | TECN    | COMMENT                                          |
|--------------------------------------------------|-------|-------------|---------|--------------------------------------------------|
| <b>9.7<math>\pm</math>2.6<math>\pm</math>1.6</b> | 2.9 M | LIBBY       | 09 CLEO | $\psi(2S) \rightarrow (\gamma +) \text{hadrons}$ |

NODE=M071S45  
 NODE=M071S45

 $\Gamma(\text{light hadrons})/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE                             | DOCUMENT ID         | TECN     | COMMENT                       |
|-----------------------------------|---------------------|----------|-------------------------------|
| <b>0.154<math>\pm</math>0.015</b> | <sup>1</sup> MENDEZ | 08 CLEO  | $e^+e^- \rightarrow \psi(2S)$ |
| 0.169 $\pm$ 0.026                 | <sup>2</sup> ADAM   | 05A CLEO | $e^+e^- \rightarrow \psi(2S)$ |

- • • We do not use the following data for averages, fits, limits, etc. • • •

- <sup>1</sup> Uses  $B(\psi(2S) \rightarrow J/\psi X)$  from MENDEZ 08 and other branching fractions from PDG 07.

- <sup>2</sup> Uses  $B(J/\psi X)$  from ADAM 05A,  $B(\chi_{cJ}\gamma)$ ,  $B(\eta_c\gamma)$  from ATHAR 04 and  $B(\ell^+\ell^-)$  from PDG 04. Superseded by MENDEZ 08.

NODE=M071S27  
 NODE=M071S27

NODE=M071S27;LINKAGE=ME  
 NODE=M071S27;LINKAGE=AD

$\Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**79.3 ± 1.7 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

88 ± 13

<sup>1</sup> FELDMAN 77 RVUE  $e^+e^-$ 

<sup>1</sup> From an overall fit assuming equal partial widths for  $e^+e^-$  and  $\mu^+\mu^-$ . For a measurement of the ratio see the entry  $\Gamma(\mu^+\mu^-)/\Gamma(e^+e^-)$  below. Includes LUTH 75, HILGER 75, BURMESTER 77.

NODE=M071R1  
NODE=M071R1

NODE=M071R;LINKAGE=L

 $\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

**80 ± 6 OUR FIT**

NODE=M071R2  
NODE=M071R2

 $\Gamma(\mu^+\mu^-)/\Gamma(e^+e^-)$  $\Gamma_7/\Gamma_6$ 

VALUE

DOCUMENT ID

TECN

COMMENT

**1.00 ± 0.08 OUR FIT**

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.89 ± 0.16

BOYARSKI 75C MRK1  $e^+e^-$ 

NODE=M071R4  
NODE=M071R4

 $\Gamma(\tau^+\tau^-)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ VALUE (units  $10^{-4}$ )

DOCUMENT ID

TECN

COMMENT

**31 ± 4 OUR FIT****30.8 ± 2.1 ± 3.8**<sup>1</sup> ABLIKIM 06W BES  $e^+e^- \rightarrow \psi(2S)$ 

<sup>1</sup> Computed using PDG 02 value of  $B(\psi(2S) \rightarrow \text{hadrons}) = 0.9810 \pm 0.0030$  to estimate the total number of  $\psi(2S)$  events.

NODE=M071R75  
NODE=M071R75

NODE=M071R75;LINKAGE=AB

————— DECAYS INTO  $J/\psi(1S)$  AND ANYTHING —————

NODE=M071305

 $\Gamma(J/\psi(1S)\text{anything})/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

VALUE

EVTS

DOCUMENT ID

TECN

COMMENT

**0.614 ± 0.006 OUR FIT****0.55 ± 0.07 OUR AVERAGE**

0.51 ± 0.12

BRANDELIK 79C DASP  $e^+e^- \rightarrow \mu^+\mu^-X$ 

0.57 ± 0.08

ABRAMS 75B MRK1  $e^+e^- \rightarrow \mu^+\mu^-X$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.6254 ± 0.0016 ± 0.0155 1.1M

<sup>1</sup> MENDEZ 08 CLEO  $\psi(2S) \rightarrow \ell^+\ell^-X$ 

0.5950 ± 0.0015 ± 0.0190 151k

ADAM 05A CLEO Repl. by MENDEZ 08

<sup>1</sup> Not independent from other measurements of MENDEZ 08.

NODE=M071R10  
NODE=M071R10

NODE=M071R10;LINKAGE=ME

 $\Gamma(e^+e^-)/\Gamma(J/\psi(1S)\text{anything})$  $\Gamma_6/\Gamma_9 = \Gamma_6/(\Gamma_{11} + \Gamma_{12} + \Gamma_{13} + 0.343\Gamma_{152} + 0.190\Gamma_{153})$ VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**1.291 ± 0.026 OUR FIT****1.28 ± 0.04 OUR AVERAGE** Error includes scale factor of 1.6. See the ideogram below.

1.22 ± 0.02 ± 0.05 5097 ± 73

<sup>1</sup> ANDREOTTI 05 E835  $p\bar{p} \rightarrow \psi(2S) \rightarrow$  $e^+e^-$ 

1.28 ± 0.03 ± 0.02

<sup>1</sup> AMBROGIANI 00A E835  $p\bar{p} \rightarrow \psi(2S)$ 

1.44 ± 0.08 ± 0.02

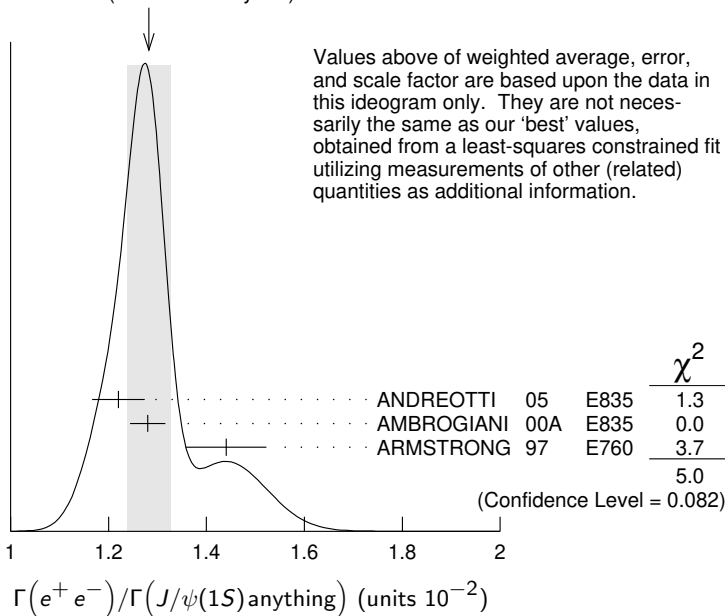
<sup>1</sup> ARMSTRONG 97 E760  $p\bar{p} \rightarrow \psi(2S)$ 

<sup>1</sup> Using  $B(J/\psi(1S) \rightarrow e^+e^-) = 0.0593 \pm 0.0010$ .

NODE=M071R72  
NODE=M071R72

NODE=M071R;LINKAGE=7A

WEIGHTED AVERAGE  
 $1.28 \pm 0.04$  (Error scaled by 1.6)



$\Gamma(\mu^+\mu^-)/\Gamma(J/\psi(1S)\text{anything})$

$$\Gamma_7/\Gamma_9 = \Gamma_7/(\Gamma_{11} + \Gamma_{12} + \Gamma_{13} + 0.343\Gamma_{152} + 0.190\Gamma_{153})$$

| VALUE                          | DOCUMENT ID | TECN | COMMENT       |
|--------------------------------|-------------|------|---------------|
| <b>0.0130 ± 0.0010 OUR FIT</b> |             |      |               |
| <b>0.014 ± 0.003</b>           | HILGER      | 75   | SPEC $e^+e^-$ |

NODE=M071R74  
 NODE=M071R74

$\Gamma(J/\psi(1S)\text{neutrals})/\Gamma_{\text{total}}$

| VALUE                          | DOCUMENT ID |
|--------------------------------|-------------|
| <b>0.2538 ± 0.0032 OUR FIT</b> |             |

$\Gamma_{10}/\Gamma$

NODE=M071R18  
 NODE=M071R18

$\Gamma(J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$

| VALUE                          | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|------|-------------|------|---------|
| <b>0.3468 ± 0.0030 OUR FIT</b> |      |             |      |         |

$\Gamma_{11}/\Gamma$

NODE=M071R12  
 NODE=M071R12

**0.348 ± 0.005 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

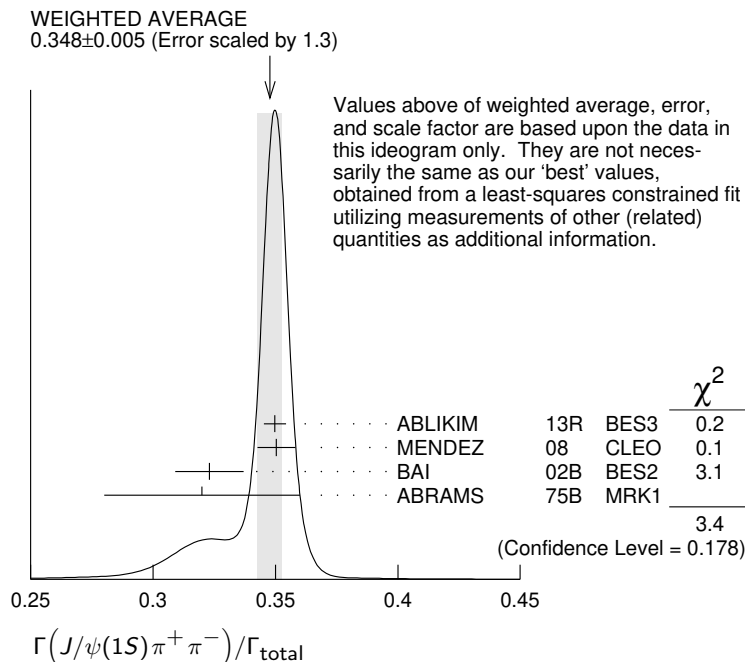
|                          |      |         |     |      |                                                  |
|--------------------------|------|---------|-----|------|--------------------------------------------------|
| 0.3498 ± 0.0002 ± 0.0045 | 20M  | ABLIKIM | 13R | BES3 | $\psi(2S) \rightarrow J/\psi \pi^+ \pi^-$        |
| 0.3504 ± 0.0007 ± 0.0077 | 565k | MENDEZ  | 08  | CLEO | $\psi(2S) \rightarrow \ell^+ \ell^- \pi^+ \pi^-$ |
| 0.323 ± 0.014            |      | BAI     | 02B | BES2 | $e^+ e^-$                                        |
| 0.32 ± 0.04              |      | ABRAMS  | 75B | MRK1 | $e^+ e^- \rightarrow J/\psi \pi^+ \pi^-$         |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |     |                   |     |      |                    |
|--------------------------|-----|-------------------|-----|------|--------------------|
| 0.3354 ± 0.0014 ± 0.0110 | 60k | <sup>1</sup> ADAM | 05A | CLEO | Repl. by MENDEZ 08 |
|--------------------------|-----|-------------------|-----|------|--------------------|

<sup>1</sup> Not independent from other values reported by ADAM 05A.

NODE=M071R;LINKAGE=AD



### $\Gamma(e^+e^-)/\Gamma(J/\psi(1S)\pi^+\pi^-)$

$\Gamma_6/\Gamma_{11}$

| VALUE                        | DOCUMENT ID         | TECN | COMMENT       |
|------------------------------|---------------------|------|---------------|
| <b>0.0229±0.0005 OUR FIT</b> |                     |      |               |
| <b>0.0252±0.0028±0.0011</b>  | <sup>1</sup> AUBERT | 02B  | BABR $e^+e^-$ |

<sup>1</sup> Using  $B(J/\psi(1S) \rightarrow e^+e^-) = 0.0593 \pm 0.0010$ .

NODE=M071R73  
NODE=M071R73

NODE=M071R73;LINKAGE=7A

### $\Gamma(\mu^+\mu^-)/\Gamma(J/\psi(1S)\pi^+\pi^-)$

$\Gamma_7/\Gamma_{11}$

| VALUE                            | DOCUMENT ID            | TECN | COMMENT                                  |
|----------------------------------|------------------------|------|------------------------------------------|
| <b>0.0230±0.0017 OUR FIT</b>     |                        |      |                                          |
| <b>0.0228±0.0018 OUR AVERAGE</b> |                        |      |                                          |
| 0.0230±0.0020±0.0012             | <sup>1</sup> AAIJ      | 16Y  | LHCB $\Lambda_b^0 \rightarrow \psi(2S)X$ |
| 0.0216±0.0026±0.0014             | <sup>2</sup> AUBERT    | 02B  | BABR $e^+e^-$                            |
| 0.0327±0.0077±0.0072             | <sup>2</sup> GRIBUSHIN | 96   | FMPS $515\pi^-Be \rightarrow 2\mu X$     |

<sup>1</sup> Using  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = (5.961 \pm 0.033) \times 10^{-2}$ .

<sup>2</sup> Using  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = (5.88 \pm 0.10) \times 10^{-2}$ .

NODE=M071R63  
NODE=M071R63

NODE=M071R63;LINKAGE=A  
NODE=M071R;LINKAGE=Q2

### $\Gamma(\tau^+\tau^-)/\Gamma(J/\psi(1S)\pi^+\pi^-)$

$\Gamma_8/\Gamma_{11}$

| VALUE (units $10^{-3}$ ) | DOCUMENT ID | TECN | COMMENT      |
|--------------------------|-------------|------|--------------|
| <b>8.8 ±1.1 OUR FIT</b>  |             |      |              |
| <b>8.73±1.39±1.57</b>    | BAI         | 02   | BES $e^+e^-$ |

NODE=M071R76  
NODE=M071R76

### $\Gamma(J/\psi(1S)\pi^+\pi^-)/\Gamma(J/\psi(1S)\text{anything})$

$\Gamma_{11}/\Gamma_9$

| VALUE                                                                         | EVTS | DOCUMENT ID            | TECN | COMMENT                                                     |
|-------------------------------------------------------------------------------|------|------------------------|------|-------------------------------------------------------------|
| <b>0.5645±0.0026 OUR FIT</b>                                                  |      |                        |      |                                                             |
| <b>0.554 ±0.008 OUR AVERAGE</b>                                               |      |                        |      | Error includes scale factor of 1.3. See the ideogram below. |
| 0.5604±0.0009±0.0062                                                          | 565k | MENDEZ                 | 08   | CLEO $\psi(2S) \rightarrow \ell^+\ell^-\pi^+\pi^-$          |
| 0.525 ±0.009 ±0.022                                                           | 4k   | ANDREOTTI              | 05   | E835 $\psi(2S) \rightarrow J/\psi X$                        |
| 0.536 ±0.007 ±0.016                                                           | 20k  | <sup>1,2</sup> ABLIKIM | 04B  | BES $\psi(2S) \rightarrow J/\psi X$                         |
| 0.496 ±0.037                                                                  |      | ARMSTRONG              | 97   | E760 $\bar{p}p \rightarrow \psi(2S)$                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                        |      |                                                             |
| 0.5637±0.0027±0.0046                                                          | 60k  | ADAM                   | 05A  | CLEO Repl. by MENDEZ 08                                     |

<sup>1</sup> From a fit to the  $J/\psi$  recoil mass spectra.

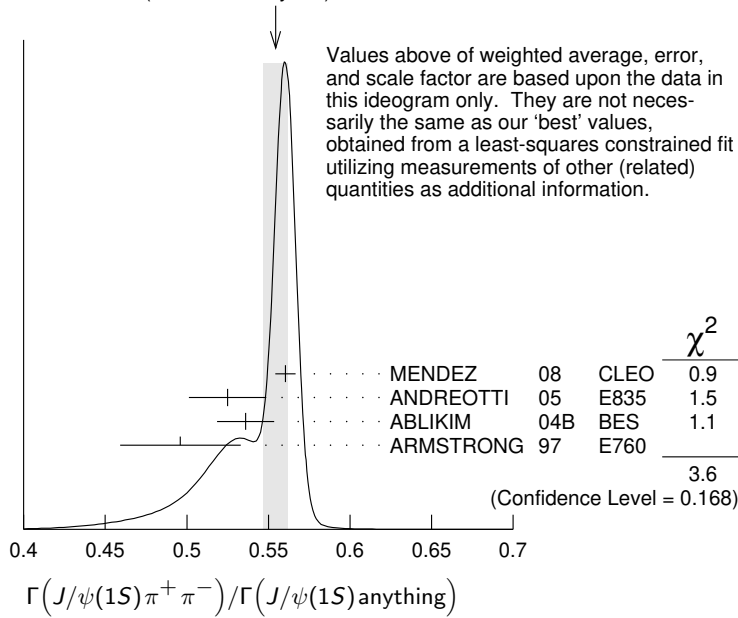
<sup>2</sup> ABLIKIM 04B quotes  $B(\psi(2S) \rightarrow J/\psi X) / B(\psi(2S) \rightarrow J/\psi\pi^+\pi^-)$ .

NODE=M071R70  
NODE=M071R70

NODE=M071R;LINKAGE=AB  
NODE=M071R;LINKAGE=AL



WEIGHTED AVERAGE  
0.554±0.008 (Error scaled by 1.3)



$\Gamma(J/\psi(1S)\text{neutrals})/\Gamma(J/\psi(1S)\pi^+\pi^-)$

$$\Gamma_{10}/\Gamma_{11} = (0.9761\Gamma_{12} + 0.719\Gamma_{13} + 0.343\Gamma_{152} + 0.190\Gamma_{153})/\Gamma_{11}$$

| VALUE                      | DOCUMENT ID  | TECN | COMMENT  |
|----------------------------|--------------|------|----------|
| <b>0.732±0.008 OUR FIT</b> |              |      |          |
| <b>0.73 ±0.09</b>          | TANENBAUM 76 | MRK1 | $e^+e^-$ |

NODE=M071R11  
NODE=M071R11

$\Gamma(J/\psi(1S)\pi^0\pi^0)/\Gamma_{\text{total}}$

| VALUE                        | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------------------------|------|-------------|------|---------|
| <b>0.1824±0.0031 OUR FIT</b> |      |             |      |         |

NODE=M071R17  
NODE=M071R17

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                      |       |                        |      |                                           |
|----------------------|-------|------------------------|------|-------------------------------------------|
| 0.1769±0.0008±0.0053 | 61k   | <sup>1</sup> MENDEZ 08 | CLEO | $\psi(2S) \rightarrow \ell^+\ell^-2\pi^0$ |
| 0.1652±0.0014±0.0058 | 13.4k | <sup>2</sup> ADAM 05A  | CLEO | Repl. by MENDEZ 08                        |

<sup>1</sup> Not independent from other measurements of MENDEZ 08.

<sup>2</sup> Not independent from other values reported by ADAM 05A.

NODE=M071R17;LINKAGE=ME  
NODE=M071R17;LINKAGE=AD

$\Gamma(J/\psi(1S)\pi^0\pi^0)/\Gamma(J/\psi(1S)\text{anything})$

| VALUE                        | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------------------------|------|-------------|------|---------|
| <b>0.2968±0.0031 OUR FIT</b> |      |             |      |         |

NODE=M071R69  
NODE=M071R69

**0.320 ±0.012 OUR AVERAGE**

|                     |           |                |      |                                 |
|---------------------|-----------|----------------|------|---------------------------------|
| 0.300 ±0.008 ±0.022 | 1655 ± 44 | ANDREOTTI 05   | E835 | $\psi(2S) \rightarrow J/\psi X$ |
| 0.328 ±0.013 ±0.008 |           | AMBROGIANI 00A | E835 | $p\bar{p} \rightarrow \psi(2S)$ |
| 0.323 ±0.033        |           | ARMSTRONG 97   | E760 | $p\bar{p} \rightarrow \psi(2S)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                      |       |           |      |                                           |
|----------------------|-------|-----------|------|-------------------------------------------|
| 0.2829±0.0012±0.0056 | 61k   | MENDEZ 08 | CLEO | $\psi(2S) \rightarrow \ell^+\ell^-2\pi^0$ |
| 0.2776±0.0025±0.0043 | 13.4k | ADAM 05A  | CLEO | Repl. by MENDEZ 08                        |

$\Gamma(J/\psi(1S)\pi^0\pi^0)/\Gamma(J/\psi(1S)\pi^+\pi^-)$

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

NODE=M071R14  
NODE=M071R14

**0.526 ±0.008 OUR FIT**

**0.513 ±0.022 OUR AVERAGE**

Error includes scale factor of 2.2.

|                      |     |                          |      |                                           |
|----------------------|-----|--------------------------|------|-------------------------------------------|
| 0.5047±0.0022±0.0102 | 61k | MENDEZ 08                | CLEO | $\psi(2S) \rightarrow \ell^+\ell^-2\pi^0$ |
| 0.570 ±0.009 ±0.026  | 14k | <sup>1</sup> ABLIKIM 04B | BES  | $\psi(2S) \rightarrow J/\psi X$           |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                      |     |                           |      |                                 |
|----------------------|-----|---------------------------|------|---------------------------------|
| 0.4924±0.0047±0.0086 | 73k | <sup>2,3</sup> ADAM 05A   | CLEO | Repl. by MENDEZ 08              |
| 0.571 ±0.018 ±0.044  |     | <sup>4</sup> ANDREOTTI 05 | E835 | $\psi(2S) \rightarrow J/\psi X$ |
| 0.53 ±0.06           |     | TANENBAUM 76              | MRK1 | $e^+e^-$                        |
| 0.64 ±0.15           |     | <sup>5</sup> HILGER 75    | SPEC | $e^+e^-$                        |

<sup>1</sup> From a fit to the  $J/\psi$  recoil mass spectra.

<sup>2</sup> Not independent from other values reported by ADAM 05A.

<sup>3</sup> Using 13,217  $J/\psi\pi^0\pi^0$  and 60,010  $J/\psi\pi^+\pi^-$  events.

<sup>4</sup> Not independent from other values reported by ANDREOTTI 05.

<sup>5</sup> Ignoring the  $J/\psi(1S)\eta$  and  $J/\psi(1S)\gamma\gamma$  decays.

NODE=M071R14;LINKAGE=AB  
NODE=M071R14;LINKAGE=AD  
NODE=M071R14;LINKAGE=AM  
NODE=M071R;LINKAGE=AN  
NODE=M071R;LINKAGE=I

$\Gamma(J/\psi(1S)\eta)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**33.7 ± 0.5 OUR FIT****32.9 ± 1.7 OUR AVERAGE**

Error includes scale factor of 2.1. See the ideogram below.

33.75 ± 0.17 ± 0.86 68.2k ABLIKIM 12M BES3  $e^+e^- \rightarrow \ell^+\ell^-2\gamma$ 29.8 ± 0.9 ± 2.3 5.7k BAI 04I BES2  $\psi(2S) \rightarrow J/\psi\gamma\gamma$ 25.5 ± 2.9 386 <sup>1</sup>OREGLIA 80 CBAL  $e^+e^- \rightarrow J/\psi 2\gamma$ 45 ± 12 17 <sup>2</sup>BRANDELIK 79B DASP  $e^+e^- \rightarrow J/\psi 2\gamma$ 42 ± 6 164 <sup>2</sup>BARTEL 78B CNTR  $e^+e^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

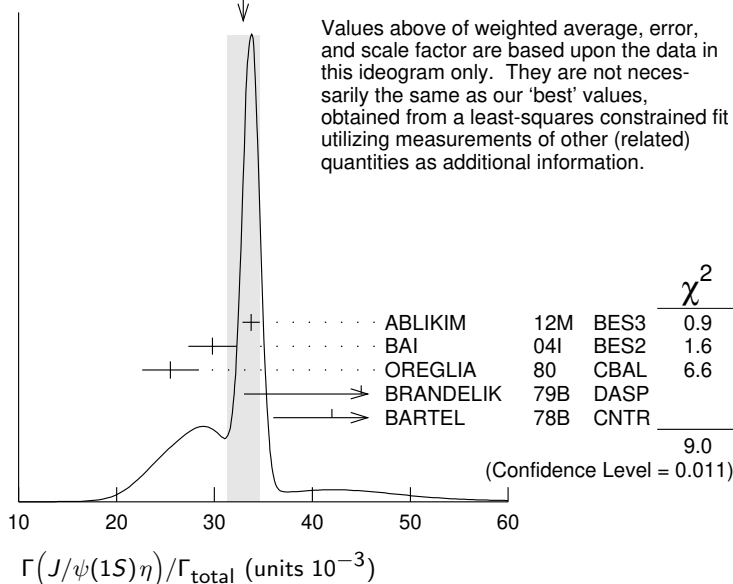
34.3 ± 0.4 ± 0.9 18.4k <sup>3</sup>MENDEZ 08 CLEO  $\psi(2S) \rightarrow \ell^+\ell^-\eta$ 32.5 ± 0.6 ± 1.1 2.8k <sup>4</sup>ADAM 05A CLEO Repl. by MENDEZ 0843 ± 8 44 TANENBAUM 76 MRK1  $e^+e^-$ <sup>1</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = 0.1181 \pm 0.0020$ .<sup>2</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \mu^+\mu^-) = 0.0588 \pm 0.0010$ .<sup>3</sup> Not independent from other measurements of MENDEZ 08.<sup>4</sup> Not independent from other values reported by ADAM 05A.NODE=M071R15  
NODE=M071R15

NODE=M071R;LINKAGE=3Q

NODE=M071R;LINKAGE=2Q

NODE=M071R15;LINKAGE=ME

NODE=M071R15;LINKAGE=AD

WEIGHTED AVERAGE  
32.9±1.7 (Error scaled by 2.1) $\Gamma(J/\psi(1S)\eta)/\Gamma(J/\psi(1S)\text{anything})$  $\Gamma_{13}/\Gamma_9$ 

VALUE

EVTS

DOCUMENT ID

TECN

COMMENT

**0.0549 ± 0.0008 OUR FIT****0.058 ± 0.007 OUR AVERAGE**

Error includes scale factor of 1.4. See the ideogram below.

0.050 ± 0.006 ± 0.003 298 ± 20 ANDREOTTI 05 E835  $\psi(2S) \rightarrow J/\psi X$ 0.072 ± 0.009 AMBROGIANI 00A E835  $p\bar{p} \rightarrow \psi(2S)$ 0.061 ± 0.015 ARMSTRONG 97 E760  $\bar{p}p \rightarrow \psi(2S)$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

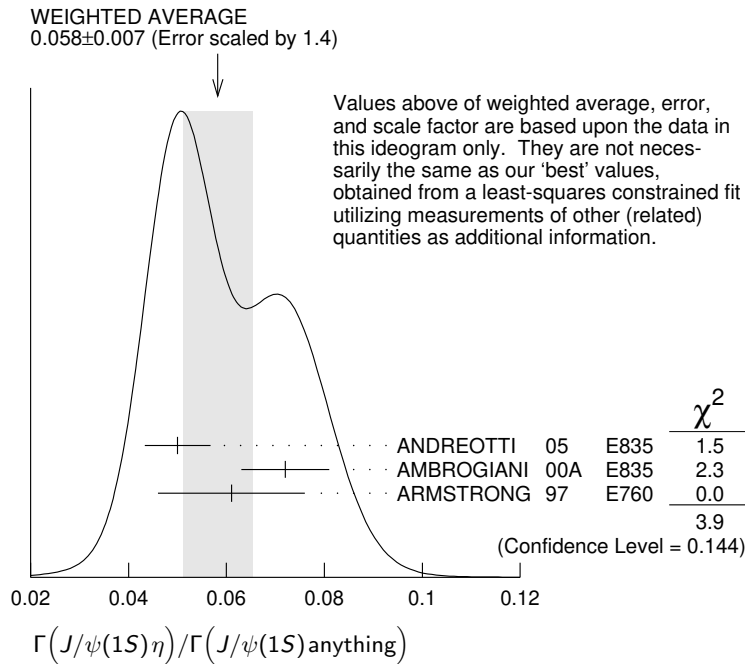
0.0549 ± 0.0006 ± 0.0009 18.4k <sup>1</sup>MENDEZ 08 CLEO  $\psi(2S) \rightarrow \ell^+\ell^-\eta$ 

0.0546 ± 0.0010 ± 0.0007 2.8k ADAM 05A CLEO Repl. by MENDEZ 08

<sup>1</sup> Not independent from other measurements of MENDEZ 08.NODE=M071R68  
NODE=M071R68

OCCUR=2

NODE=M071R68;LINKAGE=ME



### $\Gamma(J/\psi(1S)\eta)/\Gamma(J/\psi(1S)\pi^+\pi^-)$

$\Gamma_{13}/\Gamma_{11}$

| VALUE                                                                         | EVTS  | DOCUMENT ID            | TECN | COMMENT                                      |
|-------------------------------------------------------------------------------|-------|------------------------|------|----------------------------------------------|
| <b>0.0972±0.0014 OUR FIT</b>                                                  |       |                        |      |                                              |
| <b>0.0979±0.0018 OUR AVERAGE</b>                                              |       |                        |      |                                              |
| 0.0979±0.0010±0.0015                                                          | 18.4k | MENDEZ                 | 08   | CLEO $\psi(2S) \rightarrow \ell^+\ell^-\eta$ |
| 0.098 ±0.005 ±0.010                                                           | 2k    | <sup>1</sup> ABLIKIM   | 04B  | BES $\psi(2S) \rightarrow J/\psi X$          |
| 0.091 ±0.021                                                                  |       | <sup>2</sup> HIMEL     | 80   | MRK2 $e^+e^- \rightarrow \psi(2S)X$          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                        |      |                                              |
| 0.0968±0.0019±0.0013                                                          | 2.8k  | <sup>3</sup> ADAM      | 05A  | CLEO Repl. by MENDEZ 08                      |
| 0.095 ±0.007 ±0.007                                                           |       | <sup>4</sup> ANDREOTTI | 05   | E835 $\psi(2S) \rightarrow J/\psi X$         |

<sup>1</sup> From a fit to the  $J/\psi$  recoil mass spectra.

<sup>2</sup> The value for  $B(\psi(2S) \rightarrow J/\psi(1S)\eta)$  reported in HIMEL 80 is derived using  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (33 \pm 3)\%$  and  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = 0.138 \pm 0.018$ . Calculated by us using  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = (0.1181 \pm 0.0020)$ .

<sup>3</sup> Not independent from other values reported by ADAM 05A.

<sup>4</sup> Not independent from other values reported by ANDREOTTI 05.

NODE=M071R71  
NODE=M071R71

NODE=M071R71;LINKAGE=AB  
NODE=M071R;LINKAGE=8H

NODE=M071R71;LINKAGE=AD  
NODE=M071R71;LINKAGE=AN

### $\Gamma(J/\psi(1S)\pi^0)/\Gamma_{\text{total}}$

$\Gamma_{14}/\Gamma$

| VALUE (units $10^{-4}$ )                                                      | EVTS | DOCUMENT ID          | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|------|----------------------|------|-------------------------------------------------|
| <b>12.68±0.32 OUR AVERAGE</b>                                                 |      |                      |      |                                                 |
| 12.6 ±0.2 ±0.3                                                                | 4.1k | ABLIKIM              | 12M  | BES3 $e^+e^- \rightarrow \ell^+\ell^-2\gamma$   |
| 13.3 ±0.8 ±0.3                                                                | 530  | MENDEZ               | 08   | CLEO $\psi(2S) \rightarrow \ell^+\ell^-2\gamma$ |
| 14.3 ±1.4 ±1.2                                                                | 280  | BAI                  | 04i  | BES2 $\psi(2S) \rightarrow J/\psi\gamma\gamma$  |
| 14 ±6                                                                         | 7    | HIMEL                | 80   | MRK2 $e^+e^-$                                   |
| 9 ±2 ±1                                                                       | 23   | <sup>1</sup> OREGLIA | 80   | CBAL $\psi(2S) \rightarrow J/\psi 2\gamma$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                      |      |                                                 |
| 13 ±1 ±1                                                                      | 88   | ADAM                 | 05A  | CLEO Repl. by MENDEZ 08                         |

<sup>1</sup> Recalculated by us using  $B(J/\psi(1S) \rightarrow \ell^+\ell^-) = 0.1181 \pm 0.0020$ .

NODE=M071R16  
NODE=M071R16

NODE=M071R16;LINKAGE=3Q

### $\Gamma(J/\psi(1S)\pi^0)/\Gamma(J/\psi(1S)\text{anything})$

$\Gamma_{14}/\Gamma_9 = \Gamma_{14}/(\Gamma_{11}+\Gamma_{12}+\Gamma_{13}+0.343\Gamma_{152}+0.190\Gamma_{153})$

| VALUE (units $10^{-2}$ )                                                      | EVTS | DOCUMENT ID         | TECN | COMMENT                                                           |
|-------------------------------------------------------------------------------|------|---------------------|------|-------------------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                     |      |                                                                   |
| 0.213±0.012±0.003                                                             | 527  | <sup>1</sup> MENDEZ | 08   | CLEO $e^+e^- \rightarrow J/\psi\gamma\gamma$                      |
| 0.22 ±0.02 ±0.01                                                              |      | <sup>2</sup> ADAM   | 05A  | CLEO $e^+e^- \rightarrow \psi(2S) \rightarrow J/\psi\gamma\gamma$ |

<sup>1</sup> Not independent from other values reported by MENDEZ 08. Supersedes ADAM 05A.

<sup>2</sup> Not independent from other values reported by ADAM 05A.

NODE=M071S25  
NODE=M071S25

NODE=M071S25;LINKAGE=ME  
NODE=M071S25;LINKAGE=AD

$\Gamma(J/\psi(1S)\pi^0)/\Gamma(J/\psi(1S)\pi^+\pi^-)$  $\Gamma_{14}/\Gamma_{11}$ 

| VALUE (units $10^{-2}$ ) | EPTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                             |     |                     |     |                                                                   |
|-----------------------------|-----|---------------------|-----|-------------------------------------------------------------------|
| $0.380 \pm 0.022 \pm 0.005$ | 527 | <sup>1</sup> MENDEZ | 08  | CLEO $e^+e^- \rightarrow J/\psi\gamma\gamma$                      |
| $0.39 \pm 0.04 \pm 0.01$    |     | <sup>2</sup> ADAM   | 05A | CLEO $e^+e^- \rightarrow \psi(2S) \rightarrow J/\psi\gamma\gamma$ |

<sup>1</sup> Not independent from other values reported by MENDEZ 08. Supersedes ADAM 05A.

<sup>2</sup> Not independent from other values reported by ADAM 05A.

NODE=M071S26  
NODE=M071S26

NODE=M071S26;LINKAGE=ME  
NODE=M071S26;LINKAGE=AD

NODE=M071310

## HADRONIC DECAYS

 $\Gamma(\pi^0 h_c(1P))/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EPTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**$8.6 \pm 1.3$  OUR AVERAGE**

|                       |     |                 |     |                                            |
|-----------------------|-----|-----------------|-----|--------------------------------------------|
| $9.0 \pm 1.5 \pm 1.3$ | 3k  | <sup>1</sup> GE | 11  | CLEO $\psi(2S) \rightarrow \pi^0$ anything |
| $8.4 \pm 1.3 \pm 1.0$ | 11k | ABLIKIM         | 10B | BES3 $\psi(2S) \rightarrow \pi^0 h_c$      |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |                  |        |     |                                                  |
|------|------------------|--------|-----|--------------------------------------------------|
| seen | $92^{+23}_{-22}$ | ADAMS  | 09  | CLEO $\psi(2S) \rightarrow 2\pi^+ 2\pi^- 2\pi^0$ |
| seen | 1282             | DOBBS  | 08A | CLEO $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$  |
| seen | $168 \pm 40$     | ROSNER | 05  | CLEO $\psi(2S) \rightarrow \pi^0 \eta_c \gamma$  |

<sup>1</sup> Assuming a width  $\Gamma(h_c(1P)) = 0.86 \text{ MeV} \equiv \Gamma_0$ , a measured dependence of the central value of  $B = (7.6 \pm 1.4 \times \Gamma(h_c(1P)/\Gamma_0) \times 10^{-4}$ , and with a systematic error that accounts for the width variation range 0.43–1.29 MeV.

NODE=M071S42  
NODE=M071S42

NODE=M071S42;LINKAGE=GE

 $\Gamma(3(\pi^+\pi^-)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EPTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**$35 \pm 16$**  6 FRANKLIN 83 MRK2  $e^+e^- \rightarrow$  hadrons

NODE=M071R37  
NODE=M071R37

 $\Gamma(2(\pi^+\pi^-)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EPTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**$29 \pm 10$  OUR AVERAGE** Error includes scale factor of 4.7. See the ideogram below.

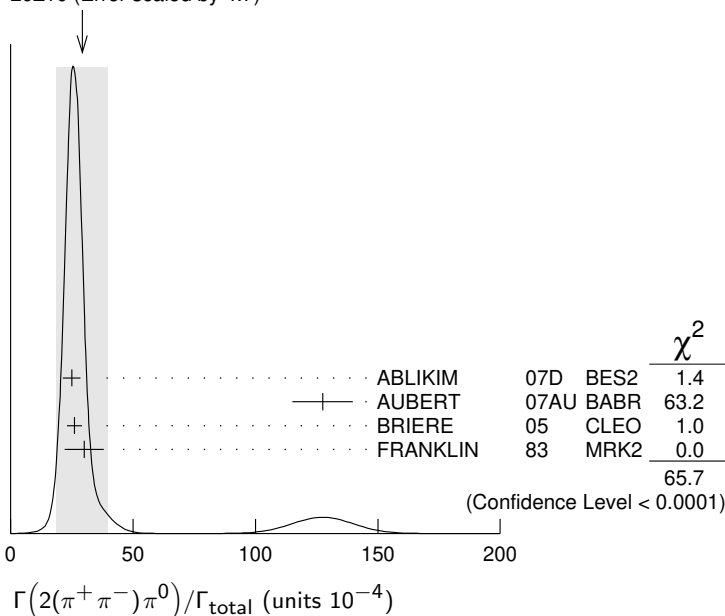
|                        |      |                     |      |                                                                   |
|------------------------|------|---------------------|------|-------------------------------------------------------------------|
| $24.9 \pm 0.7 \pm 3.6$ | 2173 | ABLIKIM             | 07D  | BES2 $e^+e^- \rightarrow \psi(2S)$                                |
| $127 \pm 12 \pm 2$     | 410  | <sup>1</sup> AUBERT | 07AU | BABR $10.6 e^+e^- \rightarrow 2(\pi^+\pi^-)\pi^0\gamma$           |
| $26.1 \pm 0.7 \pm 3.0$ | 1703 | BRIERE              | 05   | CLEO $e^+e^- \rightarrow \psi(2S) \rightarrow 2(\pi^+\pi^-)\pi^0$ |
| $30 \pm 8$             | 42   | FRANKLIN            | 83   | MRK2 $e^+e^-$                                                     |

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(\psi(2S) \rightarrow 2(\pi^+\pi^-)\pi^0)/\Gamma_{\text{total}}] \times [\Gamma(\psi(2S) \rightarrow e^+e^-)] = (297 \pm 22 \pm 18) \times 10^{-4} \text{ keV}$  which we divide by our best value  $\Gamma(\psi(2S) \rightarrow e^+e^-) = 2.33 \pm 0.04 \text{ keV}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071R22  
NODE=M071R22

NODE=M071R22;LINKAGE=UB

WEIGHTED AVERAGE  
 $29 \pm 10$  (Error scaled by 4.7)



$\Gamma(\rho\pi(1320))/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | CL%      | EVTS | DOCUMENT ID | TECN     | COMMENT                                   |
|-------------------------------------------------------------------------------|----------|------|-------------|----------|-------------------------------------------|
| <b>2.55±0.73±0.47</b>                                                         | 112 ± 31 |      | BAI         | 04C BES2 | $\psi(2S) \rightarrow 2(\pi^+\pi^-)\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |          |      |             |          |                                           |
| <2.3                                                                          | 90       |      | BAI         | 98J BES  | $e^+e^-$                                  |

NODE=M071R65  
 NODE=M071R65

 $\Gamma(\rho\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

| VALUE (units $10^{-4}$ )     | EVTS | DOCUMENT ID        | TECN     | COMMENT                                               |
|------------------------------|------|--------------------|----------|-------------------------------------------------------|
| <b>2.94±0.08 OUR FIT</b>     |      |                    |          |                                                       |
| <b>3.02±0.08 OUR AVERAGE</b> |      |                    |          |                                                       |
| 3.05±0.02±0.12               | 19k  | ABLIKIM            | 18T BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow \rho\bar{p}$ |
| 3.08±0.05±0.18               | 4.5k | <sup>1</sup> DOBBS | 14       | $e^+e^- \rightarrow \psi(2S) \rightarrow \rho\bar{p}$ |
| 3.36±0.09±0.25               | 1.6k | ABLIKIM            | 07C BES  | $e^+e^- \rightarrow \psi(2S) \rightarrow \rho\bar{p}$ |
| 2.87±0.12±0.15               | 557  | PEDLAR             | 05 CLEO  | $e^+e^- \rightarrow \psi(2S) \rightarrow \rho\bar{p}$ |
| 1.4 ±0.8                     | 4    | BRANDELIK          | 79C DASP | $e^+e^- \rightarrow \psi(2S) \rightarrow \rho\bar{p}$ |
| 2.3 ±0.7                     |      | FELDMAN            | 77 MRK1  | $e^+e^- \rightarrow \psi(2S) \rightarrow \rho\bar{p}$ |

NODE=M071R25  
 NODE=M071R25

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M071R25;LINKAGE=A

 $\Gamma(\rho\bar{p})/\Gamma(J/\psi(1S)\pi^+\pi^-)$  $\Gamma_{21}/\Gamma_{11}$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID | TECN   | COMMENT                                               |
|--------------------------|-------------|--------|-------------------------------------------------------|
| <b>8.49±0.23 OUR FIT</b> |             |        |                                                       |
| <b>6.98±0.49±0.97</b>    | BAI         | 01 BES | $e^+e^- \rightarrow \psi(2S) \rightarrow \rho\bar{p}$ |

NODE=M071S40  
 NODE=M071S40

 $\Gamma(n\bar{n})/\Gamma_{\text{total}}$  $\Gamma_{22}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                            |
|--------------------------|------|-------------|----------|----------------------------------------------------|
| <b>3.06±0.06±0.14</b>    | 6k   | ABLIKIM     | 18T BES3 | $e^+e^- \rightarrow \psi(2S) \rightarrow n\bar{n}$ |

NODE=M071P10  
 NODE=M071P10

 $\Gamma(\Delta^{++}\bar{\Delta}^{--})/\Gamma_{\text{total}}$  $\Gamma_{23}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID      | TECN   | COMMENT                                              |
|--------------------------|------|------------------|--------|------------------------------------------------------|
| <b>12.8±1.0±3.4</b>      | 157  | <sup>1</sup> BAI | 01 BES | $e^+e^- \rightarrow \psi(2S) \rightarrow$<br>hadrons |

NODE=M071R50  
 NODE=M071R50

<sup>1</sup> Estimated using  $B(\psi(2S) \rightarrow J/\psi\pi^+\pi^-) = 0.310 \pm 0.028$ .

NODE=M071R50;LINKAGE=PP

 $\Gamma(\Lambda\bar{\Lambda}\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | DOCUMENT ID          | TECN     | COMMENT                                                  |
|-------------------------------------------------------------------------------|-----|----------------------|----------|----------------------------------------------------------|
| <b>&lt; 0.29</b>                                                              | 90  | <sup>1</sup> ABLIKIM | 13F BES3 | $\psi(2S) \rightarrow \rho\bar{p}\pi^+\pi^-\gamma\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                      |          |                                                          |
| <12                                                                           | 90  | <sup>2</sup> ABLIKIM | 07H BES2 | $e^+e^- \rightarrow \psi(2S)$                            |

NODE=M071R6  
 NODE=M071R6

<sup>1</sup> Using  $B(\Lambda \rightarrow \pi^- p) = 63.9\%$  and  $B(\pi^0 \rightarrow \gamma\gamma) = 98.8\%$ .

<sup>2</sup> Using  $B(\Lambda \rightarrow \pi^- p) = 63.9\%$  and  $B(\eta \rightarrow \gamma\gamma) = 39.4\%$ .

NODE=M071R6;LINKAGE=AL  
 NODE=M071R6;LINKAGE=AB

 $\Gamma(\Lambda\bar{\Lambda}\eta)/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS                 | DOCUMENT ID | TECN | COMMENT                                                  |
|-------------------------------------------------------------------------------|-----|----------------------|-------------|------|----------------------------------------------------------|
| <b>2.48±0.34±0.19</b>                                                         | 60  | <sup>1</sup> ABLIKIM | 13F BES3    |      | $\psi(2S) \rightarrow \rho\bar{p}\pi^+\pi^-\gamma\gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                      |             |      |                                                          |
| <4.9                                                                          | 90  | <sup>2</sup> ABLIKIM | 07H BES2    |      | $e^+e^- \rightarrow \psi(2S)$                            |

NODE=M071R7  
 NODE=M071R7

<sup>1</sup> Using  $B(\Lambda \rightarrow \pi^- p) = 63.9\%$  and  $B(\eta \rightarrow \gamma\gamma) = 39.31\%$ .

<sup>2</sup> Using  $B(\Lambda \rightarrow \pi^- p) = 63.9\%$ .

NODE=M071R7;LINKAGE=AL  
 NODE=M071R7;LINKAGE=AB

 $\Gamma(\Lambda\bar{p}K^+)/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN    | COMMENT                                                            |
|--------------------------|------|-------------|---------|--------------------------------------------------------------------|
| <b>1.0±0.1±0.1</b>       | 74.0 | BRIERE      | 05 CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow$<br>$\rho\bar{p}K^+\pi^-$ |

NODE=M071S18  
 NODE=M071S18

 $\Gamma(K^*(892)^+\bar{p}\Lambda + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN      | COMMENT                       |
|--------------------------|------|-------------|-----------|-------------------------------|
| <b>6.3±0.5±0.5</b>       | 1011 | ABLIKIM     | 19AU BES3 | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071P25  
 NODE=M071P25

 $\Gamma(\Lambda\bar{p}K^+\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{28}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN    | COMMENT                                                                      |
|--------------------------|------|-------------|---------|------------------------------------------------------------------------------|
| <b>1.8±0.3±0.3</b>       | 45.8 | BRIERE      | 05 CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow$<br>$\rho\bar{p}K^+\pi^+\pi^-\pi^-$ |

NODE=M071S19  
 NODE=M071S19

$\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID | TECN    | COMMENT                                                               |
|-----------------------------------------|------|-------------|---------|-----------------------------------------------------------------------|
| <b><math>2.8 \pm 0.4 \pm 0.5</math></b> | 73.4 | BRIERE      | 05 CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow \rho\bar{\rho}2(\pi^+\pi^-)$ |

 $\Gamma_{29}/\Gamma$ 

NODE=M071S17  
 NODE=M071S17

 $\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                                                      | CL%  | EVTS           | DOCUMENT ID                                                 | TECN      | COMMENT                                                  |
|-------------------------------------------------------------------------------|------|----------------|-------------------------------------------------------------|-----------|----------------------------------------------------------|
| <b><math>3.81 \pm 0.13</math> OUR AVERAGE</b>                                 |      |                | Error includes scale factor of 1.4. See the ideogram below. |           |                                                          |
| $3.97 \pm 0.02 \pm 0.12$                                                      | 31k  |                | ABLIKIM                                                     | 17L BES3  | $e^+e^- \rightarrow \Lambda\bar{\Lambda}$                |
| $3.71 \pm 0.05 \pm 0.15$                                                      | 6.5k | <sup>1</sup>   | DOBBS                                                       | 17        | $e^+e^- \rightarrow \Lambda\bar{\Lambda}$                |
| $3.39 \pm 0.20 \pm 0.32$                                                      | 337  |                | ABLIKIM                                                     | 07C BES   | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| $6.4 \pm 1.8 \pm 0.1$                                                         |      | <sup>2</sup>   | AUBERT                                                      | 07BD BABR | $10.6 e^+e^- \rightarrow \Lambda\bar{\Lambda}\gamma$     |
| $3.28 \pm 0.23 \pm 0.25$                                                      | 208  |                | PEDLAR                                                      | 05 CLEO   | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                |                                                             |           |                                                          |
| $3.75 \pm 0.09 \pm 0.23$                                                      | 1.9k | <sup>1,3</sup> | DOBBS                                                       | 14        | $e^+e^- \rightarrow \Lambda\bar{\Lambda}$                |
| $1.81 \pm 0.20 \pm 0.27$                                                      | 80   | <sup>4</sup>   | BAI                                                         | 01 BES    | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| < 4                                                                           | 90   |                | FELDMAN                                                     | 77 MRK1   | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

 $\Gamma_{30}/\Gamma$ 

NODE=M071R28  
 NODE=M071R28

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

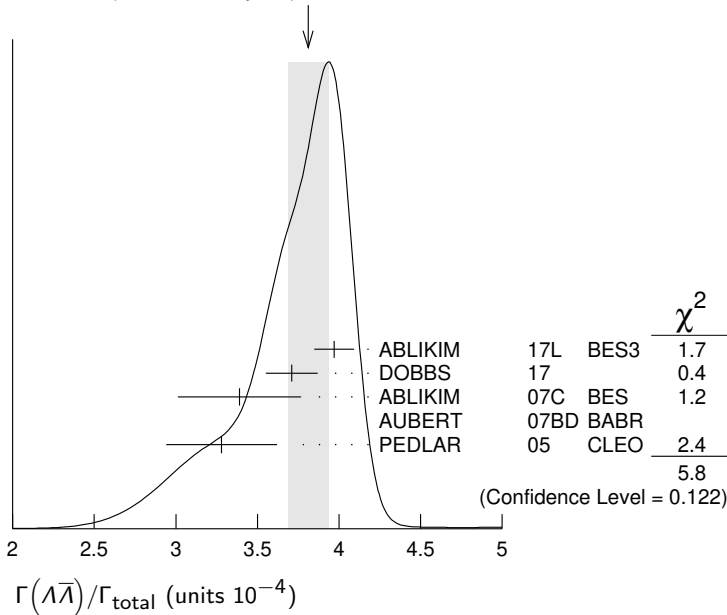
<sup>2</sup> AUBERT 07BD reports  $[\Gamma(\psi(2S) \rightarrow \Lambda\bar{\Lambda})/\Gamma_{\text{total}}] \times [\Gamma(\psi(2S) \rightarrow e^+e^-)] = (15 \pm 4 \pm 1) \times 10^{-4}$  keV which we divide by our best value  $\Gamma(\psi(2S) \rightarrow e^+e^-) = 2.33 \pm 0.04$  keV. Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> Superseded by DOBBS 17.<sup>4</sup> Estimated using  $B(\psi(2S) \rightarrow J/\psi\pi^+\pi^-) = 0.310 \pm 0.028$ .

NODE=M071R28;LINKAGE=A  
 NODE=M071R28;LINKAGE=AU

NODE=M071R28;LINKAGE=B  
 NODE=M071R28;LINKAGE=PP

WEIGHTED AVERAGE  
 $3.81 \pm 0.13$  (Error scaled by 1.4)

 $\Gamma(\Lambda\bar{\Sigma}^+\pi^- + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                   | EVTS | DOCUMENT ID | TECN     | COMMENT                               |
|--------------------------------------------|------|-------------|----------|---------------------------------------|
| <b><math>1.40 \pm 0.03 \pm 0.13</math></b> | 2.8k | ABLIKIM     | 13W BES3 | $\psi(2S) \rightarrow \text{hadrons}$ |

 $\Gamma_{31}/\Gamma$ 

NODE=M071S65  
 NODE=M071S65

 $\Gamma(\Lambda\bar{\Sigma}^-\pi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                   | EVTS | DOCUMENT ID | TECN     | COMMENT                               |
|--------------------------------------------|------|-------------|----------|---------------------------------------|
| <b><math>1.54 \pm 0.04 \pm 0.13</math></b> | 2.8k | ABLIKIM     | 13W BES3 | $\psi(2S) \rightarrow \text{hadrons}$ |

 $\Gamma_{32}/\Gamma$ 

NODE=M071S66  
 NODE=M071S66

 $\Gamma(\Lambda\bar{\Sigma}^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )                   | EVTS | DOCUMENT ID        | COMMENT                                                     |
|--------------------------------------------|------|--------------------|-------------------------------------------------------------|
| <b><math>1.23 \pm 0.23 \pm 0.08</math></b> | 30   | <sup>1</sup> DOBBS | 17 $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

 $\Gamma_{33}/\Gamma$ 

NODE=M071P08  
 NODE=M071P08

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

NODE=M071P08;LINKAGE=A

$\Gamma(\Sigma^0 \bar{p} K^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                           |
|--------------------------|------|----------------------|----------|---------------------------------------------------|
| <b>1.67±0.13±0.12</b>    | 276  | <sup>1</sup> ABLIKIM | 13D BES3 | $\psi(2S) \rightarrow \gamma \Lambda \bar{p} K^+$ |

<sup>1</sup> Using  $B(\Lambda \rightarrow p \pi^-) = 63.9\%$ , and  $B(\Sigma^0 \rightarrow \Lambda \gamma) = 100\%$ .NODE=M071S63  
NODE=M071S63

NODE=M071S63;LINKAGE=AB

 $\Gamma(\Sigma^+ \bar{\Sigma}^-)/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ 

| VALUE (units $10^{-4}$ )     | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------------------------|------|-------------|------|---------|
| <b>2.32±0.12 OUR AVERAGE</b> |      |             |      |         |

|                |      |                    |         |                                                           |
|----------------|------|--------------------|---------|-----------------------------------------------------------|
| 2.31±0.06±0.10 | 1.9k | <sup>1</sup> DOBBS | 17      | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 2.57±0.44±0.68 | 35   | PEDLAR             | 05 CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |     |                      |    |                                                           |
|----------------|-----|----------------------|----|-----------------------------------------------------------|
| 2.51±0.15±0.16 | 281 | <sup>1,2</sup> DOBBS | 14 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
|----------------|-----|----------------------|----|-----------------------------------------------------------|

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> Superseded by DOBBS 17.NODE=M071R47  
NODE=M071R47NODE=M071R47;LINKAGE=A  
NODE=M071R47;LINKAGE=B $\Gamma(\Sigma^0 \bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ 

| VALUE (units $10^{-4}$ )     | EVTS | DOCUMENT ID | TECN | COMMENT                             |
|------------------------------|------|-------------|------|-------------------------------------|
| <b>2.35±0.09 OUR AVERAGE</b> |      |             |      | Error includes scale factor of 1.1. |

|                |      |                    |          |                                                           |
|----------------|------|--------------------|----------|-----------------------------------------------------------|
| 2.44±0.03±0.11 | 7k   | ABLIKIM            | 17L BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 2.22±0.05±0.11 | 2.6k | <sup>1</sup> DOBBS | 17       | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 2.35±0.36±0.32 | 59   | ABLIKIM            | 07C BES  | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 2.63±0.35±0.21 | 58   | PEDLAR             | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |     |                      |        |                                                           |
|----------------|-----|----------------------|--------|-----------------------------------------------------------|
| 2.25±0.11±0.16 | 439 | <sup>1,2</sup> DOBBS | 14     | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 1.2 ±0.4 ±0.4  | 8   | <sup>3</sup> BAI     | 01 BES | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> Superseded by DOBBS 17.<sup>3</sup> Estimated using  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.310 \pm 0.028$ .NODE=M071R51  
NODE=M071R51NODE=M071R51;LINKAGE=A  
NODE=M071R51;LINKAGE=B  
NODE=M071R51;LINKAGE=PP $\Gamma(\Sigma(1385)^+ \bar{\Sigma}(1385)^-)/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ 

| VALUE (units $10^{-5}$ )   | EVTS | DOCUMENT ID | TECN | COMMENT |
|----------------------------|------|-------------|------|---------|
| <b>8.5±0.7 OUR AVERAGE</b> |      |             |      |         |

|             |      |                  |          |                                                            |
|-------------|------|------------------|----------|------------------------------------------------------------|
| 8.4±0.5±0.5 | 1.5k | ABLIKIM          | 16L BES3 | $\psi(2S) \rightarrow \Sigma(1385)^+ \bar{\Sigma}(1385)^-$ |
| 11 ±3 ±3    | 14   | <sup>1</sup> BAI | 01 BES   | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$  |

<sup>1</sup> Estimated using  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.310 \pm 0.028$ .NODE=M071R52  
NODE=M071R52

OCCUR=2

NODE=M071R52;LINKAGE=PP

 $\Gamma(\Sigma(1385)^- \bar{\Sigma}(1385)^+)/\Gamma_{\text{total}}$  $\Gamma_{38}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                                    |
|--------------------------|------|-------------|----------|------------------------------------------------------------|
| <b>8.5±0.6±0.6</b>       | 1.4k | ABLIKIM     | 16L BES3 | $\psi(2S) \rightarrow \Sigma(1385)^- \bar{\Sigma}(1385)^+$ |

NODE=M071R00  
NODE=M071R00 $\Gamma(\Sigma(1385)^0 \bar{\Sigma}(1385)^0)/\Gamma_{\text{total}}$  $\Gamma_{39}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                                   |
|--------------------------|------|-------------|----------|-----------------------------------------------------------|
| <b>0.69±0.05±0.05</b>    | 2.2k | ABLIKIM     | 17E BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

NODE=M071P00  
NODE=M071P00 $\Gamma(\Xi^- \bar{\Xi}^+)/\Gamma_{\text{total}}$  $\Gamma_{40}/\Gamma$ 

| VALUE (units $10^{-4}$ )     | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                             |
|------------------------------|-----|------|-------------|------|-------------------------------------|
| <b>2.87±0.11 OUR AVERAGE</b> |     |      |             |      | Error includes scale factor of 1.1. |

|                |      |                    |          |                                                           |
|----------------|------|--------------------|----------|-----------------------------------------------------------|
| 3.03±0.05±0.14 | 3.6k | <sup>1</sup> DOBBS | 17       | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 2.78±0.05±0.14 | 5k   | ABLIKIM            | 16L BES3 | $\psi(2S) \rightarrow \Xi^- \bar{\Xi}^+$                  |
| 3.03±0.40±0.32 | 67   | ABLIKIM            | 07C BES  | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 2.38±0.30±0.21 | 63   | PEDLAR             | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |     |                      |         |                                                           |
|----------------|-----|----------------------|---------|-----------------------------------------------------------|
| 2.66±0.12±0.20 | 548 | <sup>1,2</sup> DOBBS | 14      | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 0.94±0.27±0.15 | 12  | <sup>3</sup> BAI     | 01 BES  | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| <2             | 90  | FELDMAN              | 77 MRK1 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> Superseded by DOBBS 17.<sup>3</sup> Estimated using  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.310 \pm 0.028$ .NODE=M071R29  
NODE=M071R29NODE=M071R29;LINKAGE=A  
NODE=M071R29;LINKAGE=B  
NODE=M071R29;LINKAGE=PP

$\Gamma(\Xi^0 \Xi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                                                      | EVTS | DOCUMENT ID                         | TECN     | COMMENT                                                   |
|-------------------------------------------------------------------------------|------|-------------------------------------|----------|-----------------------------------------------------------|
| <b>2.3 ± 0.4 OUR AVERAGE</b>                                                  |      | Error includes scale factor of 4.2. |          |                                                           |
| 2.73 ± 0.03 ± 0.13                                                            | 11k  | ABLIKIM                             | 17E BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 1.97 ± 0.06 ± 0.11                                                            | 1.2k | <sup>1</sup> DOBBS                  | 17       | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| 2.75 ± 0.64 ± 0.61                                                            | 19   | PEDLAR                              | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                     |          |                                                           |
| 2.02 ± 0.19 ± 0.15                                                            | 112  | <sup>1,2</sup> DOBBS                | 14       | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| <sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.    |      |                                     |          |                                                           |
| <sup>2</sup> Superseded by DOBBS 17.                                          |      |                                     |          |                                                           |

Γ<sub>41</sub>/Γ

NODE=M071R48  
NODE=M071R48

 $\Gamma(\Xi(1530)^0 \Xi(1530)^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )                                                                      | CL% | EVTS | DOCUMENT ID          | TECN     | COMMENT                                                   |
|-----------------------------------------------------------------------------------------------|-----|------|----------------------|----------|-----------------------------------------------------------|
| <b>5.2 ± 0.3<sup>+3.2</sup><sub>-1.2</sub></b>                                                |     | 527  | <sup>1</sup> ABLIKIM | 13s BES3 | $\psi(2S) \rightarrow \eta p \bar{p}$                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                 |     |      |                      |          |                                                           |
| < 32                                                                                          | 90  |      | PEDLAR               | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| < 8.1                                                                                         | 90  |      | <sup>2</sup> BAI     | 01 BES   | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |
| <sup>1</sup> With $N(1535)$ decaying to $p\eta$ .                                             |     |      |                      |          |                                                           |
| <sup>2</sup> Estimated using $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.310 \pm 0.028$ . |     |      |                      |          |                                                           |

Γ<sub>42</sub>/Γ

NODE=M071R53  
NODE=M071R53

NODE=M071R53;LINKAGE=A  
NODE=M071R53;LINKAGE=PP

 $\Gamma(\Xi(1530)^- \Xi(1530)^+)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )   | EVTS | DOCUMENT ID | TECN      | COMMENT                                                   |
|----------------------------|------|-------------|-----------|-----------------------------------------------------------|
| <b>11.45 ± 0.40 ± 0.59</b> | 5k   | ABLIKIM     | 19AT BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

Γ<sub>44</sub>/Γ

NODE=M071P26  
NODE=M071P26

 $\Gamma(\Xi(1530)^- \Xi^+)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN      | COMMENT                                                   |
|--------------------------|------|-------------|-----------|-----------------------------------------------------------|
| <b>7.0 ± 1.1 ± 0.4</b>   | 399  | ABLIKIM     | 19AT BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$ |

Γ<sub>45</sub>/Γ

NODE=M071P27  
NODE=M071P27

 $\Gamma(K^- \Lambda \Xi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )  | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                    |
|---------------------------|------|-------------|----------|----------------------------------------------------------------------------|
| <b>3.86 ± 0.27 ± 0.32</b> | 236  | ABLIKIM     | 15I BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow K^- \Lambda \Xi^+ + \text{c.c.}$ |

Γ<sub>43</sub>/Γ

NODE=M071S82  
NODE=M071S82

 $\Gamma(\Xi(1690)^- \Xi^+ \rightarrow K^- \Lambda \Xi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-6}$ )  | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                    |
|---------------------------|------|-------------|----------|----------------------------------------------------------------------------|
| <b>5.21 ± 1.48 ± 0.57</b> | 74   | ABLIKIM     | 15I BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow K^- \Lambda \Xi^+ + \text{c.c.}$ |

Γ<sub>46</sub>/Γ

NODE=M071S83  
NODE=M071S83

 $\Gamma(\Xi(1820)^- \Xi^+ \rightarrow K^- \Lambda \Xi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-6}$ )   | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                    |
|----------------------------|------|-------------|----------|----------------------------------------------------------------------------|
| <b>12.03 ± 2.94 ± 1.22</b> | 136  | ABLIKIM     | 15I BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow K^- \Lambda \Xi^+ + \text{c.c.}$ |

Γ<sub>47</sub>/Γ

NODE=M071S84  
NODE=M071S84

 $\Gamma(K^- \Sigma^0 \Xi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )  | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                     |
|---------------------------|------|-------------|----------|-----------------------------------------------------------------------------|
| <b>3.67 ± 0.33 ± 0.28</b> | 142  | ABLIKIM     | 15I BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow K^- \Sigma^0 \Xi^+ + \text{c.c.}$ |

Γ<sub>48</sub>/Γ

NODE=M071S85  
NODE=M071S85

 $\Gamma(\Omega^- \bar{\Omega}^+)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS | DOCUMENT ID                                                                             | TECN     | COMMENT                                                                                  |
|-------------------------------------------------------------------------------|-----|------|-----------------------------------------------------------------------------------------|----------|------------------------------------------------------------------------------------------|
| <b>5.66 ± 0.30 OUR AVERAGE</b>                                                |     |      | Error includes scale factor of 1.3. [(0.52 ± 0.04) × 10 <sup>-4</sup> OUR 2020 AVERAGE] |          |                                                                                          |
| 5.85 ± 0.12 ± 0.25                                                            |     | 4k   | <sup>1</sup> ABLIKIM                                                                    | 21E BES3 | $\psi(2S) \rightarrow \Omega^- \bar{\Omega}^+ \rightarrow \Lambda K^- \bar{\Lambda} K^+$ |
| 5.2 ± 0.3 ± 0.3                                                               |     | 326  | <sup>1,2</sup> DOBBS                                                                    | 17       | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$                                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                                                                                         |          |                                                                                          |
| 4.7 ± 0.9 ± 0.5                                                               |     | 27   | <sup>1,2,3</sup> DOBBS                                                                  | 14       | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$                                |
| < 15                                                                          | 90  |      | ABLIKIM                                                                                 | 12Q BES2 | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$                                |
| < 16                                                                          | 90  |      | PEDLAR                                                                                  | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$                                |
| < 7.3                                                                         | 90  |      | <sup>4</sup> BAI                                                                        | 01 BES   | $e^+ e^- \rightarrow \psi(2S) \rightarrow \text{hadrons}$                                |

Γ<sub>49</sub>/Γ

NODE=M071R54  
NODE=M071R54

NEW



<sup>1</sup> Using  $B(\Omega^- \rightarrow \Lambda K^-) = (67.8 \pm 0.7)\%$  and  $B(\Lambda \rightarrow p \pi^-) = (63.9 \pm 0.5)\%$ .

<sup>2</sup> Using CLEO-c data but not authored by the CLEO Collaboration.

<sup>3</sup> Superseded by DOBBS 17.

<sup>4</sup> Estimated using  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.310 \pm 0.028$ .

### $\Gamma(\pi^0 p \bar{p})/\Gamma_{\text{total}}$

| VALUE (units $10^{-4}$ )       | EVTs | DOCUMENT ID          | TECN | COMMENT                                                                 |
|--------------------------------|------|----------------------|------|-------------------------------------------------------------------------|
| <b>1.53 ± 0.07 OUR AVERAGE</b> |      |                      |      |                                                                         |
| 1.65 ± 0.03 ± 0.15             | 4.5k | ABLIKIM              | 13A  | BES3 $\psi(2S) \rightarrow p \bar{p} \pi^0$                             |
| 1.54 ± 0.06 ± 0.06             | 948  | ALEXANDER            | 10   | CLEO $\psi(2S) \rightarrow \pi^0 p \bar{p}$                             |
| 1.32 ± 0.10 ± 0.15             | 256  | <sup>1</sup> ABLIKIM | 05E  | BES2 $e^+ e^- \rightarrow \psi(2S) \rightarrow p \bar{p} \gamma \gamma$ |
| 1.4 ± 0.5                      | 9    | FRANKLIN             | 83   | MRK2 $e^+ e^-$                                                          |

<sup>1</sup> Computed using  $B(\pi^0 \rightarrow \gamma \gamma) = (98.80 \pm 0.03)\%$ .

### $\Gamma(N(940) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p})/\Gamma_{\text{total}}$

| VALUE (units $10^{-5}$ )       | EVTs | DOCUMENT ID          | TECN | COMMENT                                     |
|--------------------------------|------|----------------------|------|---------------------------------------------|
| <b>6.42 ± 0.20 +1.78 -1.28</b> | 1.9k | <sup>1</sup> ABLIKIM | 13A  | BES3 $\psi(2S) \rightarrow p \bar{p} \pi^0$ |

<sup>1</sup> From a fit of  $\pi^0 p \bar{p}$  data to eight distinct intermediate  $N \bar{p}$  resonant states.

### $\Gamma(N(1440) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p})/\Gamma_{\text{total}}$

| VALUE (units $10^{-5}$ )         | EVTs | DOCUMENT ID | TECN | COMMENT                             |
|----------------------------------|------|-------------|------|-------------------------------------|
| <b>7.3 +1.7 -1.5 OUR AVERAGE</b> |      |             |      | Error includes scale factor of 2.5. |

|                         |      |                        |     |                                             |
|-------------------------|------|------------------------|-----|---------------------------------------------|
| 3.58 ± 0.25 +1.59 -0.84 | 1.1k | <sup>1</sup> ABLIKIM   | 13A | BES3 $\psi(2S) \rightarrow p \bar{p} \pi^0$ |
| 8.1 ± 0.7 ± 0.3         | 474  | <sup>2</sup> ALEXANDER | 10  | CLEO $\psi(2S) \rightarrow \pi^0 p \bar{p}$ |

<sup>1</sup> From a fit of  $\pi^0 p \bar{p}$  data to eight distinct intermediate  $N \bar{p}$  resonant states.

<sup>2</sup> From a fit of the  $p \bar{p}$  and  $p \pi^0$  mass distributions to a combination of  $N(1440) \bar{p}$ , a broad  $p \bar{p}$  enhancement around 2100 MeV, and two other broad, unestablished resonances.

### $\Gamma(N(1520) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p})/\Gamma_{\text{total}}$

| VALUE (units $10^{-5}$ )       | EVTs | DOCUMENT ID          | TECN | COMMENT                                     |
|--------------------------------|------|----------------------|------|---------------------------------------------|
| <b>0.64 ± 0.05 +0.22 -0.17</b> | 0.2k | <sup>1</sup> ABLIKIM | 13A  | BES3 $\psi(2S) \rightarrow p \bar{p} \pi^0$ |

<sup>1</sup> From a fit of  $\pi^0 p \bar{p}$  data to eight distinct intermediate  $N \bar{p}$  resonant states.

### $\Gamma(N(1535) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p})/\Gamma_{\text{total}}$

| VALUE (units $10^{-5}$ )       | EVTs | DOCUMENT ID          | TECN | COMMENT                                     |
|--------------------------------|------|----------------------|------|---------------------------------------------|
| <b>2.47 ± 0.28 +0.99 -0.97</b> | 0.7k | <sup>1</sup> ABLIKIM | 13A  | BES3 $\psi(2S) \rightarrow p \bar{p} \pi^0$ |

<sup>1</sup> From a fit of  $\pi^0 p \bar{p}$  data to eight distinct intermediate  $N \bar{p}$  resonant states.

### $\Gamma(N(1650) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p})/\Gamma_{\text{total}}$

| VALUE (units $10^{-5}$ )       | EVTs | DOCUMENT ID          | TECN | COMMENT                                     |
|--------------------------------|------|----------------------|------|---------------------------------------------|
| <b>3.76 ± 0.28 +1.37 -1.66</b> | 1.1k | <sup>1</sup> ABLIKIM | 13A  | BES3 $\psi(2S) \rightarrow p \bar{p} \pi^0$ |

<sup>1</sup> From a fit of  $\pi^0 p \bar{p}$  data to eight distinct intermediate  $N \bar{p}$  resonant states.

### $\Gamma(N(1720) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p})/\Gamma_{\text{total}}$

| VALUE (units $10^{-5}$ )       | EVTs | DOCUMENT ID          | TECN | COMMENT                                     |
|--------------------------------|------|----------------------|------|---------------------------------------------|
| <b>1.79 ± 0.10 +0.24 -0.71</b> | 0.5k | <sup>1</sup> ABLIKIM | 13A  | BES3 $\psi(2S) \rightarrow p \bar{p} \pi^0$ |

<sup>1</sup> From a fit of  $\pi^0 p \bar{p}$  data to eight distinct intermediate  $N \bar{p}$  resonant states.

### $\Gamma(N(2300) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p})/\Gamma_{\text{total}}$

| VALUE (units $10^{-5}$ )       | EVTs | DOCUMENT ID          | TECN | COMMENT                                     |
|--------------------------------|------|----------------------|------|---------------------------------------------|
| <b>2.62 ± 0.28 +1.12 -0.64</b> | 0.9k | <sup>1</sup> ABLIKIM | 13A  | BES3 $\psi(2S) \rightarrow p \bar{p} \pi^0$ |

<sup>1</sup> From a fit of  $\pi^0 p \bar{p}$  data to eight distinct intermediate  $N \bar{p}$  resonant states.

### $\Gamma(N(2570) \bar{p} + \text{c.c.} \rightarrow \pi^0 p \bar{p})/\Gamma_{\text{total}}$

| VALUE (units $10^{-5}$ )       | EVTs | DOCUMENT ID          | TECN | COMMENT                                     |
|--------------------------------|------|----------------------|------|---------------------------------------------|
| <b>2.13 ± 0.08 +0.40 -0.30</b> | 0.8k | <sup>1</sup> ABLIKIM | 13A  | BES3 $\psi(2S) \rightarrow p \bar{p} \pi^0$ |

<sup>1</sup> From a fit of  $\pi^0 p \bar{p}$  data to eight distinct intermediate  $N \bar{p}$  resonant states.

NODE=M071R54;LINKAGE=D  
NODE=M071R54;LINKAGE=A  
NODE=M071R54;LINKAGE=B  
NODE=M071R54;LINKAGE=PP

NODE=M071R35  
NODE=M071R35

NODE=M071R35;LINKAGE=AB

NODE=M071S56  
NODE=M071S56

NODE=M071S56;LINKAGE=AB

NODE=M071S50  
NODE=M071S50

NODE=M071S50;LINKAGE=AB  
NODE=M071S50;LINKAGE=AL

NODE=M071S57  
NODE=M071S57

NODE=M071S57;LINKAGE=AB

NODE=M071S58  
NODE=M071S58

NODE=M071S58;LINKAGE=AB

NODE=M071S59  
NODE=M071S59

NODE=M071S59;LINKAGE=AB

NODE=M071S60  
NODE=M071S60

NODE=M071S60;LINKAGE=AB

NODE=M071S61  
NODE=M071S61

NODE=M071S61;LINKAGE=AB

NODE=M071S62  
NODE=M071S62

NODE=M071S62;LINKAGE=AB

### $\Gamma(\eta p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{59}/\Gamma$

| VALUE (units $10^{-5}$ )                    | EVTS           | DOCUMENT ID            | TECN     | COMMENT                                                                     |
|---------------------------------------------|----------------|------------------------|----------|-----------------------------------------------------------------------------|
| <b><math>6.0 \pm 0.4</math> OUR AVERAGE</b> |                |                        |          |                                                                             |
| $6.4 \pm 0.2 \pm 0.6$                       | 679            | <sup>1</sup> ABLIKIM   | 13S BES3 | $\psi(2S) \rightarrow \eta p \bar{p}$                                       |
| $5.6 \pm 0.6 \pm 0.3$                       | 154            | <sup>1</sup> ALEXANDER | 10 CLEO  | $\psi(2S) \rightarrow \eta p \bar{p}$                                       |
| $5.8 \pm 1.1 \pm 0.7$                       | $44.8 \pm 8.5$ | <sup>2</sup> ABLIKIM   | 05E BES2 | $e^+ e^- \rightarrow \psi(2S) \rightarrow$<br>$p \bar{p} \gamma \gamma$     |
| $8 \pm 3 \pm 3$                             | 9.8            | BRIERE                 | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S) \rightarrow$<br>$p \bar{p} \pi^+ \pi^- \pi^0$ |

<sup>1</sup> With  $N(1535)$  decaying to  $p \eta$ .

<sup>2</sup> Computed using  $B(\eta \rightarrow \gamma \gamma) = (39.43 \pm 0.26)\%$ .

NODE=M071R56  
NODE=M071R56

NODE=M071R56;LINKAGE=A  
NODE=M071R56;LINKAGE=AB

### $\Gamma(N(1535) \bar{p} + \text{c.c.} \rightarrow \eta p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{60}/\Gamma$

| VALUE (units $10^{-5}$ )                | EVTS | DOCUMENT ID            | TECN    | COMMENT                               |
|-----------------------------------------|------|------------------------|---------|---------------------------------------|
| <b><math>4.4 \pm 0.6 \pm 0.3</math></b> | 123  | <sup>1</sup> ALEXANDER | 10 CLEO | $\psi(2S) \rightarrow \eta p \bar{p}$ |

<sup>1</sup> From a fit of the  $p \bar{p}$  and  $p \eta$  distributions to a combination of  $N^*(1535) \bar{p}$  and a broad  $p \bar{p}$  enhancement around 2100 MeV.

NODE=M071S53  
NODE=M071S53

NODE=M071S53;LINKAGE=AL

### $\Gamma(\omega p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{61}/\Gamma$

| VALUE (units $10^{-4}$ )                      | EVTS           | DOCUMENT ID      | TECN    | COMMENT                                                                     |
|-----------------------------------------------|----------------|------------------|---------|-----------------------------------------------------------------------------|
| <b><math>0.69 \pm 0.21</math> OUR AVERAGE</b> |                |                  |         |                                                                             |
| $0.6 \pm 0.2 \pm 0.2$                         | 21.2           | BRIERE           | 05 CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow$<br>$p \bar{p} \pi^+ \pi^- \pi^0$ |
| $0.8 \pm 0.3 \pm 0.1$                         | $14.9 \pm 0.1$ | <sup>1</sup> BAI | 03B BES | $\psi(2S) \rightarrow p \bar{p} \pi^+ \pi^- \pi^0$                          |

<sup>1</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .

NODE=M071R79  
NODE=M071R79

NODE=M071R;LINKAGE=B3

### $\Gamma(\eta' p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{62}/\Gamma$

| VALUE (units $10^{-5}$ )                   | EVTS | DOCUMENT ID          | TECN     | COMMENT                                |
|--------------------------------------------|------|----------------------|----------|----------------------------------------|
| <b><math>1.10 \pm 0.10 \pm 0.08</math></b> | 491  | <sup>1</sup> ABLIKIM | 19N BES3 | $\psi(2S) \rightarrow \eta' p \bar{p}$ |

<sup>1</sup> From the combination of  $p \bar{p} \eta' \rightarrow p \bar{p} \pi^+ \pi^- \eta$  and  $p \bar{p} \eta' \rightarrow p \bar{p} \pi^+ \pi^- \gamma$  channels.

NODE=M071P20  
NODE=M071P20

NODE=M071P20;LINKAGE=A

### $\Gamma(\phi p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{63}/\Gamma$

| VALUE (units $10^{-6}$ )                   | CL% | EVTS | DOCUMENT ID | TECN      | COMMENT                                                           |
|--------------------------------------------|-----|------|-------------|-----------|-------------------------------------------------------------------|
| <b><math>6.06 \pm 0.38 \pm 0.48</math></b> |     | 753  | ABLIKIM     | 19AO BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow$<br>$p \bar{p} K^+ K^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                  |         |                                                                   |
|-------|----|------------------|---------|-------------------------------------------------------------------|
| $<24$ | 90 | BRIERE           | 05 CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow$<br>$p \bar{p} K^+ K^-$ |
| $<26$ | 90 | <sup>1</sup> BAI | 03B BES | $\psi(2S) \rightarrow$<br>$K^+ K^- p \bar{p}$                     |

<sup>1</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .

NODE=M071R82  
NODE=M071R82

NODE=M071R82;LINKAGE=B3

### $\Gamma(\phi X(1835) \rightarrow \phi p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{64}/\Gamma$

| VALUE                                       | CL% | DOCUMENT ID | TECN      | COMMENT                                                           |
|---------------------------------------------|-----|-------------|-----------|-------------------------------------------------------------------|
| <b><math>&lt;1.82 \times 10^{-7}</math></b> | 90  | ABLIKIM     | 19AO BES3 | $e^+ e^- \rightarrow \psi(2S) \rightarrow$<br>$p \bar{p} K^+ K^-$ |

NODE=M071P21  
NODE=M071P21

### $\Gamma(\pi^+ \pi^- p \bar{p})/\Gamma_{\text{total}}$ $\Gamma_{65}/\Gamma$

| VALUE (units $10^{-4}$ )                    | EVTS  | DOCUMENT ID            | TECN    | COMMENT                                                               |
|---------------------------------------------|-------|------------------------|---------|-----------------------------------------------------------------------|
| <b><math>6.0 \pm 0.4</math> OUR AVERAGE</b> |       |                        |         |                                                                       |
| $5.9 \pm 0.2 \pm 0.4$                       | 904.5 | BRIERE                 | 05 CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow$<br>$p \bar{p} \pi^+ \pi^-$ |
| $8 \pm 2$                                   |       | <sup>1</sup> TANENBAUM | 78 MRK1 | $e^+ e^-$                                                             |

<sup>1</sup> Assuming entirely strong decay.

NODE=M071R31  
NODE=M071R31

NODE=M071R;LINKAGE=K

### $\Gamma(p \bar{n} \pi^- \text{ or c.c.})/\Gamma_{\text{total}}$ $\Gamma_{66}/\Gamma$

| VALUE (units $10^{-4}$ )                      | EVTS | DOCUMENT ID | TECN     | COMMENT                               |
|-----------------------------------------------|------|-------------|----------|---------------------------------------|
| <b><math>2.48 \pm 0.17</math> OUR AVERAGE</b> |      |             |          |                                       |
| $2.45 \pm 0.11 \pm 0.21$                      | 851  | ABLIKIM     | 06I BES2 | $e^+ e^- \rightarrow p \pi^- X$       |
| $2.52 \pm 0.12 \pm 0.22$                      | 849  | ABLIKIM     | 06I BES2 | $e^+ e^- \rightarrow \bar{p} \pi^+ X$ |

NODE=M071R01  
NODE=M071R01

OCCUR=2

### $\Gamma(p \bar{n} \pi^- \pi^0)/\Gamma_{\text{total}}$ $\Gamma_{67}/\Gamma$

| VALUE (units $10^{-4}$ )                   | EVTS         | DOCUMENT ID | TECN     | COMMENT                               |
|--------------------------------------------|--------------|-------------|----------|---------------------------------------|
| <b><math>3.18 \pm 0.50 \pm 0.50</math></b> | $135 \pm 21$ | ABLIKIM     | 06I BES2 | $e^+ e^- \rightarrow p \pi^- \pi^0 X$ |

NODE=M071R02  
NODE=M071R02

$\Gamma(\eta\pi^+\pi^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                                                      |
|--------------------------|-----|-------------|---------|--------------------------------------------------------------|
| <b>&lt;1.6</b>           | 90  | BRIERE      | 05 CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow 2(\pi^+\pi^-)\pi^0$ |

 $\Gamma_{69}/\Gamma$ 

NODE=M071S06  
 NODE=M071S06

 $\Gamma(\eta\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                                                      | EVTS  | DOCUMENT ID         | TECN    | COMMENT                                                                            |
|-------------------------------------------------------------------------------|-------|---------------------|---------|------------------------------------------------------------------------------------|
| <b><math>9.5 \pm 0.7 \pm 1.5</math></b>                                       |       | <sup>1</sup> BRIERE | 05 CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadr}$                              |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                     |         |                                                                                    |
| $10.3 \pm 0.8 \pm 1.4$                                                        | 201.7 | <sup>2</sup> BRIERE | 05 CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow \eta 3\pi(\eta \rightarrow \gamma\gamma)$ |
| $8.1 \pm 1.4 \pm 1.6$                                                         | 50.0  | <sup>2</sup> BRIERE | 05 CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow \eta 3\pi(\eta \rightarrow 3\pi)$         |

 $\Gamma_{70}/\Gamma$ 

NODE=M071S07  
 NODE=M071S07

<sup>1</sup> Average of  $\eta \rightarrow \gamma\gamma$  and  $\eta \rightarrow 3\pi$ .<sup>2</sup> Not independent from other values reported by BRIERE 05.

OCCUR=2

OCCUR=3

NODE=M071S07;LINKAGE=BR  
 NODE=M071S07;LINKAGE=BI

 $\Gamma(2(\pi^+\pi^-)\eta)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ )                | EVTS | DOCUMENT ID         | TECN      | COMMENT                                           |
|-----------------------------------------|------|---------------------|-----------|---------------------------------------------------|
| <b><math>1.2 \pm 0.6 \pm 0.1</math></b> | 16   | <sup>1</sup> AUBERT | 07AU BABR | $10.6 e^+e^- \rightarrow 2(\pi^+\pi^-)\eta\gamma$ |

<sup>1</sup> AUBERT 07AU quotes  $\Gamma_{ee}^{\psi(2S)} \cdot B(\psi(2S) \rightarrow 2(\pi^+\pi^-)\eta) \cdot B(\eta \rightarrow \gamma\gamma) = 1.2 \pm 0.7 \pm 0.1 \text{ eV}$ .

 $\Gamma_{71}/\Gamma$ 

NODE=M071S38  
 NODE=M071S38

NODE=M071S38;LINKAGE=UB

 $\Gamma(\eta'\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID | TECN    | COMMENT                                               |
|-----------------------------------------|------|-------------|---------|-------------------------------------------------------|
| <b><math>4.5 \pm 1.6 \pm 1.3</math></b> | 12.8 | BRIERE      | 05 CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow \text{hadr}$ |

 $\Gamma_{73}/\Gamma$ 

NODE=M071S08  
 NODE=M071S08

 $\Gamma(\omega\pi^+\pi^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                    | EVTS         | DOCUMENT ID                                                 | TECN      | COMMENT                                                      |
|---------------------------------------------|--------------|-------------------------------------------------------------|-----------|--------------------------------------------------------------|
| <b><math>7.3 \pm 1.2</math> OUR AVERAGE</b> |              | Error includes scale factor of 2.1. See the ideogram below. |           |                                                              |
| $8.4 \pm 0.5 \pm 1.2$                       | 386          | ABLIKIM                                                     | 07D BES2  | $e^+e^- \rightarrow \psi(2S)$                                |
| $12.2 \pm 2.2 \pm 0.7$                      | 37           | <sup>1</sup> AUBERT                                         | 07AU BABR | $10.6 e^+e^- \rightarrow \omega\pi^+\pi^-\gamma$             |
| $8.2 \pm 0.5 \pm 0.7$                       | 391          | BRIERE                                                      | 05 CLEO   | $e^+e^- \rightarrow \psi(2S) \rightarrow 2(\pi^+\pi^-)\pi^0$ |
| $4.8 \pm 0.6 \pm 0.7$                       | $100 \pm 22$ | <sup>2</sup> BAI                                            | 03B BES   | $\psi(2S) \rightarrow 2(\pi^+\pi^-)\pi^0$                    |

<sup>1</sup> AUBERT 07AU quotes  $\Gamma_{ee}^{\psi(2S)} \cdot B(\psi(2S) \rightarrow \omega\pi^+\pi^-) \cdot B(\omega \rightarrow 3\pi) = 2.69 \pm 0.73 \pm 0.16 \text{ eV}$ .

<sup>2</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi\pi^+\pi^-) = 0.305 \pm 0.016$ .

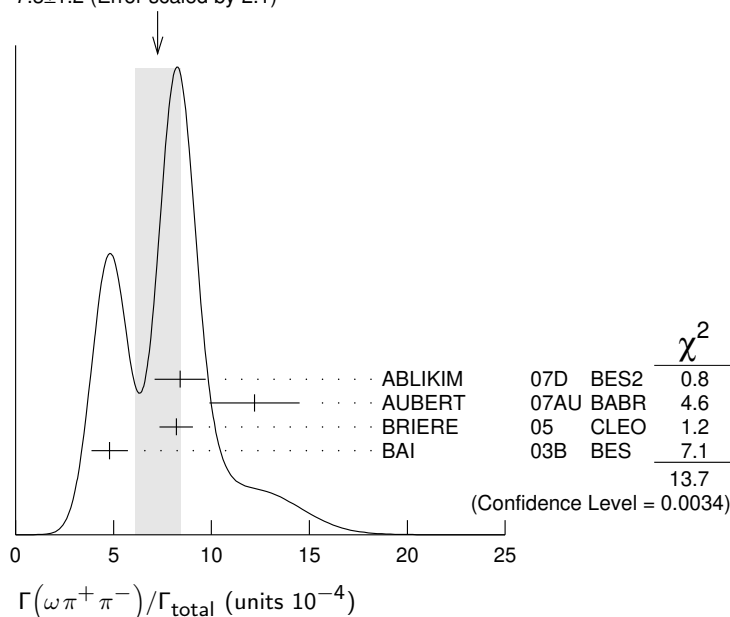
 $\Gamma_{74}/\Gamma$ 

NODE=M071R77  
 NODE=M071R77

NODE=M071R77;LINKAGE=UB

NODE=M071R77;LINKAGE=B3

WEIGHTED AVERAGE  
 $7.3 \pm 1.2$  (Error scaled by 2.1)



$\Gamma(b_1^\pm \pi^\mp)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                                                      | EVTS        | DOCUMENT ID                         | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------|-------------|-------------------------------------|----------|---------------------------------------------|
| <b>4.0 <math>\pm</math> 0.6 OUR AVERAGE</b>                                   |             | Error includes scale factor of 1.1. |          |                                             |
| 5.1 $\pm$ 0.6 $\pm$ 0.8                                                       | 202         | ABLIKIM                             | 07D BES2 | $e^+ e^- \rightarrow \psi(2S)$              |
| 4.18 $^{+0.43}_{-0.42}$ $\pm$ 0.92                                            | 170         | ADAM                                | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S)$              |
| 3.2 $\pm$ 0.6 $\pm$ 0.5                                                       | 61 $\pm$ 11 | 1,2 BAI                             | 03B BES  | $\psi(2S) \rightarrow 2(\pi^+ \pi^-) \pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |                                     |          |                                             |
| 5.2 $\pm$ 0.8 $\pm$ 1.0                                                       |             | <sup>1</sup> BAI                    | 99c BES  | Repl. by BAI 03B                            |

<sup>1</sup> Assuming  $B(b_1 \rightarrow \omega \pi)=1$ .<sup>2</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .NODE=M071R40  
NODE=M071R40NODE=M071R;LINKAGE=M1  
NODE=M071R40;LINKAGE=B3 $\Gamma(b_1^0 \pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                                       | EVTS | DOCUMENT ID | TECN    | COMMENT                        |
|----------------------------------------------------------------|------|-------------|---------|--------------------------------|
| <b>2.35<math>^{+0.47}_{-0.42}</math> <math>\pm</math> 0.40</b> | 45   | ADAM        | 05 CLEO | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071R21  
NODE=M071R21 $\Gamma(\omega f_2(1270))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | EVTS        | DOCUMENT ID      | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------|-----|-------------|------------------|----------|---------------------------------------------|
| <b>2.2 <math>\pm</math> 0.4 OUR AVERAGE</b>                                   |     |             |                  |          |                                             |
| 2.3 $\pm$ 0.5 $\pm$ 0.4                                                       |     | 57          | ABLIKIM          | 07D BES2 | $e^+ e^- \rightarrow \psi(2S)$              |
| 2.05 $\pm$ 0.41 $\pm$ 0.38                                                    |     | 62 $\pm$ 12 | BAI              | 04C BES2 | $\psi(2S) \rightarrow 2(\pi^+ \pi^-) \pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |                  |          |                                             |
| <1.5                                                                          | 90  |             | <sup>1</sup> BAI | 03B BES  | $\psi(2S) \rightarrow 2(\pi^+ \pi^-) \pi^0$ |
| <1.7                                                                          | 90  |             | BAI              | 98J BES  | Repl. by BAI 03B                            |

<sup>1</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .NODE=M071R64  
NODE=M071R64

NODE=M071R64;LINKAGE=B3

 $\Gamma(\pi^+ \pi^- K^+ K^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                                                      | EVTS  | DOCUMENT ID            | TECN      | COMMENT                                                        |
|-------------------------------------------------------------------------------|-------|------------------------|-----------|----------------------------------------------------------------|
| <b>7.3 <math>\pm</math> 0.5 OUR AVERAGE</b>                                   |       |                        |           |                                                                |
| 8.1 $\pm$ 1.3 $\pm$ 0.3                                                       | 133   | LEES                   | 12F BABR  | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$          |
| 7.1 $\pm$ 0.3 $\pm$ 0.4                                                       | 817.2 | BRIERE                 | 05 CLEO   | $e^+ e^- \rightarrow \psi(2S) \rightarrow K^+ K^- \pi^+ \pi^-$ |
| 16 $\pm$ 4                                                                    |       | <sup>1</sup> TANENBAUM | 78 MRK1   | $e^+ e^-$                                                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                        |           |                                                                |
| 11.0 $\pm$ 1.9 $\pm$ 0.2                                                      | 85    | <sup>2</sup> AUBERT    | 07AK BABR | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$          |

<sup>1</sup> Assuming entirely strong decay.<sup>2</sup> Superseded by LEES 12F. AUBERT 07AK reports [ $\Gamma(\psi(2S) \rightarrow \pi^+ \pi^- K^+ K^-)/\Gamma_{\text{total}}$ ]  $\times [\Gamma(\psi(2S) \rightarrow e^+ e^-)] = (2.56 \pm 0.42 \pm 0.16) \times 10^{-3}$  keV which we divide by our best value  $\Gamma(\psi(2S) \rightarrow e^+ e^-) = 2.33 \pm 0.04$  keV. Our first error is their experiment's error and our second error is the systematic error from using our best value.NODE=M071R24  
NODE=M071R24NODE=M071R24;LINKAGE=K  
NODE=M071R24;LINKAGE=BE $\Gamma(\rho^0 K^+ K^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                             | EVTS  | DOCUMENT ID | TECN    | COMMENT                                                        |
|------------------------------------------------------|-------|-------------|---------|----------------------------------------------------------------|
| <b>2.2 <math>\pm</math> 0.2 <math>\pm</math> 0.4</b> | 223.8 | BRIERE      | 05 CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow K^+ K^- \pi^+ \pi^-$ |

NODE=M071S09  
NODE=M071S09 $\Gamma(K^*(892)^0 \bar{K}_2^*(1430)^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | EVTS        | DOCUMENT ID | TECN    | COMMENT                                    |
|-------------------------------------------------------------------------------|-----|-------------|-------------|---------|--------------------------------------------|
| <b>1.86 <math>\pm</math> 0.32 <math>\pm</math> 0.43</b>                       |     | 93 $\pm$ 16 | BAI         | 04C     | $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |             |         |                                            |
| <1.2                                                                          | 90  |             | BAI         | 98J BES | $e^+ e^-$                                  |

NODE=M071R66  
NODE=M071R66 $\Gamma(K^+ K^- \pi^+ \pi^- \eta)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ )                             | EVTS | DOCUMENT ID         | TECN      | COMMENT                                                    |
|------------------------------------------------------|------|---------------------|-----------|------------------------------------------------------------|
| <b>1.3 <math>\pm</math> 0.7 <math>\pm</math> 0.1</b> | 7    | <sup>1</sup> AUBERT | 07AU BABR | 10.6 $e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \eta \gamma$ |

<sup>1</sup> AUBERT 07AU quotes  $\Gamma_{ee}^{\psi(2S)} \cdot B(\psi(2S) \rightarrow 2(\pi^+ \pi^-) \eta) \cdot B(\eta \rightarrow \gamma \gamma) = 1.2 \pm 0.7 \pm 0.1$  eV.NODE=M071S39  
NODE=M071S39

NODE=M071S39;LINKAGE=UB

 $\Gamma(K^+ K^- 2(\pi^+ \pi^-) \pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                              | EVTS | DOCUMENT ID | TECN     | COMMENT                        |
|-------------------------------------------------------|------|-------------|----------|--------------------------------|
| <b>10.0 <math>\pm</math> 2.5 <math>\pm</math> 1.8</b> | 65   | ABLIKIM     | 07D BES2 | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071R09  
NODE=M071R09

$\Gamma(K_1(1270)^\pm K^\mp)/\Gamma_{\text{total}}$  $\Gamma_{87}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID      | TECN | COMMENT      |
|--------------------------|------------------|------|--------------|
| <b>10.0±1.8±2.1</b>      | <sup>1</sup> BAI | 99C  | BES $e^+e^-$ |

<sup>1</sup> Assuming  $B(K_1(1270) \rightarrow K\rho)=0.42 \pm 0.06$ NODE=M071R41  
NODE=M071R41

NODE=M071R;LINKAGE=M2

 $\Gamma(K_S^0 K_S^0 \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{88}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS   | DOCUMENT ID | TECN | COMMENT                            |
|--------------------------|--------|-------------|------|------------------------------------|
| <b>2.20±0.25±0.37</b>    | 83 ± 9 | ABLIKIM     | 050  | BES2 $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071R49  
NODE=M071R49 $\Gamma(\rho^0 \rho^0)/\Gamma_{\text{total}}$  $\Gamma_{89}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                                                 |
|--------------------------|------|-------------|------|-------------------------------------------------------------------------|
| <b>0.5±0.1±0.2</b>       | 61.1 | BRIERE      | 05   | CLEO $e^+e^- \rightarrow \psi(2S) \rightarrow \rho\bar{\rho}\pi^+\pi^-$ |

NODE=M071S14  
NODE=M071S14 $\Gamma(K^+ \bar{K}^*(892)^0 \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{90}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID | TECN | COMMENT       |
|--------------------------|-------------|------|---------------|
| <b>6.7±2.5</b>           | TANENBAUM   | 78   | MRK1 $e^+e^-$ |

NODE=M071R34  
NODE=M071R34 $\Gamma(2(\pi^+ \pi^-))/\Gamma_{\text{total}}$  $\Gamma_{91}/\Gamma$ 

| VALUE (units $10^{-4}$ )   | EVTS                                | DOCUMENT ID | TECN | COMMENT                                                       |
|----------------------------|-------------------------------------|-------------|------|---------------------------------------------------------------|
| <b>2.4±0.6 OUR AVERAGE</b> | Error includes scale factor of 2.2. |             |      |                                                               |
| 2.2±0.2±0.2                | 308                                 | BRIERE      | 05   | CLEO $e^+e^- \rightarrow \psi(2S) \rightarrow 2(\pi^+ \pi^-)$ |
| 4.5±1.0                    |                                     | TANENBAUM   | 78   | MRK1 $e^+e^-$                                                 |

NODE=M071R27  
NODE=M071R27 $\Gamma(\rho^0 \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{92}/\Gamma$ 

| VALUE (units $10^{-4}$ )   | EVTS                                | DOCUMENT ID | TECN | COMMENT                                                       |
|----------------------------|-------------------------------------|-------------|------|---------------------------------------------------------------|
| <b>2.2±0.6 OUR AVERAGE</b> | Error includes scale factor of 1.4. |             |      |                                                               |
| 2.0±0.2±0.4                | 285.5                               | BRIERE      | 05   | CLEO $e^+e^- \rightarrow \psi(2S) \rightarrow 2(\pi^+ \pi^-)$ |
| 4.2±1.5                    |                                     | TANENBAUM   | 78   | MRK1 $e^+e^-$                                                 |

NODE=M071R33  
NODE=M071R33 $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{93}/\Gamma$ 

| VALUE (units $10^{-4}$ )    | EVTS  | DOCUMENT ID         | TECN | COMMENT                                                                  |
|-----------------------------|-------|---------------------|------|--------------------------------------------------------------------------|
| <b>12.6±0.9 OUR AVERAGE</b> |       |                     |      |                                                                          |
| 18.9±5.7±0.3                | 32    | <sup>1</sup> AUBERT | 07AU | BABR $10.6 e^+e^- \rightarrow K^+ K^- \pi^+ \pi^- \pi^0 \gamma$          |
| 11.7±1.0±1.5                | 597   | ABLIKIM             | 06G  | BES2 $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$                    |
| 12.7±0.5±1.0                | 711.6 | BRIERE              | 05   | CLEO $e^+e^- \rightarrow \psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |

NODE=M071S10  
NODE=M071S10

<sup>1</sup> AUBERT 07AU reports  $[\Gamma(\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}] \times [\Gamma(\psi(2S) \rightarrow e^+ e^-)] = (44 \pm 13 \pm 3) \times 10^{-4}$  keV which we divide by our best value  $\Gamma(\psi(2S) \rightarrow e^+ e^-) = 2.33 \pm 0.04$  keV. Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071S10;LINKAGE=UB

 $\Gamma(\omega f_0(1710) \rightarrow \omega K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{94}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                               |
|--------------------------|------|-------------|------|-------------------------------------------------------|
| <b>5.9±2.0±0.9</b>       | 19   | ABLIKIM     | 06G  | BES2 $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |

NODE=M071S20  
NODE=M071S20 $\Gamma(K^*(892)^0 K^- \pi^+ \pi^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{95}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                               |
|--------------------------|------|-------------|------|-------------------------------------------------------|
| <b>8.6±1.3±1.8</b>       | 238  | ABLIKIM     | 06G  | BES2 $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |

NODE=M071S21  
NODE=M071S21 $\Gamma(K^*(892)^+ K^- \pi^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{96}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                               |
|--------------------------|------|-------------|------|-------------------------------------------------------|
| <b>9.6±2.2±1.7</b>       | 133  | ABLIKIM     | 06G  | BES2 $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |

NODE=M071S22  
NODE=M071S22 $\Gamma(K^*(892)^+ K^- \rho^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{97}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                               |
|--------------------------|------|-------------|------|-------------------------------------------------------|
| <b>7.3±2.2±1.4</b>       | 78   | ABLIKIM     | 06G  | BES2 $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |

NODE=M071S23  
NODE=M071S23

$\Gamma(K^*(892)^0 K^- \rho^+ + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                          |
|--------------------------|------|-------------|----------|--------------------------------------------------|
| <b>6.1±1.3±1.2</b>       | 125  | ABLIKIM     | 06G BES2 | $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |

 $\Gamma_{98}/\Gamma$ 

 NODE=M071S24  
 NODE=M071S24

 $\Gamma(\eta K^+ K^-, \text{no } \eta\phi)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**3.49±0.17 OUR AVERAGE** [(3.1 ± 0.4) × 10<sup>-5</sup> OUR 2020 AVERAGE]

**3.49±0.09±0.15** 1.8k <sup>1</sup> ABLIKIM 20F BES3  $\psi(2S) \rightarrow K^+ K^- \gamma\gamma$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |      |                        |          |                                                                      |
|----------------|------|------------------------|----------|----------------------------------------------------------------------|
| 3.08±0.29±0.25 | 0.3k | <sup>1,2</sup> ABLIKIM | 12L BES3 | $\psi(2S) \rightarrow K^+ K^- \gamma\gamma$                          |
| <13            | 90   | BRIERE                 | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |

<sup>1</sup> Excluding  $\eta\phi$ .

<sup>2</sup> Superseded by ABLIKIM 20F.

 $\Gamma_{99}/\Gamma$ 

 NODE=M071S11  
 NODE=M071S11

NEW

 $\Gamma(\omega K^+ K^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**1.62±0.11 OUR AVERAGE** Error includes scale factor of 1.1.

 1.56±0.04±0.11 2.8k ABLIKIM 14G BES3  $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ 

 2.38±0.37±0.29 78 ABLIKIM 06G BES2  $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ 

 1.9 ±0.3 ±0.3 76.8 BRIERE 05 CLEO  $e^+ e^- \rightarrow \psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ 

 1.5 ±0.3 ±0.2 23 <sup>1</sup> BAI 03B BES  $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ 
<sup>1</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .

 $\Gamma_{100}/\Gamma$ 

 NODE=M071R78  
 NODE=M071R78

 $\Gamma(\omega K^*(892)^+ K^- + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**20.7±2.6 OUR AVERAGE**

 18.9±2.9±2.2 396 ABLIKIM 13M BES3  $\psi(2S) \rightarrow \omega K_S^0 K^- \pi^+$ 

 22.6±3.0±2.4 535 ABLIKIM 13M BES3  $\psi(2S) \rightarrow \omega K^+ K^- \pi^0$ 
 $\Gamma_{101}/\Gamma$ 

 NODE=M071S67  
 NODE=M071S67

OCCUR=2

 $\Gamma(\omega K_2^*(1430)^+ K^- + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**6.1 ±1.2 OUR AVERAGE**

 6.39±1.50±0.78 128 ABLIKIM 13M BES3  $\psi(2S) \rightarrow \omega K_S^0 K^- \pi^+$ 

 5.86±1.61±0.83 143 ABLIKIM 13M BES3  $\psi(2S) \rightarrow \omega K^+ K^- \pi^0$ 
 $\Gamma_{102}/\Gamma$ 

 NODE=M071S68  
 NODE=M071S68

OCCUR=2

 $\Gamma(\omega \bar{K}^*(892)^0 K^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**16.8±2.5±1.6** 356 ABLIKIM 13M BES3  $\psi(2S) \rightarrow \omega K_S^0 K^- \pi^+$ 
 $\Gamma_{103}/\Gamma$ 

 NODE=M071S69  
 NODE=M071S69

 $\Gamma(\omega \bar{K}_2^*(1430)^0 K^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**5.82±2.08±0.72** 116 ABLIKIM 13M BES3  $\psi(2S) \rightarrow \omega K_S^0 K^- \pi^+$ 
 $\Gamma_{104}/\Gamma$ 

 NODE=M071S70  
 NODE=M071S70

 $\Gamma(\omega X(1440) \rightarrow \omega K_S^0 K^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**1.60±0.27±0.24** 109 <sup>1</sup> ABLIKIM 13M BES3  $\psi(2S) \rightarrow \omega K_S^0 K^- \pi^+$ 
<sup>1</sup> X(1440) compatible with  $\eta(1405)$  and  $\eta(1475)$ . A  $f_1(1420)$  is also possible.

 $\Gamma_{105}/\Gamma$ 

 NODE=M071S71  
 NODE=M071S71

NODE=M071S71;LINKAGE=AB

 $\Gamma(\omega X(1440) \rightarrow \omega K^+ K^- \pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**1.09±0.20±0.16** 82 <sup>1</sup> ABLIKIM 13M BES3  $\psi(2S) \rightarrow \omega K^+ K^- \pi^0$ 
<sup>1</sup> X(1440) compatible with  $\eta(1405)$  and  $\eta(1475)$ . A  $f_1(1420)$  is also possible.

 $\Gamma_{106}/\Gamma$ 

 NODE=M071S72  
 NODE=M071S72

NODE=M071S72;LINKAGE=AB

 $\Gamma(\omega f_1(1285) \rightarrow \omega K_S^0 K^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.302±0.098±0.027** 22 <sup>1</sup> ABLIKIM 13M BES3  $\psi(2S) \rightarrow \omega K_S^0 K^- \pi^+$ 
<sup>1</sup> Statistical significance 4.5  $\sigma$ . This measurement is equivalent to a limit of  $< 0.478 \times 10^{-5}$  at 90% C.L.

 $\Gamma_{107}/\Gamma$ 

 NODE=M071S73  
 NODE=M071S73

NODE=M071S73;LINKAGE=AB

$\Gamma(\omega f_1(1285) \rightarrow \omega K^+ K^- \pi^0) / \Gamma_{\text{total}}$ 
 $\Gamma_{108} / \Gamma$ 

| VALUE (units $10^{-5}$ )     | EVTS | DOCUMENT ID          | TECN     | COMMENT                                     |
|------------------------------|------|----------------------|----------|---------------------------------------------|
| <b>0.125 ± 0.070 ± 0.013</b> | 10   | <sup>1</sup> ABLIKIM | 13M BES3 | $\psi(2S) \rightarrow \omega K^+ K^- \pi^0$ |

<sup>1</sup> Statistical significance 3.2  $\sigma$ . This measurement is equivalent to a limit of  $< 0.221 \times 10^{-5}$  at 90% C.L.

NODE=M071S74  
NODE=M071S74

NODE=M071S74;LINKAGE=AB

 $\Gamma(3(\pi^+ \pi^-)) / \Gamma_{\text{total}}$ 
 $\Gamma_{109} / \Gamma$ 

| VALUE (units $10^{-4}$ )     | EVTS                                | DOCUMENT ID | TECN | COMMENT |
|------------------------------|-------------------------------------|-------------|------|---------|
| <b>3.5 ± 2.0 OUR AVERAGE</b> | Error includes scale factor of 2.8. |             |      |         |

|                    |     |                        |          |                                                           |
|--------------------|-----|------------------------|----------|-----------------------------------------------------------|
| 5.45 ± 0.42 ± 0.87 | 671 | ABLIKIM                | 05H BES2 | $e^+ e^- \rightarrow \psi(2S) \rightarrow 3(\pi^+ \pi^-)$ |
| 1.5 ± 1.0          |     | <sup>1</sup> TANENBAUM | 78 MRK1  | $e^+ e^-$                                                 |

<sup>1</sup> Assuming entirely strong decay.

NODE=M071R32  
NODE=M071R32

NODE=M071R32;LINKAGE=K

 $\Gamma(p\bar{p}\pi^+ \pi^- \pi^0) / \Gamma_{\text{total}}$ 
 $\Gamma_{110} / \Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS  | DOCUMENT ID | TECN    | COMMENT                                                              |
|--------------------------|-------|-------------|---------|----------------------------------------------------------------------|
| <b>7.3 ± 0.4 ± 0.6</b>   | 434.9 | BRIERE      | 05 CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow p\bar{p}\pi^+ \pi^- \pi^0$ |

NODE=M071S15  
NODE=M071S15

 $\Gamma(K^+ K^-) / \Gamma_{\text{total}}$ 
 $\Gamma_{111} / \Gamma$ 

| VALUE (units $10^{-5}$ )  | CL%  | EVTS | DOCUMENT ID            | TECN | COMMENT                        |
|---------------------------|------|------|------------------------|------|--------------------------------|
| <b>7.48 ± 0.23 ± 0.39</b> | 1.3k |      | <sup>1</sup> METREVELI | 12   | $\psi(2S) \rightarrow K^+ K^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |    |                        |          |                                      |
|-----------------|----|------------------------|----------|--------------------------------------|
| 6.2 ± 1.5 ± 0.2 | 66 | <sup>2,3</sup> LEES    | 15J BABR | $e^+ e^- \rightarrow K^+ K^- \gamma$ |
| 8.3 ± 1.5 ± 0.2 | 66 | <sup>3,4</sup> LEES    | 15J BABR | $e^+ e^- \rightarrow K^+ K^- \gamma$ |
| 6.3 ± 0.6 ± 0.3 |    | <sup>5</sup> DOBBS     | 06A CLEO | $e^+ e^-$                            |
| 10 ± 7          |    | <sup>5</sup> BRANDELIK | 79C DASP | $e^+ e^-$                            |
| < 5             | 90 | FELDMAN                | 77 MRK1  | $e^+ e^-$                            |

<sup>1</sup> Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

<sup>2</sup>  $\sin\phi > 0$ .

<sup>3</sup> Using  $\Gamma(\psi(2S) \rightarrow e^+ e^-) = (2.37 \pm 0.04) \text{ keV}$ .

<sup>4</sup>  $\sin\phi < 0$ .

<sup>5</sup> Interference with non-resonant  $K^+ K^-$  production not taken into account.

NODE=M071R23  
NODE=M071R23

OCCUR=2

NODE=M071R23;LINKAGE=ME  
NODE=M071R23;LINKAGE=A  
NODE=M071R23;LINKAGE=B  
NODE=M071R23;LINKAGE=C  
NODE=M071R23;LINKAGE=BA

 $\Gamma(K_S^0 K_L^0) / \Gamma_{\text{total}}$ 
 $\Gamma_{112} / \Gamma$ 

| VALUE (units $10^{-5}$ )       | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|------|-------------|------|---------|
| <b>5.34 ± 0.33 OUR AVERAGE</b> |      |             |      |         |

|                    |          |                        |          |                                                              |
|--------------------|----------|------------------------|----------|--------------------------------------------------------------|
| 5.28 ± 0.25 ± 0.34 | 478 ± 23 | <sup>1</sup> METREVELI | 12       | $\psi(2S) \rightarrow K_S^0 K_L^0$                           |
| 5.8 ± 0.8 ± 0.4    |          | DOBBS                  | 06A CLEO | $e^+ e^-$                                                    |
| 5.24 ± 0.47 ± 0.48 | 156 ± 14 | <sup>2</sup> BAI       | 04B BES2 | $\psi(2S) \rightarrow K_S^0 K_L^0 \rightarrow \pi^+ \pi^- X$ |

<sup>1</sup> Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

<sup>2</sup> Using  $B(K_S^0 \rightarrow \pi^+ \pi^-) = 0.6860 \pm 0.0027$ .

NODE=M071R87  
NODE=M071R87

NODE=M071R87;LINKAGE=ME  
NODE=M071R;LINKAGE=KZ

 $\Gamma(\pi^+ \pi^- \pi^0) / \Gamma_{\text{total}}$ 
 $\Gamma_{113} / \Gamma$ 

| VALUE (units $10^{-4}$ )       | EVTS                                                        | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|-------------------------------------------------------------|-------------|------|---------|
| <b>2.01 ± 0.17 OUR AVERAGE</b> | Error includes scale factor of 1.7. See the ideogram below. |             |      |         |

|                                               |          |                      |          |                                      |
|-----------------------------------------------|----------|----------------------|----------|--------------------------------------|
| 2.14 ± 0.03 <sup>+0.12</sup> <sub>-0.11</sub> | 7k       | <sup>1</sup> ABLIKIM | 12H BES3 | $e^+ e^- \rightarrow \psi(2S)$       |
| 1.81 ± 0.18 ± 0.19                            | 260 ± 19 | <sup>2</sup> ABLIKIM | 05J BES2 | $e^+ e^- \rightarrow \psi(2S)$       |
| 1.88 <sup>+0.16</sup> <sub>-0.15</sub> ± 0.28 | 194      | ADAM                 | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S)$       |
| 0.85 ± 0.46                                   | 4        | FRANKLIN             | 83 MRK2  | $e^+ e^- \rightarrow \text{hadrons}$ |

<sup>1</sup> From  $\psi(2S) \rightarrow \pi^+ \pi^- \pi^0$  events directly. The quoted systematic error includes a contribution of 4% (added in quadrature) from the uncertainty on the number of  $\psi(2S)$  events.

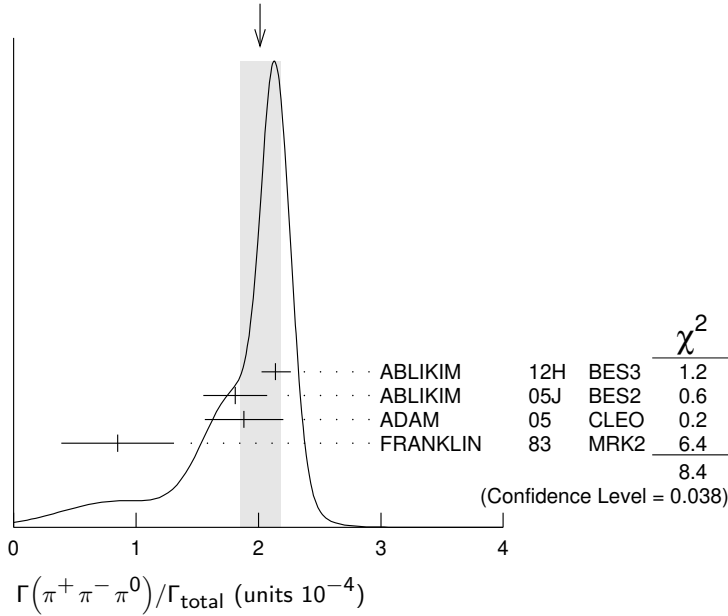
<sup>2</sup> From a PW analysis of  $\psi(2S) \rightarrow \pi^+ \pi^- \pi^0$ .

NODE=M071R36  
NODE=M071R36

NODE=M071R36;LINKAGE=AB

NODE=M071R;LINKAGE=AK

WEIGHTED AVERAGE  
2.01±0.17 (Error scaled by 1.7)



### $\Gamma(\rho(2150)\pi \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ $\Gamma_{114}/\Gamma$

| VALUE (units $10^{-4}$ )        | DOCUMENT ID                   | TECN | COMMENT                                                          |
|---------------------------------|-------------------------------|------|------------------------------------------------------------------|
| $1.94 \pm 0.25^{+1.15}_{-0.34}$ | <sup>1</sup> ABLIKIM 05J BES2 |      | $\psi(2S) \rightarrow \rho(2150)\pi \rightarrow \pi^+\pi^-\pi^0$ |

<sup>1</sup> From a PW analysis of  $\psi(2S) \rightarrow \pi^+\pi^-\pi^0$ .

NODE=M071R57  
NODE=M071R57

NODE=M071R57;LINKAGE=AK

### $\Gamma(\rho(770)\pi \rightarrow \pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ $\Gamma_{115}/\Gamma$

| VALUE (units $10^{-4}$ )        | CL% | EVTS | DOCUMENT ID                   | TECN | COMMENT                                                         |
|---------------------------------|-----|------|-------------------------------|------|-----------------------------------------------------------------|
| <b>0.32±0.12 OUR AVERAGE</b>    |     |      |                               |      | Error includes scale factor of 1.8.                             |
| $0.51 \pm 0.07 \pm 0.11$        |     |      | <sup>1</sup> ABLIKIM 05J BES2 |      | $\psi(2S) \rightarrow \rho(770)\pi \rightarrow \pi^+\pi^-\pi^0$ |
| $0.24^{+0.08}_{-0.07} \pm 0.02$ | 22  |      | ADAM 05 CLEO                  |      | $e^+e^- \rightarrow \psi(2S)$                                   |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |              |                  |          |
|-------|----|--------------|------------------|----------|
| <0.83 | 90 | 1            | FRANKLIN 83 MRK2 | $e^+e^-$ |
| <10   | 90 |              | BARTEL 76 CNTR   | $e^+e^-$ |
| <10   | 90 | <sup>2</sup> | ABRAMS 75 MRK1   | $e^+e^-$ |

<sup>1</sup> From a PW analysis of  $\psi(2S) \rightarrow \pi^+\pi^-\pi^0$ .

<sup>2</sup> Final state  $\rho^0\pi^0$ .

NODE=M071R26  
NODE=M071R26

NODE=M071R26;LINKAGE=AK  
NODE=M071R;LINKAGE=N

### $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$ $\Gamma_{116}/\Gamma$

| VALUE (units $10^{-5}$ )     | CL% | EVTS | DOCUMENT ID               | TECN | COMMENT                           |
|------------------------------|-----|------|---------------------------|------|-----------------------------------|
| <b>0.78±0.26 OUR AVERAGE</b> |     |      |                           |      |                                   |
| $0.76 \pm 0.25 \pm 0.06$     | 30  |      | <sup>1</sup> METREVELI 12 |      | $\psi(2S) \rightarrow \pi^+\pi^-$ |
| $8 \pm 5$                    |     |      | BRANDELIK 79C DASP        |      | $e^+e^-$                          |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |  |                 |                               |
|------|----|--|-----------------|-------------------------------|
| <2.1 | 90 |  | DOBBS 06A CLEO  | $e^+e^- \rightarrow \psi(2S)$ |
| <5   | 90 |  | FELDMAN 77 MRK1 | $e^+e^-$                      |

<sup>1</sup> Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration. Using  $\psi(3770) \rightarrow \pi^+\pi^-$  for continuum subtraction.

NODE=M071R20  
NODE=M071R20

NODE=M071R20;LINKAGE=ME

### $\Gamma(K_1(1400)^\pm K^\mp)/\Gamma_{\text{total}}$ $\Gamma_{117}/\Gamma$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT  |
|--------------------------|-----|--------------------------|------|----------|
| <b>&lt;3.1</b>           | 90  | <sup>1</sup> BAI 99C BES |      | $e^+e^-$ |

<sup>1</sup> Assuming  $B(K_1(1400) \rightarrow K^*\pi)=0.94 \pm 0.06$

NODE=M071R45  
NODE=M071R45

NODE=M071R;LINKAGE=M3

### $\Gamma(K_2^*(1430)^\pm K^\mp)/\Gamma_{\text{total}}$ $\Gamma_{118}/\Gamma$

| VALUE (units $10^{-5}$ )        | EVTS     | DOCUMENT ID      | TECN | COMMENT                       |
|---------------------------------|----------|------------------|------|-------------------------------|
| $7.12 \pm 0.62^{+1.13}_{-0.61}$ | 251 ± 22 | ABLIKIM 12L BES3 |      | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071S54  
NODE=M071S54



$\Gamma(K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{119}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTs | DOCUMENT ID | TECN     | COMMENT                              |
|-------------------------------------------------------------------------------|-----|------|-------------|----------|--------------------------------------|
| <b><math>4.07 \pm 0.16 \pm 0.26</math></b>                                    |     | 0.9k | ABLIKIM     | 12L BES3 | $e^+ e^- \rightarrow \psi(2S)$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |             |          |                                      |
| <8.9                                                                          | 90  | 1    | FRANKLIN    | 83 MRK2  | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M071R38  
 NODE=M071R38

 $\Gamma(K^+ K^*(892)^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{122}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTs          | DOCUMENT ID | TECN     | COMMENT                              |
|-------------------------------------------------------------------------------|-----|---------------|-------------|----------|--------------------------------------|
| <b><math>2.9 \pm 0.4</math> OUR AVERAGE</b>                                   |     |               |             |          | Error includes scale factor of 1.2.  |
| $3.18 \pm 0.30^{+0.26}_{-0.31}$                                               |     | 0.2k          | ABLIKIM     | 12L BES3 | $e^+ e^- \rightarrow \psi(2S)$       |
| $2.9^{+1.3}_{-1.7} \pm 0.4$                                                   |     | $9.6 \pm 4.2$ | ABLIKIM     | 05I BES2 | $e^+ e^- \rightarrow \psi(2S)$       |
| $1.3^{+1.0}_{-0.7} \pm 0.3$                                                   |     | 7             | ADAM        | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S)$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |               |             |          |                                      |
| <5.4                                                                          | 90  |               | FRANKLIN    | 83 MRK2  | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M071R39  
 NODE=M071R39

 $\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{123}/\Gamma$ 

| VALUE (units $10^{-5}$ )                     | EVTs           | DOCUMENT ID | TECN     | COMMENT                        |
|----------------------------------------------|----------------|-------------|----------|--------------------------------|
| <b><math>10.9 \pm 2.0</math> OUR AVERAGE</b> |                |             |          |                                |
| $13.3^{+2.4}_{-2.8} \pm 1.7$                 | $65.6 \pm 9.0$ | ABLIKIM     | 05I BES2 | $e^+ e^- \rightarrow \psi(2S)$ |
| $9.2^{+2.7}_{-2.2} \pm 0.9$                  | 25             | ADAM        | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071R30  
 NODE=M071R30

 $\Gamma(K^+ K^*(892)^- + \text{c.c.})/\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})$  $\Gamma_{122}/\Gamma_{123}$ 

| VALUE                                         | DOCUMENT ID | TECN     | COMMENT                        |
|-----------------------------------------------|-------------|----------|--------------------------------|
| <b><math>0.16 \pm 0.06</math> OUR AVERAGE</b> |             |          |                                |
| $0.22^{+0.10}_{-0.14}$                        | ABLIKIM     | 05I BES2 | $e^+ e^- \rightarrow \psi(2S)$ |
| $0.14^{+0.08}_{-0.06}$                        | ADAM        | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071R46  
 NODE=M071R46

 $\Gamma(\phi \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{124}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | EVTs           | DOCUMENT ID           | TECN      | COMMENT                                                        |
|-------------------------------------------------------------------------------|----------------|-----------------------|-----------|----------------------------------------------------------------|
| <b><math>1.18 \pm 0.26</math> OUR AVERAGE</b>                                 |                |                       |           | Error includes scale factor of 1.5. See the ideogram below.    |
| $2.3 \pm 0.8 \pm 0.1$                                                         | $19 \pm 6$     | LEES                  | 12F BABR  | $10.6 e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$          |
| $0.9 \pm 0.2 \pm 0.1$                                                         | 47.6           | BRIERE                | 05 CLEO   | $e^+ e^- \rightarrow \psi(2S) \rightarrow K^+ K^- \pi^+ \pi^-$ |
| $1.5 \pm 0.2 \pm 0.2$                                                         | $51.5 \pm 8.3$ | <sup>1</sup> BAI      | 03B BES   | $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^-$                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                |                       |           |                                                                |
| $2.45 \pm 0.96 \pm 0.04$                                                      | $10 \pm 4$     | <sup>2,3</sup> AUBERT | 07AK BABR | $10.6 e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$          |

NODE=M071R80  
 NODE=M071R80

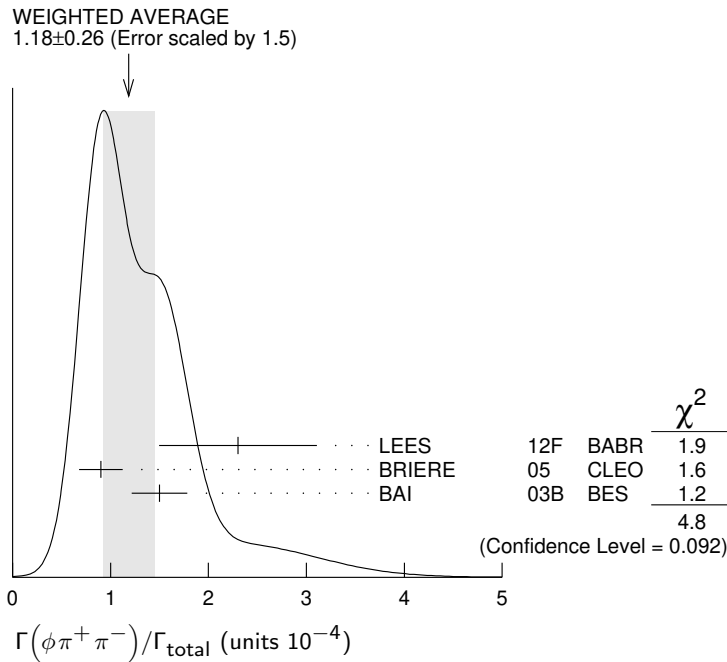
<sup>1</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .

<sup>2</sup> Superseded by LEES 12F. AUBERT 07AK reports  $[\Gamma(\psi(2S) \rightarrow \phi \pi^+ \pi^-)/\Gamma_{\text{total}}] \times [\Gamma(\psi(2S) \rightarrow e^+ e^-)] = (0.57 \pm 0.22 \pm 0.04) \times 10^{-3}$  keV which we divide by our best value  $\Gamma(\psi(2S) \rightarrow e^+ e^-) = 2.33 \pm 0.04$  keV. Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> Using  $B(\phi \rightarrow K^+ K^-) = (49.3 \pm 0.6)\%$ .

NODE=M071R80;LINKAGE=B3  
 NODE=M071R80;LINKAGE=BE

NODE=M071R80;LINKAGE=UB



### $\Gamma(\phi f_0(980) \rightarrow \pi^+ \pi^-) / \Gamma_{\text{total}}$

$\Gamma_{125} / \Gamma$

| VALUE (units $10^{-4}$ )                                                      | EVTS       | DOCUMENT ID                         | TECN      | COMMENT                                               |
|-------------------------------------------------------------------------------|------------|-------------------------------------|-----------|-------------------------------------------------------|
| <b>0.75±0.33 OUR AVERAGE</b>                                                  |            | Error includes scale factor of 1.6. |           |                                                       |
| 1.5 ±0.5 ±0.1                                                                 | 12 ± 4     | LEES                                | 12F BABR  | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$ |
| 0.6 ±0.2 ±0.1                                                                 | 18.4 ± 6.4 | <sup>1</sup> BAI                    | 03B BES   | $\psi(2S) \rightarrow K^+ K^- \pi^+ \pi^-$            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |            |                                     |           |                                                       |
| 1.46±0.71±0.02                                                                | 6 ± 3      | <sup>2,3</sup> AUBERT               | 07AK BABR | 10.6 $e^+ e^- \rightarrow \pi^+ \pi^- K^+ K^- \gamma$ |

<sup>1</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .

<sup>2</sup> Superseded by LEES 12F. AUBERT 07AK reports  $[\Gamma(\psi(2S) \rightarrow \phi f_0(980) \rightarrow \pi^+ \pi^-) / \Gamma_{\text{total}}] \times [\Gamma(\psi(2S) \rightarrow e^+ e^-)] = (0.34 \pm 0.16 \pm 0.04) \times 10^{-3}$  keV which we divide by our best value  $\Gamma(\psi(2S) \rightarrow e^+ e^-) = 2.33 \pm 0.04$  keV. Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>3</sup> Using  $B(\phi \rightarrow K^+ K^-) = (49.3 \pm 0.6)\%$ .

NODE=M071R83  
NODE=M071R83

NODE=M071R83;LINKAGE=B3  
NODE=M071R83;LINKAGE=BE

NODE=M071R83;LINKAGE=UB

### $\Gamma(2(K^+ K^-)) / \Gamma_{\text{total}}$

$\Gamma_{126} / \Gamma$

| VALUE (units $10^{-4}$ )     | EVTS | DOCUMENT ID | TECN     | COMMENT                                               |
|------------------------------|------|-------------|----------|-------------------------------------------------------|
| <b>0.63±0.13 OUR AVERAGE</b> |      |             |          |                                                       |
| 0.9 ±0.4 ±0.1                | 13   | LEES        | 12F BABR | 10.6 $e^+ e^- \rightarrow 2(K^+ K^-) \gamma$          |
| 0.6 ±0.1 ±0.1                | 59.2 | BRIERE      | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S) \rightarrow 2(K^+ K^-)$ |

NODE=M071S12  
NODE=M071S12

### $\Gamma(\phi K^+ K^-) / \Gamma_{\text{total}}$

$\Gamma_{127} / \Gamma$

| VALUE (units $10^{-4}$ )     | EVTS       | DOCUMENT ID      | TECN    | COMMENT                                               |
|------------------------------|------------|------------------|---------|-------------------------------------------------------|
| <b>0.70±0.16 OUR AVERAGE</b> |            |                  |         |                                                       |
| 0.8 ±0.2 ±0.1                | 36.8       | BRIERE           | 05 CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow 2(K^+ K^-)$ |
| 0.6 ±0.2 ±0.1                | 16.1 ± 5.0 | <sup>1</sup> BAI | 03B BES | $\psi(2S) \rightarrow 2(K^+ K^-)$                     |

<sup>1</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .

NODE=M071R81  
NODE=M071R81

NODE=M071R81;LINKAGE=B3

### $\Gamma(2(K^+ K^-) \pi^0) / \Gamma_{\text{total}}$

$\Gamma_{128} / \Gamma$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN    | COMMENT                                                     |
|--------------------------|------|-------------|---------|-------------------------------------------------------------|
| <b>1.1±0.2±0.2</b>       | 44.7 | BRIERE      | 05 CLEO | $e^+ e^- \rightarrow \psi(2S) \rightarrow 2(K^+ K^-) \pi^0$ |

NODE=M071S13  
NODE=M071S13

### $\Gamma(\phi \eta) / \Gamma_{\text{total}}$

$\Gamma_{129} / \Gamma$

| VALUE (units $10^{-5}$ )                 | EVTS | DOCUMENT ID | TECN     | COMMENT                        |
|------------------------------------------|------|-------------|----------|--------------------------------|
| <b>3.10±0.31 OUR AVERAGE</b>             |      |             |          |                                |
| 3.14±0.23±0.23                           | 0.2k | ABLIKIM     | 12L BES3 | $e^+ e^- \rightarrow \psi(2S)$ |
| 2.0 <sup>+1.5</sup> <sub>-1.1</sub> ±0.4 | 6    | ADAM        | 05 CLEO  | $e^+ e^- \rightarrow \psi(2S)$ |
| 3.3 ±1.1 ±0.5                            | 17   | ABLIKIM     | 04K BES  | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071R89  
NODE=M071R89

$\Gamma(\eta\phi(2170), \phi(2170) \rightarrow \phi f_0(980), f_0 \rightarrow \pi^+\pi^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{130}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                                |
|-----------------------|-----|-------------|----------|----------------------------------------|
| $<2.2 \times 10^{-6}$ | 90  | ABLIKIM     | 19I BES3 | $e^+e^- \rightarrow \eta\phi f_0(980)$ |

NODE=M071P19  
NODE=M071P19

 $\Gamma(\phi\eta')/\Gamma_{\text{total}}$ 
 $\Gamma_{131}/\Gamma$ 

| VALUE (units $10^{-5}$ )                    | EVTS | DOCUMENT ID          | TECN      | COMMENT                       |
|---------------------------------------------|------|----------------------|-----------|-------------------------------|
| <b>1.54<math>\pm</math>0.20 OUR AVERAGE</b> |      |                      |           |                               |
| 1.51 $\pm$ 0.16 $\pm$ 0.12                  | 201  | ABLIKIM              | 19BA BES3 | $e^+e^- \rightarrow \psi(2S)$ |
| 3.1 $\pm$ 1.4 $\pm$ 0.7                     | 8    | <sup>1</sup> ABLIKIM | 04K BES   | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071R90  
NODE=M071R90

<sup>1</sup> Calculated combining  $\eta' \rightarrow \gamma\rho$  and  $\eta\pi^+\pi^-$  channels.

NODE=M071R;LINKAGE=AI

 $\Gamma(\omega\eta')/\Gamma_{\text{total}}$ 
 $\Gamma_{134}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                  | EVTS | DOCUMENT ID          | TECN    | COMMENT                       |
|-----------------------------------------------------------|------|----------------------|---------|-------------------------------|
| <b>3.2<math>^{+2.4}_{-2.0}</math> <math>\pm</math>0.7</b> | 4    | <sup>1</sup> ABLIKIM | 04K BES | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071R91  
NODE=M071R91

<sup>1</sup> Calculated combining  $\eta' \rightarrow \gamma\rho$  and  $\eta\pi^+\pi^-$  channels.

NODE=M071R91;LINKAGE=AI

 $\Gamma(\omega\pi^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{135}/\Gamma$ 

| VALUE (units $10^{-5}$ )                   | EVTS | DOCUMENT ID | TECN    | COMMENT                       |
|--------------------------------------------|------|-------------|---------|-------------------------------|
| <b>2.1 <math>\pm</math>0.6 OUR AVERAGE</b> |      |             |         |                               |
| 2.5 $^{+1.2}_{-1.0}$ $\pm$ 0.2             | 14   | ADAM        | 05 CLEO | $e^+e^- \rightarrow \psi(2S)$ |
| 1.87 $^{+0.68}_{-0.62}$ $\pm$ 0.28         | 14   | ABLIKIM     | 04L BES | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071R92  
NODE=M071R92

 $\Gamma(\rho\eta')/\Gamma_{\text{total}}$ 
 $\Gamma_{136}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                       | EVTS | DOCUMENT ID | TECN    | COMMENT                       |
|----------------------------------------------------------------|------|-------------|---------|-------------------------------|
| <b>1.87 <math>^{+1.64}_{-1.11}</math> <math>\pm</math>0.33</b> | 2    | ABLIKIM     | 04L BES | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071R93  
NODE=M071R93

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                               |     |                      |           |                               |
|-------------------------------|-----|----------------------|-----------|-------------------------------|
| 1.02 $\pm$ 0.11 $\pm$ 0.24    | 143 | <sup>1</sup> ABLIKIM | 17AK BES3 | $e^+e^- \rightarrow \psi(2S)$ |
| 0.569 $\pm$ 0.128 $\pm$ 0.236 | 80  | <sup>2</sup> ABLIKIM | 17AK BES3 | $e^+e^- \rightarrow \psi(2S)$ |

OCCUR=2

<sup>1</sup> Destructive-interference solution of a partial wave analysis of the decay  $\psi(2S) \rightarrow \pi^+\pi^-\eta'$ .

NODE=M071R93;LINKAGE=A

<sup>2</sup> Constructive-interference solution of a partial wave analysis of the decay  $\psi(2S) \rightarrow \pi^+\pi^-\eta'$ .

NODE=M071R93;LINKAGE=B

 $\Gamma(\rho\eta)/\Gamma_{\text{total}}$ 
 $\Gamma_{137}/\Gamma$ 

| VALUE (units $10^{-5}$ )                   | EVTS | DOCUMENT ID | TECN    | COMMENT                             |
|--------------------------------------------|------|-------------|---------|-------------------------------------|
| <b>2.2 <math>\pm</math>0.6 OUR AVERAGE</b> |      |             |         | Error includes scale factor of 1.1. |
| 3.0 $^{+1.1}_{-0.9}$ $\pm$ 0.2             | 18   | ADAM        | 05 CLEO | $e^+e^- \rightarrow \psi(2S)$       |
| 1.78 $^{+0.67}_{-0.62}$ $\pm$ 0.17         | 13   | ABLIKIM     | 04L BES | $e^+e^- \rightarrow \psi(2S)$       |

NODE=M071R94  
NODE=M071R94

 $\Gamma(\omega\eta)/\Gamma_{\text{total}}$ 
 $\Gamma_{138}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | DOCUMENT ID | TECN    | COMMENT                       |
|-------------------------------------------------------------------------------|-----|-------------|---------|-------------------------------|
| <b>&lt;1.1</b>                                                                | 90  | ADAM        | 05 CLEO | $e^+e^- \rightarrow \psi(2S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |         |                               |
| <3.1                                                                          | 90  | ABLIKIM     | 04K BES | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071R95  
NODE=M071R95

 $\Gamma(\phi\pi^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{139}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | DOCUMENT ID | TECN     | COMMENT                       |
|-------------------------------------------------------------------------------|-----|-------------|----------|-------------------------------|
| <b>&lt;0.04</b>                                                               | 90  | ABLIKIM     | 12L BES3 | $e^+e^- \rightarrow \psi(2S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                               |
| <0.7                                                                          | 90  | ADAM        | 05 CLEO  | $e^+e^- \rightarrow \psi(2S)$ |
| <0.4                                                                          | 90  | ABLIKIM     | 04K BES  | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071R96  
NODE=M071R96

 $\Gamma(\eta_c\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{140}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                       |
|--------------------------|-----|-------------|---------|-------------------------------|
| <b>&lt;1.0</b>           | 90  | PEDLAR      | 07 CLEO | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071R03  
NODE=M071R03

 $\Gamma(p\bar{p}K^+K^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{141}/\Gamma$ 

| VALUE (units $10^{-5}$ )                         | EVTS | DOCUMENT ID | TECN    | COMMENT                                                  |
|--------------------------------------------------|------|-------------|---------|----------------------------------------------------------|
| <b>2.7<math>\pm</math>0.6<math>\pm</math>0.4</b> | 30.1 | BRIERE      | 05 CLEO | $e^+e^- \rightarrow \psi(2S) \rightarrow p\bar{p}K^+K^-$ |

NODE=M071S16  
NODE=M071S16

$\Gamma(\bar{\Lambda}nK_S^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{142}/\Gamma$ 

| VALUE (units $10^{-4}$ )                   | EVTs | DOCUMENT ID          | TECN     | COMMENT                     |
|--------------------------------------------|------|----------------------|----------|-----------------------------|
| <b><math>0.81 \pm 0.11 \pm 0.14</math></b> | 50   | <sup>1</sup> ABLIKIM | 08C BES2 | $e^+e^- \rightarrow J/\psi$ |

<sup>1</sup> Using  $B(\bar{\Lambda} \rightarrow \bar{p}\pi^+) = 63.9\%$  and  $B(K_S^0 \rightarrow \pi^+\pi^-) = 69.2\%$ .

NODE=M071R08  
NODE=M071R08

NODE=M071R08;LINKAGE=AB

 $\Gamma(\phi f_2'(1525))/\Gamma_{\text{total}}$  $\Gamma_{143}/\Gamma$ 

| VALUE (units $10^{-4}$ )                   | CL%        | EVTs | DOCUMENT ID | TECN | COMMENT                          |
|--------------------------------------------|------------|------|-------------|------|----------------------------------|
| <b><math>0.44 \pm 0.12 \pm 0.11</math></b> | $20 \pm 6$ | BAI  | 04C         |      | $\psi(2S) \rightarrow 2(K^+K^-)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |    |     |         |  |                                |
|---------|----|-----|---------|--|--------------------------------|
| $<0.45$ | 90 | BAI | 98J BES |  | $e^+e^- \rightarrow 2(K^+K^-)$ |
|---------|----|-----|---------|--|--------------------------------|

NODE=M071R67  
NODE=M071R67

 $\Gamma(\phi f_1(1285))/\Gamma_{\text{total}}$  $\Gamma_{132}/\Gamma$ 

| VALUE (units $10^{-5}$ )                | EVTs | DOCUMENT ID          | TECN      | COMMENT                       |
|-----------------------------------------|------|----------------------|-----------|-------------------------------|
| <b><math>3.0 \pm 0.4 \pm 1.3</math></b> | 234  | <sup>1</sup> ABLIKIM | 19BA BES3 | $e^+e^- \rightarrow \psi(2S)$ |

<sup>1</sup> ABLIKIM 19BA reports  $[\Gamma(\psi(2S) \rightarrow \phi f_1(1285))/\Gamma_{\text{total}}] \times [B(f_1(1285) \rightarrow \eta\pi^+\pi^-)] = (1.03 \pm 0.10 \pm 0.09) \times 10^{-5}$  which we divide by our best value  $B(f_1(1285) \rightarrow \eta\pi^+\pi^-) = (35 \pm 15) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071P22  
NODE=M071P22

NODE=M071P22;LINKAGE=B

 $\Gamma(\phi\eta(1405) \rightarrow \phi\pi^+\pi^-\eta)/\Gamma_{\text{total}}$  $\Gamma_{133}/\Gamma$ 

| VALUE (units $10^{-6}$ )                   | EVTs | DOCUMENT ID | TECN      | COMMENT                       |
|--------------------------------------------|------|-------------|-----------|-------------------------------|
| <b><math>8.46 \pm 1.37 \pm 0.92</math></b> | 195  | ABLIKIM     | 19BA BES3 | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071P24  
NODE=M071P24

 $\Gamma(\Theta(1540)\bar{\Theta}(1540) \rightarrow K_S^0 p K^- \bar{n} + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{144}/\Gamma$ 

| VALUE (units $10^{-5}$ )     | CL% | DOCUMENT ID | TECN     | COMMENT  |
|------------------------------|-----|-------------|----------|----------|
| <b><math>&lt;0.88</math></b> | 90  | BAI         | 04G BES2 | $e^+e^-$ |

NODE=M071S01  
NODE=M071S01

 $\Gamma(\Theta(1540)K^-\bar{n} \rightarrow K_S^0 p K^- \bar{n})/\Gamma_{\text{total}}$  $\Gamma_{145}/\Gamma$ 

| VALUE (units $10^{-5}$ )    | CL% | DOCUMENT ID | TECN     | COMMENT  |
|-----------------------------|-----|-------------|----------|----------|
| <b><math>&lt;1.0</math></b> | 90  | BAI         | 04G BES2 | $e^+e^-$ |

NODE=M071S02  
NODE=M071S02

 $\Gamma(\Theta(1540)K_S^0 \bar{p} \rightarrow K_S^0 \bar{p} K^+ n)/\Gamma_{\text{total}}$  $\Gamma_{146}/\Gamma$ 

| VALUE (units $10^{-5}$ )     | CL% | DOCUMENT ID | TECN     | COMMENT  |
|------------------------------|-----|-------------|----------|----------|
| <b><math>&lt;0.70</math></b> | 90  | BAI         | 04G BES2 | $e^+e^-$ |

NODE=M071S03  
NODE=M071S03

 $\Gamma(\bar{\Theta}(1540)K^+ n \rightarrow K_S^0 \bar{p} K^+ n)/\Gamma_{\text{total}}$  $\Gamma_{147}/\Gamma$ 

| VALUE (units $10^{-5}$ )    | CL% | DOCUMENT ID | TECN     | COMMENT  |
|-----------------------------|-----|-------------|----------|----------|
| <b><math>&lt;2.6</math></b> | 90  | BAI         | 04G BES2 | $e^+e^-$ |

NODE=M071S04  
NODE=M071S04

 $\Gamma(\bar{\Theta}(1540)K_S^0 p \rightarrow K_S^0 p K^- \bar{n})/\Gamma_{\text{total}}$  $\Gamma_{148}/\Gamma$ 

| VALUE (units $10^{-5}$ )     | CL% | DOCUMENT ID | TECN     | COMMENT  |
|------------------------------|-----|-------------|----------|----------|
| <b><math>&lt;0.60</math></b> | 90  | BAI         | 04G BES2 | $e^+e^-$ |

NODE=M071S05  
NODE=M071S05

 $\Gamma(K_S^0 K_S^0)/\Gamma_{\text{total}}$  $\Gamma_{149}/\Gamma$ 

| VALUE (units $10^{-4}$ )      | DOCUMENT ID      | TECN    | COMMENT  |
|-------------------------------|------------------|---------|----------|
| <b><math>&lt;0.046</math></b> | <sup>1</sup> BAI | 04D BES | $e^+e^-$ |

<sup>1</sup> Forbidden by CP.

NODE=M071R88  
NODE=M071R88

NODE=M071R;LINKAGE=BA

 $\Gamma(\Lambda_c^+ \bar{p} e^+ e^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{150}/\Gamma$ 

| VALUE                                      | CL% | EVTs | DOCUMENT ID | TECN     | COMMENT                       |
|--------------------------------------------|-----|------|-------------|----------|-------------------------------|
| <b><math>&lt;1.7 \times 10^{-6}</math></b> | 90  | 450M | ABLIKIM     | 18Q BES3 | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071P11  
NODE=M071P11

## RADIATIVE DECAYS

 $\Gamma(\gamma\chi_{c0}(1P))/\Gamma_{\text{total}}$  $\Gamma_{151}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**$9.79 \pm 0.20$  OUR FIT**

**$9.33 \pm 0.26$  OUR AVERAGE**

|                             |      |                       |     |      |                               |
|-----------------------------|------|-----------------------|-----|------|-------------------------------|
| $9.389 \pm 0.014 \pm 0.332$ | 4.7M | ABLIKIM               | 17U | BES3 | $e^+e^- \rightarrow \gamma X$ |
| $9.22 \pm 0.11 \pm 0.46$    | 72k  | ATHAR                 | 04  | CLEO | $e^+e^- \rightarrow \gamma X$ |
| $9.9 \pm 0.5 \pm 0.8$       |      | <sup>1</sup> GAISER   | 86  | CBAL | $e^+e^- \rightarrow \gamma X$ |
| $7.2 \pm 2.3$               |      | <sup>1</sup> BIDDICK  | 77  | CNTR | $e^+e^- \rightarrow \gamma X$ |
| $7.5 \pm 2.6$               |      | <sup>1</sup> WHITAKER | 76  | MRK1 | $e^+e^-$                      |

<sup>1</sup> Angular distribution  $(1+\cos^2\theta)$  assumed.

NODE=M071315

NODE=M071R55  
NODE=M071R55

NODE=M071R;LINKAGE=A

$\Gamma(\gamma\chi_{c1}(1P))/\Gamma_{\text{total}}$ VALUE (units  $10^{-2}$ ) EVTS

DOCUMENT ID

TECN

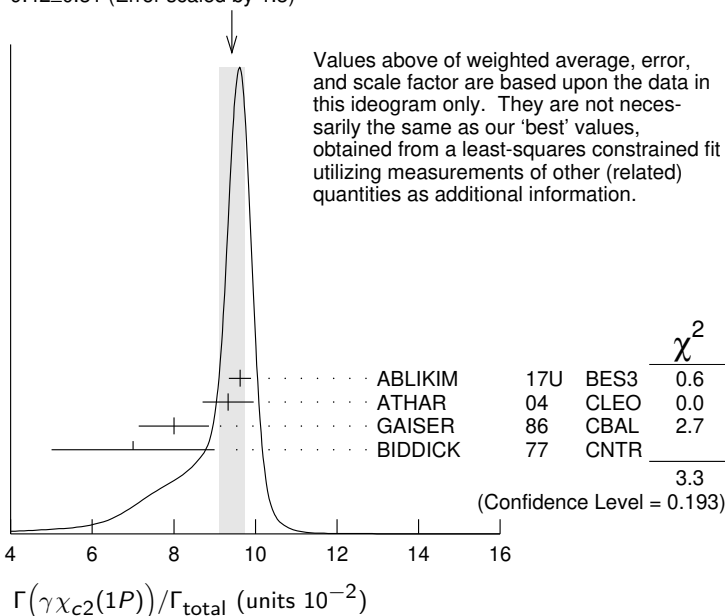
COMMENT

 $\Gamma_{152}/\Gamma$ NODE=M071R58  
NODE=M071R58**9.75  $\pm$  0.24 OUR FIT****9.54  $\pm$  0.29 OUR AVERAGE**9.905  $\pm$  0.011  $\pm$  0.353 5.0M ABLIKIM 17U BES3  $e^+e^- \rightarrow \gamma X$ 9.07  $\pm$  0.11  $\pm$  0.54 76k ATHAR 04 CLEO  $e^+e^- \rightarrow \gamma X$ 9.0  $\pm$  0.5  $\pm$  0.7 <sup>1</sup> GAISER 86 CBAL  $e^+e^- \rightarrow \gamma X$ 7.1  $\pm$  1.9 <sup>2</sup> BIDDICK 77 CNTR  $e^+e^- \rightarrow \gamma X$ <sup>1</sup> Angular distribution  $(1-0.189 \cos^2\theta)$  assumed.<sup>2</sup> Valid for isotropic distribution of the photon.NODE=M071R;LINKAGE=G  
NODE=M071R;LINKAGE=B $\Gamma(\gamma\chi_{c2}(1P))/\Gamma_{\text{total}}$ VALUE (units  $10^{-2}$ ) EVTS

DOCUMENT ID

TECN

COMMENT

 $\Gamma_{153}/\Gamma$ NODE=M071R59  
NODE=M071R59**9.52  $\pm$  0.20 OUR FIT****9.42  $\pm$  0.31 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.9.621  $\pm$  0.013  $\pm$  0.272 4.2M ABLIKIM 17U BES3  $e^+e^- \rightarrow \gamma X$ 9.33  $\pm$  0.14  $\pm$  0.61 79k ATHAR 04 CLEO  $e^+e^- \rightarrow \gamma X$ 8.0  $\pm$  0.5  $\pm$  0.7 <sup>1</sup> GAISER 86 CBAL  $e^+e^- \rightarrow \gamma X$ 7.0  $\pm$  2.0 <sup>2</sup> BIDDICK 77 CNTR  $e^+e^- \rightarrow \gamma X$ <sup>1</sup> Angular distribution  $(1-0.052 \cos^2\theta)$  assumed.<sup>2</sup> Valid for isotropic distribution of the photon.NODE=M071R;LINKAGE=F  
NODE=M071R59;LINKAGE=BWEIGHTED AVERAGE  
9.42 $\pm$ 0.31 (Error scaled by 1.3) $[\Gamma(\gamma\chi_{c0}(1P)) + \Gamma(\gamma\chi_{c1}(1P)) + \Gamma(\gamma\chi_{c2}(1P))]/\Gamma_{\text{total}}$  ( $\Gamma_{151} + \Gamma_{152} + \Gamma_{153})/\Gamma$ 

VALUE DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

27.6  $\pm$  0.3  $\pm$  2.0 <sup>1</sup> ATHAR 04 CLEO  $e^+e^- \rightarrow \gamma X$ <sup>1</sup> Not independent from ATHAR 04 measurements of  $B(\gamma\chi_{cJ})$ .NODE=M071R19  
NODE=M071R19

NODE=M071R;LINKAGE=AH

 $\Gamma(\gamma\chi_{c0}(1P))/\Gamma(\gamma\chi_{c1}(1P))$ 

VALUE DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.02  $\pm$  0.01  $\pm$  0.07 <sup>1</sup> ATHAR 04 CLEO  $e^+e^- \rightarrow \gamma X$ <sup>1</sup> Not independent from ATHAR 04 measurements of  $B(\gamma\chi_{cJ})$ . $\Gamma_{151}/\Gamma_{152}$ NODE=M071R97  
NODE=M071R97

NODE=M071R97;LINKAGE=AH

 $\Gamma(\gamma\chi_{c2}(1P))/\Gamma(\gamma\chi_{c1}(1P))$ 

VALUE DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.03  $\pm$  0.02  $\pm$  0.03 <sup>1</sup> ATHAR 04 CLEO  $e^+e^- \rightarrow \gamma X$ <sup>1</sup> Not independent from ATHAR 04 measurements of  $B(\gamma\chi_{cJ})$ . $\Gamma_{153}/\Gamma_{152}$ NODE=M071R98  
NODE=M071R98

NODE=M071R98;LINKAGE=AH

$\Gamma(\gamma\chi_{c0}(1P))/\Gamma(\gamma\chi_{c2}(1P))$  $\Gamma_{151}/\Gamma_{153}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

$0.99 \pm 0.02 \pm 0.08$  <sup>1</sup> ATHAR 04 CLEO  $e^+e^- \rightarrow \gamma X$

<sup>1</sup> Not independent from ATHAR 04 measurements of  $B(\gamma\chi_{cJ})$ .

NODE=M071R99  
NODE=M071R99

NODE=M071R99;LINKAGE=AH

 $\Gamma(\gamma\eta_c(1S))/\Gamma_{\text{total}}$  $\Gamma_{154}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.34  $\pm$  0.05 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

$0.432 \pm 0.016 \pm 0.060$  MITCHELL 09 CLEO  $e^+e^- \rightarrow \gamma X$

$0.32 \pm 0.04 \pm 0.06$  <sup>1</sup> ATHAR 04 CLEO  $e^+e^- \rightarrow \gamma X$

$0.28 \pm 0.06$  <sup>2</sup> GAISER 86 CBAL  $e^+e^- \rightarrow \gamma X$

<sup>1</sup> ATHAR 04 used  $\Gamma_{\eta_c(1S)} = 24.8 \pm 4.9$  MeV to obtain this result.

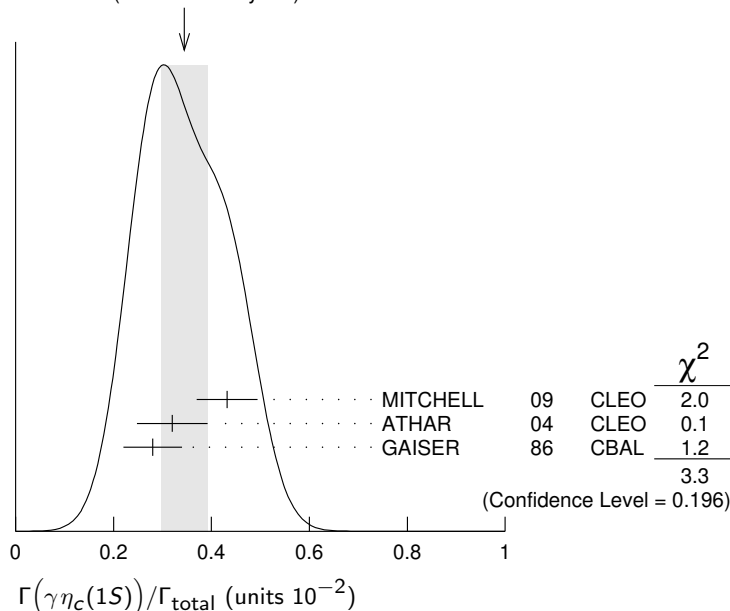
<sup>2</sup> GAISER 86 used  $\Gamma_{\eta_c(1S)} = 11.5 \pm 4.5$  MeV to obtain this result.

NODE=M071R60  
NODE=M071R60

NODE=M071R60;LINKAGE=AT

NODE=M071R60;LINKAGE=GA

WEIGHTED AVERAGE  
0.34 $\pm$ 0.05 (Error scaled by 1.3)

 $\Gamma(\gamma\eta_c(2S))/\Gamma_{\text{total}}$  $\Gamma_{155}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

**7  $\pm$  2  $\pm$  4** <sup>1</sup> ABLIKIM 12G BES3  $\psi(2S) \rightarrow \gamma K^0 K \pi, K K \pi^0$

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 8 90 <sup>2</sup> CRONIN-HEN..10 CLEO  $\psi(2S) \rightarrow \gamma K \bar{K} \pi$

< 20 90 ATHAR 04 CLEO  $e^+e^- \rightarrow \gamma X$

20-130 95 EDWARDS 82C CBAL  $e^+e^- \rightarrow \gamma X$

<sup>1</sup> ABLIKIM 12G reports  $[\Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}] \times [B(\eta_c(2S) \rightarrow K \bar{K} \pi)] = (1.30 \pm 0.20 \pm 0.30) \times 10^{-5}$  which we divide by our best value  $B(\eta_c(2S) \rightarrow K \bar{K} \pi) = (1.9 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> CRONIN-HENNESSY 10 reports  $[\Gamma(\psi(2S) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}] \times [B(\eta_c(2S) \rightarrow K \bar{K} \pi)] < 14.5 \times 10^{-6}$  which we divide by our best value  $B(\eta_c(2S) \rightarrow K \bar{K} \pi) = 1.9 \times 10^{-2}$ . This measurement assumes  $\Gamma(\eta_c(2S)) = 14$  MeV. CRONIN-HENNESSY 10 gives the analytic dependence of limits on width.

NODE=M071R62  
NODE=M071R62

NODE=M071R62;LINKAGE=AB

NODE=M071R62;LINKAGE=CR

 $\Gamma(\gamma\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{156}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**1.04  $\pm$  0.22 OUR AVERAGE** Error includes scale factor of 1.4.

$0.95 \pm 0.16 \pm 0.05$  423 ABLIKIM 17X BES3  $\psi(2S) \rightarrow \gamma\pi^0$

$1.58 \pm 0.40 \pm 0.13$  37 ABLIKIM 10F BES3  $\psi(2S) \rightarrow \gamma\pi^0$

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 5 90 PEDLAR 09 CLE3  $\psi(2S) \rightarrow \gamma X$

< 5400 95 <sup>1</sup> LIBERMAN 75 SPEC  $e^+e^-$

<  $1 \times 10^4$  90 WIJK 75 DASP  $e^+e^-$

<sup>1</sup> Restated by us using  $B(\psi(2S) \rightarrow \mu^+ \mu^-) = 0.0077$ .

NODE=M071R42  
NODE=M071R42

NODE=M071R;LINKAGE=U

$\Gamma(\gamma\eta'(958))/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ ) CL% EVTS**1.24  $\pm 0.04$  OUR AVERAGE**1.251  $\pm 0.022 \pm 0.062$  56k1.26  $\pm 0.03 \pm 0.08$  22261.19  $\pm 0.08 \pm 0.03$ 1.24  $\pm 0.27 \pm 0.15$  231.54  $\pm 0.31 \pm 0.20$   $\sim 43$ 

DOCUMENT ID

TECN

COMMENT

ABLIKIM

17X

BES3

 $\psi(2S) \rightarrow \gamma\pi^+\pi^-\eta,$  $\gamma\pi^0\pi^0\eta$ <sup>1</sup> ABLIKIM

10F

BES3

 $\psi(2S) \rightarrow 3\gamma\pi^+\pi^-,$  $2\gamma\pi^+\pi^-$ 

PEDLAR

09

CLE3

 $\psi(2S) \rightarrow \gamma X$ 

ABLIKIM

06R

BES2

 $e^+e^- \rightarrow \psi(2S)$ 

BAI

98F

BES

 $\psi(2S) \rightarrow \pi^+\pi^-2\gamma,$  $\pi^+\pi^-3\gamma$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt; 60 90

<sup>2</sup> BRAUNSCH...

77

DASP

 $e^+e^-$ 

&lt; 11 90

<sup>3</sup> BARTEL

76

CNTR

 $e^+e^-$ <sup>1</sup> Combining the results from  $\eta' \rightarrow \pi^+\pi^-\eta$  and  $\eta' \rightarrow \pi^+\pi^-\gamma$  decay modes.<sup>2</sup> Restated by us using total decay width 228 keV.<sup>3</sup> The value is normalized to the branching ratio for  $\Gamma(J/\psi(1S)\eta)/\Gamma_{\text{total}}$ .NODE=M071R44  
NODE=M071R44 $\Gamma(\gamma f_2(1270))/\Gamma_{\text{total}}$ VALUE (units  $10^{-4}$ ) EVTS**2.73<sup>+0.29</sup><sub>-0.25</sub> OUR AVERAGE**

Error includes scale factor of 1.8.

2.84  $\pm 0.15^{+0.03}_{-0.10}$  1.9k<sup>1,2</sup> DOBBS

15

 $\psi(2S) \rightarrow \gamma\pi\pi$ 2.12  $\pm 0.19 \pm 0.32$ <sup>3,4</sup> BAI

03C

BES

 $\psi(2S) \rightarrow \gamma\pi\pi$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.08  $\pm 0.19 \pm 0.33$  200.6  $\pm 18.8$ <sup>3</sup> BAI

03C

BES

 $\psi(2S) \rightarrow \gamma\pi^+\pi^-$ 2.90  $\pm 1.08 \pm 1.07$  29.9  $\pm 11.1$ <sup>3</sup> BAI

03C

BES

 $\psi(2S) \rightarrow \gamma\pi^0\pi^0$ <sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> DOBBS 15 reports  $[\Gamma(\psi(2S) \rightarrow \gamma f_2(1270))/\Gamma_{\text{total}}] \times [B(f_2(1270) \rightarrow \pi\pi)] = (2.39 \pm 0.09 \pm 0.09) \times 10^{-4}$  which we divide by our best value  $B(f_2(1270) \rightarrow \pi\pi) = (84.2^{+2.9}_{-0.9}) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.<sup>3</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi\pi^+\pi^-) = 0.305 \pm 0.016$ .<sup>4</sup> Combining the results from  $\pi^+\pi^-$  and  $\pi^0\pi^0$  decay modes.NODE=M071R44;LINKAGE=AB  
NODE=M071R;LINKAGE=R  
NODE=M071R;LINKAGE=CNODE=M071R84  
NODE=M071R84OCCUR=2  
OCCUR=3NODE=M071R84;LINKAGE=A  
NODE=M071R84;LINKAGE=BNODE=M071R;LINKAGE=3B  
NODE=M071R;LINKAGE=B9 $\Gamma(\gamma f_0(1370) \rightarrow \gamma K\bar{K})/\Gamma_{\text{total}}$ VALUE (units  $10^{-5}$ ) EVTS**3.1  $\pm 1.0 \pm 1.4$** 

175

<sup>1</sup> DOBBS

15

COMMENT

 $\psi(2S) \rightarrow \gamma K\bar{K}$ <sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.NODE=M071S75  
NODE=M071S75

NODE=M071S75;LINKAGE=A

 $\Gamma(\gamma f_0(1500))/\Gamma_{\text{total}}$ VALUE (units  $10^{-5}$ ) EVTS**9.3  $\pm 1.8 \pm 0.6$** 

274

<sup>1,2</sup> DOBBS

15

COMMENT

 $\psi(2S) \rightarrow \gamma\pi\pi$ <sup>1</sup> DOBBS 15 reports  $[\Gamma(\psi(2S) \rightarrow \gamma f_0(1500))/\Gamma_{\text{total}}] \times [B(f_0(1500) \rightarrow \pi\pi)] = (3.2 \pm 0.6 \pm 0.2) \times 10^{-5}$  which we divide by our best value  $B(f_0(1500) \rightarrow \pi\pi) = (34.5 \pm 2.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.<sup>2</sup> Using CLEO-c data but not authored by the CLEO Collaboration.NODE=M071S76  
NODE=M071S76

NODE=M071S76;LINKAGE=A

NODE=M071S76;LINKAGE=B

 $\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$ VALUE (units  $10^{-5}$ ) EVTS**3.3  $\pm 0.8 \pm 0.1$** 

136

<sup>1,2</sup> DOBBS

15

COMMENT

 $\psi(2S) \rightarrow \gamma K\bar{K}$ <sup>1</sup> DOBBS 15 reports  $[\Gamma(\psi(2S) \rightarrow \gamma f'_2(1525))/\Gamma_{\text{total}}] \times [B(f'_2(1525) \rightarrow K\bar{K})] = (2.9 \pm 0.6 \pm 0.3) \times 10^{-5}$  which we divide by our best value  $B(f'_2(1525) \rightarrow K\bar{K}) = (87.6 \pm 2.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.<sup>2</sup> Using CLEO-c data but not authored by the CLEO Collaboration.NODE=M071S77  
NODE=M071S77

NODE=M071S77;LINKAGE=A

NODE=M071S77;LINKAGE=B

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma\pi\pi)/\Gamma_{\text{total}}$ VALUE (units  $10^{-5}$ ) EVTS**3.5  $\pm 0.6$  OUR AVERAGE**

290

<sup>1</sup> DOBBS

15

COMMENT

 $\psi(2S) \rightarrow \gamma\pi\pi$ 3.01  $\pm 0.41 \pm 1.24$  35.6  $\pm 4.8$ <sup>2</sup> BAI

03C

BES

 $\psi(2S) \rightarrow \gamma\pi^+\pi^-$ <sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi\pi^+\pi^-) = 0.305 \pm 0.016$ .NODE=M071R85  
NODE=M071R85NODE=M071R85;LINKAGE=A  
NODE=M071R85;LINKAGE=3B

$\Gamma(\gamma f_0(1710) \rightarrow \gamma K \bar{K})/\Gamma_{\text{total}}$   $\Gamma_{164}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**6.6  $\pm$  0.7 OUR AVERAGE**

|                         |  |     |                    |    |                                         |
|-------------------------|--|-----|--------------------|----|-----------------------------------------|
| 6.7 $\pm$ 0.6 $\pm$ 0.6 |  | 375 | <sup>1</sup> DOBBS | 15 | $\psi(2S) \rightarrow \gamma K \bar{K}$ |
|-------------------------|--|-----|--------------------|----|-----------------------------------------|

|                            |                |     |     |         |                                       |
|----------------------------|----------------|-----|-----|---------|---------------------------------------|
| 6.04 $\pm$ 0.90 $\pm$ 1.32 | 39.6 $\pm$ 5.9 | 2,3 | BAI | 03C BES | $\psi(2S) \rightarrow \gamma K^+ K^-$ |
|----------------------------|----------------|-----|-----|---------|---------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |               |         |         |                                           |
|--------|----|---------------|---------|---------|-------------------------------------------|
| < 15.6 | 90 | 6.8 $\pm$ 3.1 | 2,3 BAI | 03C BES | $\psi(2S) \rightarrow \gamma K_S^0 K_S^0$ |
|--------|----|---------------|---------|---------|-------------------------------------------|

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> Includes unknown branching fractions to  $K^+ K^-$  or  $K_S^0 K_S^0$ . We have multiplied the  $K^+ K^-$  result by a factor of 2 and the  $K_S^0 K_S^0$  result by a factor of 4 to obtain the  $K \bar{K}$  result.<sup>3</sup> Normalized to  $B(\psi(2S) \rightarrow J/\psi \pi^+ \pi^-) = 0.305 \pm 0.016$ .NODE=M071R86  
NODE=M071R86

OCCUR=2

NODE=M071R86;LINKAGE=A  
NODE=M071R;LINKAGE=CK

NODE=M071R86;LINKAGE=3B

 $\Gamma(\gamma f_0(2100) \rightarrow \gamma \pi \pi)/\Gamma_{\text{total}}$   $\Gamma_{165}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | COMMENT |
|--------------------------|------|-------------|---------|
|--------------------------|------|-------------|---------|

|                                                      |     |                    |                                          |
|------------------------------------------------------|-----|--------------------|------------------------------------------|
| <b>4.8 <math>\pm</math> 0.5 <math>\pm</math> 0.9</b> | 373 | <sup>1</sup> DOBBS | 15 $\psi(2S) \rightarrow \gamma \pi \pi$ |
|------------------------------------------------------|-----|--------------------|------------------------------------------|

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.NODE=M071S78  
NODE=M071S78

NODE=M071S78;LINKAGE=A

 $\Gamma(\gamma f_0(2200) \rightarrow \gamma K \bar{K})/\Gamma_{\text{total}}$   $\Gamma_{166}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | COMMENT |
|--------------------------|------|-------------|---------|
|--------------------------|------|-------------|---------|

|                                                      |     |                    |                                            |
|------------------------------------------------------|-----|--------------------|--------------------------------------------|
| <b>3.2 <math>\pm</math> 0.6 <math>\pm</math> 0.8</b> | 207 | <sup>1</sup> DOBBS | 15 $\psi(2S) \rightarrow \gamma K \bar{K}$ |
|------------------------------------------------------|-----|--------------------|--------------------------------------------|

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.NODE=M071S79  
NODE=M071S79

NODE=M071S79;LINKAGE=A

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma \pi \pi)/\Gamma_{\text{total}}$   $\Gamma_{167}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | COMMENT |
|-------|-----|-------------|---------|
|-------|-----|-------------|---------|

|                                             |    |           |                                          |
|---------------------------------------------|----|-----------|------------------------------------------|
| <b>&lt; 5.8 <math>\times 10^{-6}</math></b> | 90 | 1,2 DOBBS | 15 $\psi(2S) \rightarrow \gamma \pi \pi$ |
|---------------------------------------------|----|-----------|------------------------------------------|

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> For  $\Gamma = 20/50$  MeV, the 90% CL upper limits for  $\pi^+ \pi^-$  and  $\pi^0 \pi^0$  are  $3.2/4.3 \times 10^{-6}$  and  $2.6/4.0 \times 10^{-6}$ , respectively.NODE=M071S80  
NODE=M071S80NODE=M071S80;LINKAGE=A  
NODE=M071S80;LINKAGE=DO $\Gamma(\gamma f_J(2220) \rightarrow \gamma K \bar{K})/\Gamma_{\text{total}}$   $\Gamma_{168}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | COMMENT |
|-------|-----|-------------|---------|
|-------|-----|-------------|---------|

|                                             |    |           |                                            |
|---------------------------------------------|----|-----------|--------------------------------------------|
| <b>&lt; 9.5 <math>\times 10^{-6}</math></b> | 90 | 1,2 DOBBS | 15 $\psi(2S) \rightarrow \gamma K \bar{K}$ |
|---------------------------------------------|----|-----------|--------------------------------------------|

<sup>1</sup> Using CLEO-c data but not authored by the CLEO Collaboration.<sup>2</sup> For  $\Gamma = 20/50$  MeV, the 90% CL upper limits for  $K^+ K^-$  and  $K_S^0 K_S^0$  are  $2.1/4.3 \times 10^{-6}$  and  $3.7/5.5 \times 10^{-6}$ , respectively.NODE=M071S81  
NODE=M071S81NODE=M071S81;LINKAGE=A  
NODE=M071S81;LINKAGE=DO $\Gamma(\gamma \eta)/\Gamma_{\text{total}}$   $\Gamma_{170}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**0.92  $\pm$  0.18 OUR AVERAGE**

|                            |     |                      |          |  |                                                                   |
|----------------------------|-----|----------------------|----------|--|-------------------------------------------------------------------|
| 0.85 $\pm$ 0.18 $\pm$ 0.04 | 382 | <sup>1</sup> ABLIKIM | 17X BES3 |  | $\psi(2S) \rightarrow \gamma \pi^+ \pi^- \pi^0$ , $\gamma 3\pi^0$ |
|----------------------------|-----|----------------------|----------|--|-------------------------------------------------------------------|

|                            |    |                      |          |  |                                                                   |
|----------------------------|----|----------------------|----------|--|-------------------------------------------------------------------|
| 1.38 $\pm$ 0.48 $\pm$ 0.09 | 13 | <sup>1</sup> ABLIKIM | 10F BES3 |  | $\psi(2S) \rightarrow \gamma \pi^+ \pi^- \pi^0$ , $\gamma 3\pi^0$ |
|----------------------------|----|----------------------|----------|--|-------------------------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |        |         |  |                                 |
|-----|----|--------|---------|--|---------------------------------|
| < 2 | 90 | PEDLAR | 09 CLE3 |  | $\psi(2S) \rightarrow \gamma X$ |
|-----|----|--------|---------|--|---------------------------------|

|      |    |     |         |  |                                            |
|------|----|-----|---------|--|--------------------------------------------|
| < 90 | 90 | BAI | 98F BES |  | $\psi(2S) \rightarrow \pi^+ \pi^- 3\gamma$ |
|------|----|-----|---------|--|--------------------------------------------|

|       |    |        |         |  |                               |
|-------|----|--------|---------|--|-------------------------------|
| < 200 | 90 | YAMADA | 77 DASP |  | $e^+ e^- \rightarrow 3\gamma$ |
|-------|----|--------|---------|--|-------------------------------|

<sup>1</sup> Combining the results from  $\eta \rightarrow \pi^+ \pi^- \pi^0$  and  $\eta \rightarrow 3\pi^0$  decay modes.NODE=M071R43  
NODE=M071R43

NODE=M071R43;LINKAGE=AB

 $\Gamma(\gamma \eta \pi^+ \pi^-)/\Gamma_{\text{total}}$   $\Gamma_{171}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

|                                                         |     |         |          |                                                |
|---------------------------------------------------------|-----|---------|----------|------------------------------------------------|
| <b>8.71 <math>\pm</math> 1.25 <math>\pm</math> 1.64</b> | 418 | ABLIKIM | 06R BES2 | $\psi(2S) \rightarrow \gamma \eta \pi^+ \pi^-$ |
|---------------------------------------------------------|-----|---------|----------|------------------------------------------------|

NODE=M071R04  
NODE=M071R04 $\Gamma(\gamma \eta(1405) \rightarrow \gamma K \bar{K} \pi)/\Gamma_{\text{total}}$   $\Gamma_{173}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|                 |    |         |          |                                                             |
|-----------------|----|---------|----------|-------------------------------------------------------------|
| <b>&lt; 0.9</b> | 90 | ABLIKIM | 06R BES2 | $\psi(2S) \rightarrow \gamma K_S^0 K^+ \pi^- + \text{c.c.}$ |
|-----------------|----|---------|----------|-------------------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |         |          |                                             |
|-------|----|---------|----------|---------------------------------------------|
| < 1.3 | 90 | ABLIKIM | 06R BES2 | $\psi(2S) \rightarrow \gamma K^+ K^- \pi^0$ |
|-------|----|---------|----------|---------------------------------------------|

|       |    |                      |         |           |
|-------|----|----------------------|---------|-----------|
| < 1.2 | 90 | <sup>1</sup> SCHARRE | 80 MRK1 | $e^+ e^-$ |
|-------|----|----------------------|---------|-----------|

<sup>1</sup> Includes unknown branching fraction  $\eta(1405) \rightarrow K \bar{K} \pi$ .NODE=M071R61  
NODE=M071R61

OCCUR=2

NODE=M071R;LINKAGE=E



$\Gamma(\gamma\eta(1405) \rightarrow \eta\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{174}/\Gamma$ 

| VALUE (units $10^{-4}$ )                   | EVTs | DOCUMENT ID | TECN     | COMMENT                                     |
|--------------------------------------------|------|-------------|----------|---------------------------------------------|
| <b><math>0.36 \pm 0.25 \pm 0.05</math></b> | 10   | ABLIKIM     | 06R BES2 | $\psi(2S) \rightarrow \gamma\eta\pi^+\pi^-$ |

NODE=M071R05  
 NODE=M071R05

 $\Gamma(\gamma\eta(1405) \rightarrow \gamma f_0(980)\pi^0 \rightarrow \gamma\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{175}/\Gamma$ 

| VALUE                                       | CL% | DOCUMENT ID | TECN      | COMMENT                                      |
|---------------------------------------------|-----|-------------|-----------|----------------------------------------------|
| <b><math>&lt; 5.0 \times 10^{-7}</math></b> | 90  | ABLIKIM     | 17AJ BES3 | $\psi(2S) \rightarrow \gamma\pi^+\pi^-\pi^0$ |

NODE=M071P09  
 NODE=M071P09

 $\Gamma(\gamma\eta(1475) \rightarrow K\bar{K}\pi)/\Gamma_{\text{total}}$  $\Gamma_{177}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | DOCUMENT ID | TECN     | COMMENT                                                     |
|-------------------------------------------------------------------------------|-----|-------------|----------|-------------------------------------------------------------|
| <b><math>&lt; 1.4</math></b>                                                  | 90  | ABLIKIM     | 06R BES2 | $\psi(2S) \rightarrow \gamma K^+ K^- \pi^0$                 |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                                                             |
| $< 1.5$                                                                       | 90  | ABLIKIM     | 06R BES2 | $\psi(2S) \rightarrow \gamma K_S^0 K^+ \pi^- + \text{c.c.}$ |

NODE=M071R06  
 NODE=M071R06

OCCUR=2

 $\Gamma(\gamma\eta(1475) \rightarrow \eta\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{178}/\Gamma$ 

| VALUE (units $10^{-4}$ )      | CL% | DOCUMENT ID | TECN     | COMMENT                                     |
|-------------------------------|-----|-------------|----------|---------------------------------------------|
| <b><math>&lt; 0.88</math></b> | 90  | ABLIKIM     | 06R BES2 | $\psi(2S) \rightarrow \gamma\eta\pi^+\pi^-$ |

NODE=M071R07  
 NODE=M071R07

 $\Gamma(\gamma 2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{179}/\Gamma$ 

| VALUE (units $10^{-5}$ )                 | EVTs | DOCUMENT ID | TECN     | COMMENT                       |
|------------------------------------------|------|-------------|----------|-------------------------------|
| <b><math>39.6 \pm 2.8 \pm 5.0</math></b> | 583  | ABLIKIM     | 07D BES2 | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071S28  
 NODE=M071S28

 $\Gamma(\gamma K^{*0} K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{180}/\Gamma$ 

| VALUE (units $10^{-5}$ )                 | EVTs | DOCUMENT ID | TECN     | COMMENT                       |
|------------------------------------------|------|-------------|----------|-------------------------------|
| <b><math>37.0 \pm 6.1 \pm 7.2</math></b> | 237  | ABLIKIM     | 07D BES2 | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071S29  
 NODE=M071S29

 $\Gamma(\gamma K^{*0} \bar{K}^{*0})/\Gamma_{\text{total}}$  $\Gamma_{181}/\Gamma$ 

| VALUE (units $10^{-5}$ )                 | EVTs | DOCUMENT ID | TECN     | COMMENT                       |
|------------------------------------------|------|-------------|----------|-------------------------------|
| <b><math>24.0 \pm 4.5 \pm 5.0</math></b> | 41   | ABLIKIM     | 07D BES2 | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071S30  
 NODE=M071S30

 $\Gamma(\gamma K_S^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{182}/\Gamma$ 

| VALUE (units $10^{-5}$ )                 | EVTs | DOCUMENT ID | TECN     | COMMENT                       |
|------------------------------------------|------|-------------|----------|-------------------------------|
| <b><math>25.6 \pm 3.6 \pm 3.6</math></b> | 115  | ABLIKIM     | 07D BES2 | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071S31  
 NODE=M071S31

 $\Gamma(\gamma K^+ K^- \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{183}/\Gamma$ 

| VALUE (units $10^{-5}$ )                 | EVTs | DOCUMENT ID | TECN     | COMMENT                       |
|------------------------------------------|------|-------------|----------|-------------------------------|
| <b><math>19.1 \pm 2.7 \pm 4.3</math></b> | 132  | ABLIKIM     | 07D BES2 | $e^+e^- \rightarrow \psi(2S)$ |

NODE=M071S32  
 NODE=M071S32

 $\Gamma(\gamma p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{184}/\Gamma$ 

| VALUE (units $10^{-5}$ )                    | EVTs | DOCUMENT ID                         | TECN     | COMMENT                                |
|---------------------------------------------|------|-------------------------------------|----------|----------------------------------------|
| <b><math>3.9 \pm 0.5</math> OUR AVERAGE</b> |      | Error includes scale factor of 2.0. |          |                                        |
| $4.18 \pm 0.26 \pm 0.18$                    | 348  | <sup>1</sup> ALEXANDER              | 10 CLEO  | $\psi(2S) \rightarrow \gamma p\bar{p}$ |
| $2.9 \pm 0.4 \pm 0.4$                       | 142  | ABLIKIM                             | 07D BES2 | $e^+e^- \rightarrow \psi(2S)$          |

NODE=M071S33  
 NODE=M071S33

<sup>1</sup> From a fit of the  $p\bar{p}$  mass distribution to a combination of  $\gamma f_2(1950)$ ,  $\gamma f_2(2150)$ , and  $\gamma p\bar{p}$  phase space, for  $M(p\bar{p}) < 2.85$  GeV, and accounting for backgrounds from  $\psi(2S) \rightarrow \pi^0 p\bar{p}$  and continuum.

NODE=M071S33;LINKAGE=AL

 $\Gamma(\gamma f_2(1950) \rightarrow \gamma p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{185}/\Gamma$ 

| VALUE (units $10^{-5}$ )                | EVTs | DOCUMENT ID            | TECN    | COMMENT                                |
|-----------------------------------------|------|------------------------|---------|----------------------------------------|
| <b><math>1.2 \pm 0.2 \pm 0.1</math></b> | 111  | <sup>1</sup> ALEXANDER | 10 CLEO | $\psi(2S) \rightarrow \gamma p\bar{p}$ |

NODE=M071S46  
 NODE=M071S46

<sup>1</sup> From a fit of the  $p\bar{p}$  mass distribution to a combination of  $\gamma f_2(1950)$ ,  $\gamma f_2(2150)$ , and  $\gamma p\bar{p}$  phase space, for  $M(p\bar{p}) < 2.85$  GeV, and accounting for backgrounds from  $\psi(2S) \rightarrow \pi^0 p\bar{p}$  and continuum.

NODE=M071S46;LINKAGE=AL

 $\Gamma(\gamma f_2(2150) \rightarrow \gamma p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{186}/\Gamma$ 

| VALUE (units $10^{-5}$ )                   | EVTs | DOCUMENT ID            | TECN    | COMMENT                                |
|--------------------------------------------|------|------------------------|---------|----------------------------------------|
| <b><math>0.72 \pm 0.18 \pm 0.03</math></b> | 73   | <sup>1</sup> ALEXANDER | 10 CLEO | $\psi(2S) \rightarrow \gamma p\bar{p}$ |

NODE=M071S47  
 NODE=M071S47

<sup>1</sup> From a fit of the  $p\bar{p}$  mass distribution to a combination of  $\gamma f_2(1950)$ ,  $\gamma f_2(2150)$ , and  $\gamma p\bar{p}$  phase space, for  $M(p\bar{p}) < 2.85$  GeV, and accounting for backgrounds from  $\psi(2S) \rightarrow \pi^0 p\bar{p}$  and continuum.

NODE=M071S47;LINKAGE=AL

$\Gamma(\gamma X(1835) \rightarrow \gamma p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{187}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                      | CL% | DOCUMENT ID | TECN     | COMMENT                                 |
|-------------------------------------------------------------------------------|-----|-------------|----------|-----------------------------------------|
| $4.57 \pm 0.36^{+1.77}_{-4.26}$                                               |     | ABLIKIM     | 12D BES3 | $J/\psi \rightarrow \gamma p \bar{p}$   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                                         |
| <1.6                                                                          | 90  | ALEXANDER   | 10 CLEO  | $\psi(2S) \rightarrow \gamma p \bar{p}$ |
| <5.4                                                                          | 90  | ABLIKIM     | 07D BES  | $\psi(2S) \rightarrow \gamma p \bar{p}$ |

NODE=M071S48  
 NODE=M071S48

 $\Gamma(\gamma X \rightarrow \gamma p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{188}/\Gamma$ For a narrow resonance in the range  $2.2 < M(X) < 2.8$  GeV.

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                                 |
|--------------------------|-----|-------------|---------|-----------------------------------------|
| <2                       | 90  | ALEXANDER   | 10 CLEO | $\psi(2S) \rightarrow \gamma p \bar{p}$ |

NODE=M071S49  
 NODE=M071S49  
 NODE=M071S49

 $\Gamma(\gamma \pi^+ \pi^- p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{189}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                        |
|--------------------------|------|-------------|----------|--------------------------------|
| $2.8 \pm 1.2 \pm 0.7$    | 17   | ABLIKIM     | 07D BES2 | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071S34  
 NODE=M071S34

 $\Gamma(\gamma 2(\pi^+ \pi^-) K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{190}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                        |
|--------------------------|-----|-------------|----------|--------------------------------|
| <22                      | 90  | ABLIKIM     | 07D BES2 | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071S35  
 NODE=M071S35

 $\Gamma(\gamma 3(\pi^+ \pi^-))/\Gamma_{\text{total}}$  $\Gamma_{191}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                        |
|--------------------------|-----|-------------|----------|--------------------------------|
| <17                      | 90  | ABLIKIM     | 07D BES2 | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071S36  
 NODE=M071S36

 $\Gamma(\gamma K^+ K^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{192}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                        |
|--------------------------|-----|-------------|----------|--------------------------------|
| <4                       | 90  | ABLIKIM     | 07D BES2 | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071S37  
 NODE=M071S37

 $\Gamma(\gamma \gamma J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{193}/\Gamma$ 

| VALUE (units $10^{-4}$ )    | EVTS | DOCUMENT ID | TECN     | COMMENT                        |
|-----------------------------|------|-------------|----------|--------------------------------|
| $3.1 \pm 0.6^{+0.8}_{-1.0}$ | 1.1k | ABLIKIM     | 120 BES3 | $e^+ e^- \rightarrow \psi(2S)$ |

NODE=M071S55  
 NODE=M071S55

• • • We do not use the following data for averages, fits, limits, etc. • • •

3.2 ± 0.6 1.1k <sup>1</sup> ABLIKIM 17N BES3  $\psi(2S) \rightarrow \gamma \gamma J/\psi$ <sup>1</sup> Uses  $B(J/\psi \rightarrow e^+ e^-) = (5.971 \pm 0.032)\%$  and  $B(J/\psi \rightarrow \mu^+ \mu^-) = (5.961 \pm 0.033)\%$ . No systematic error estimation.

NODE=M071S55;LINKAGE=A

 $\Gamma(e^+ e^- \eta')/\Gamma_{\text{total}}$  $\Gamma_{194}/\Gamma$ 

| VALUE (units $10^{-6}$ )       | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                          |
|--------------------------------|------|-------------|----------|----------------------------------------------------------------------------------|
| <b>1.90 ± 0.26 OUR AVERAGE</b> |      |             |          |                                                                                  |
| 1.99 ± 0.33 ± 0.12             | 57   | ABLIKIM     | 18Z BES3 | $\psi(2S) \rightarrow \eta' e^+ e^-$ ,<br>$\eta' \rightarrow \gamma \pi^+ \pi^-$ |
| 1.79 ± 0.38 ± 0.11             | 20   | ABLIKIM     | 18Z BES3 | $\psi(2S) \rightarrow \eta' e^+ e^-$ ,<br>$\eta' \rightarrow \eta \pi^+ \pi^-$   |

NODE=M071P12  
 NODE=M071P12

OCCUR=2

 $\Gamma(e^+ e^- \chi_{c0}(1P))/\Gamma_{\text{total}}$  $\Gamma_{195}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                      |
|--------------------------|------|----------------------|----------|----------------------------------------------|
| <b>10.6 ± 2.4 ± 0.4</b>  | 48   | <sup>1</sup> ABLIKIM | 17I BES3 | $\psi(2S) \rightarrow e^+ e^- \gamma J/\psi$ |

NODE=M071P01  
 NODE=M071P01

<sup>1</sup> ABLIKIM 17I reports  $(11.7 \pm 2.5 \pm 1.0) \times 10^{-4}$  from a measurement of  $[\Gamma(\psi(2S) \rightarrow e^+ e^- \chi_{c0}(1P))/\Gamma_{\text{total}}] \times [B(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S))]$  assuming  $B(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S)) = (1.27 \pm 0.06) \times 10^{-2}$ , which we rescale to our best value  $B(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S)) = (1.40 \pm 0.05) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071P01;LINKAGE=B

 $\Gamma(e^+ e^- \chi_{c1}(1P))/\Gamma_{\text{total}}$  $\Gamma_{196}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                      |
|--------------------------|------|----------------------|----------|----------------------------------------------|
| <b>8.5 ± 0.6 ± 0.2</b>   | 873  | <sup>1</sup> ABLIKIM | 17I BES3 | $\psi(2S) \rightarrow e^+ e^- \gamma J/\psi$ |

NODE=M071P02  
 NODE=M071P02

<sup>1</sup> ABLIKIM 17I reports  $(8.6 \pm 0.3 \pm 0.6) \times 10^{-4}$  from a measurement of  $[\Gamma(\psi(2S) \rightarrow e^+ e^- \chi_{c1}(1P))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S))]$  assuming  $B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)) = (33.9 \pm 1.2) \times 10^{-2}$ , which we rescale to our best value  $B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)) = (34.3 \pm 1.0) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M071P02;LINKAGE=B

$\Gamma(e^+e^- \chi_{c2}(1P))/\Gamma_{\text{total}}$ 
 $\Gamma_{197}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b><math>7.0 \pm 0.7 \pm 0.2</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 227  | <sup>1</sup> ABLIKIM | 17I BES3 | $\psi(2S) \rightarrow e^+e^- \gamma J/\psi$ |
| <sup>1</sup> ABLIKIM 17I reports $(6.9 \pm 0.5 \pm 0.6) \times 10^{-4}$ from a measurement of $[\Gamma(\psi(2S) \rightarrow e^+e^- \chi_{c2}(1P))/\Gamma_{\text{total}}] \times [B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S))]$ assuming $B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)) = (19.2 \pm 0.7) \times 10^{-2}$ , which we rescale to our best value $B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)) = (19.0 \pm 0.5) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                      |          |                                             |

NODE=M071P03  
NODE=M071P03

NODE=M071P03;LINKAGE=B

 $\Gamma(e^+e^- \chi_{c0}(1P))/\Gamma(\gamma \chi_{c0}(1P))$ 
 $\Gamma_{195}/\Gamma_{151}$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                   | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b><math>9.4 \pm 1.9 \pm 0.6</math></b>                                                                                                                                                                                    | 48   | <sup>1</sup> ABLIKIM | 17I BES3 | $\psi(2S) \rightarrow e^+e^- \gamma J/\psi$ |
| <sup>1</sup> Uses $B(\psi(2S) \rightarrow \gamma \chi_{c0}(1P)) \times B(\chi_{c0}(1P) \rightarrow \gamma J/\psi(1S)) = (15.8 \pm 0.3 \pm 0.6) \times 10^{-4}$ from ABLIKIM 17N and accounts for common systematic errors. |      |                      |          |                                             |

NODE=M071P04  
NODE=M071P04

NODE=M071P04;LINKAGE=A

 $\Gamma(e^+e^- \chi_{c1}(1P))/\Gamma(\gamma \chi_{c1}(1P))$ 
 $\Gamma_{196}/\Gamma_{152}$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                     | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b><math>8.3 \pm 0.3 \pm 0.4</math></b>                                                                                                                                                                                      | 873  | <sup>1</sup> ABLIKIM | 17I BES3 | $\psi(2S) \rightarrow e^+e^- \gamma J/\psi$ |
| <sup>1</sup> Uses $B(\psi(2S) \rightarrow \gamma \chi_{c1}(1P)) \times B(\chi_{c1}(1P) \rightarrow \gamma J/\psi(1S)) = (351.8 \pm 1.0 \pm 12.0) \times 10^{-4}$ from ABLIKIM 17N and accounts for common systematic errors. |      |                      |          |                                             |

NODE=M071P05  
NODE=M071P05

NODE=M071P05;LINKAGE=A

 $\Gamma(e^+e^- \chi_{c2}(1P))/\Gamma(\gamma \chi_{c2}(1P))$ 
 $\Gamma_{197}/\Gamma_{153}$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                                                                    | EVTs | DOCUMENT ID          | TECN     | COMMENT                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|----------|---------------------------------------------|
| <b><math>6.6 \pm 0.5 \pm 0.4</math></b>                                                                                                                                                                                     | 227  | <sup>1</sup> ABLIKIM | 17I BES3 | $\psi(2S) \rightarrow e^+e^- \gamma J/\psi$ |
| <sup>1</sup> Uses $B(\psi(2S) \rightarrow \gamma \chi_{c2}(1P)) \times B(\chi_{c2}(1P) \rightarrow \gamma J/\psi(1S)) = (199.6 \pm 0.8 \pm 7.0) \times 10^{-4}$ from ABLIKIM 17N and accounts for common systematic errors. |      |                      |          |                                             |

NODE=M071P06  
NODE=M071P06

NODE=M071P06;LINKAGE=A

### WEAK DECAYS

 $\Gamma(D^0 e^+ e^- + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{198}/\Gamma$ 

| VALUE                                                                                              | CL% | DOCUMENT ID          | TECN      | COMMENT                       |
|----------------------------------------------------------------------------------------------------|-----|----------------------|-----------|-------------------------------|
| <b><math>&lt; 1.4 \times 10^{-7}</math></b>                                                        | 90  | <sup>1</sup> ABLIKIM | 17AF BES3 | $e^+e^- \rightarrow \psi(2S)$ |
| <sup>1</sup> Using $D^0$ decays to $K^- \pi^+$ , $K^- \pi^+ \pi^0$ , and $K^- \pi^+ \pi^+ \pi^-$ . |     |                      |           |                               |

NODE=M071330

NODE=M071P07  
NODE=M071P07

NODE=M071P07;LINKAGE=A

### OTHER DECAYS

 $\Gamma(\text{invisible})/\Gamma(e^+e^-)$ 
 $\Gamma_{199}/\Gamma_6$ 

| VALUE                        | CL% | DOCUMENT ID | TECN     | COMMENT                          |
|------------------------------|-----|-------------|----------|----------------------------------|
| <b><math>&lt; 2.0</math></b> | 90  | LEES        | 13I BABR | $B \rightarrow K^{(*)} \psi(2S)$ |

NODE=M071S64  
NODE=M071S64

### $\psi(2S)$ CROSS-PARTICLE BRANCHING RATIOS

NODE=M071240

For measurements involving  $B(\psi(2S) \rightarrow \gamma \chi_{cJ}(1P)) \times B(\chi_{cJ}(1P) \rightarrow X)$  see the corresponding entries in the  $\chi_{cJ}(1P)$  sections.

NODE=M071240

### MULTIPOLE AMPLITUDE RATIOS IN RADIATIVE DECAYS

NODE=M071250

#### $\psi(2S) \rightarrow \gamma \chi_{cJ}(1P)$ and $\chi_{cJ} \rightarrow \gamma J/\psi(1S)$

#### $a_2(\chi_{c1})/a_2(\chi_{c2})$ Magnetic quadrupole transition amplitude ratio

| VALUE (units $10^{-2}$ )                 | EVTs | DOCUMENT ID          | TECN     | COMMENT                                            |
|------------------------------------------|------|----------------------|----------|----------------------------------------------------|
| <b><math>63 \pm 7</math> OUR AVERAGE</b> |      |                      |          |                                                    |
| $61.7 \pm 8.3$                           | 253k | <sup>1</sup> ABLIKIM | 17N BES3 | $\psi(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| $67^{+19}_{-13}$                         | 59k  | <sup>2</sup> ARTUSO  | 09 CLEO  | $\psi(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

NODE=M071QAR  
NODE=M071QAR

<sup>1</sup> Statistical and systematic errors combined.

<sup>2</sup> Statistical and systematic errors combined. Using values from fits with floating  $M2$  amplitudes  $a_2(\chi_{c1})$ ,  $a_2(\chi_{c2})$ ,  $b_2(\chi_{c1})$ ,  $b_2(\chi_{c2})$  and fixed  $E3$  amplitudes of  $a_3(\chi_{c2}) = b_3(\chi_{c2}) = 0$ . Not independent of values for  $a_2(\chi_{c1}(1P))$  and  $a_2(\chi_{c2}(1P))$  from ARTUSO 09.

NODE=M071QAR;LINKAGE=A  
NODE=M071QAR;LINKAGE=AR

**$b_2(\chi_{c2})/b_2(\chi_{c1})$  Magnetic quadrupole transition amplitude ratio**

| VALUE (units $10^{-2}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**60±31 OUR AVERAGE**

|                                  |      |                      |          |                                                 |
|----------------------------------|------|----------------------|----------|-------------------------------------------------|
| 74±40                            | 253k | <sup>1</sup> ABLIKIM | 17N BES3 | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$ |
| 37 <sup>+53</sup> <sub>-47</sub> | 59k  | <sup>2</sup> ARTUSO  | 09 CLEO  | $\psi(2S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

<sup>1</sup> Statistical and systematic errors combined. Derived from the reported measurement of  $b_2(\chi_{c1})/b_2(\chi_{c2}) = 1.35 \pm 0.72$ .

<sup>2</sup> Statistical and systematic errors combined. Using values from fits with floating  $M2$  amplitudes  $a_2(\chi_{c1})$ ,  $a_2(\chi_{c2})$ ,  $b_2(\chi_{c1})$ ,  $b_2(\chi_{c2})$  and fixed  $E3$  amplitudes of  $a_3(\chi_{c2}) = b_3(\chi_{c2}) = 0$ . Not independent of values for  $b_2(\chi_{c1}(1P))$  and  $b_2(\chi_{c2}(1P))$  from ARTUSO 09.

NODE=M071QBR  
NODE=M071QBR

NODE=M071QBR;LINKAGE=A

NODE=M071QBR;LINKAGE=AR

 **$\psi(2S)$  REFERENCES**

NODE=M071

|               |      |                |                                   |                     |             |
|---------------|------|----------------|-----------------------------------|---------------------|-------------|
| ABLIKIM       | 21E  | PRL 126 092002 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=61033 |
| ABLIKIM       | 20F  | PR D101 032008 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=60256 |
| ABLIKIM       | 19AO | PR D99 112010  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=59892 |
| ABLIKIM       | 19AT | PR D100 051101 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=59989 |
| ABLIKIM       | 19AU | PR D100 052010 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=59996 |
| ABLIKIM       | 19BA | PR D100 092003 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=60024 |
| ABLIKIM       | 19I  | PR D99 012014  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=59605 |
| ABLIKIM       | 19N  | PR D99 032006  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=59615 |
| ABLIKIM       | 18Q  | PR D97 091102  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=58933 |
| ABLIKIM       | 18T  | PR D98 032006  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=58975 |
| ABLIKIM       | 18Z  | PL B783 452    | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=59038 |
| ANASHIN       | 18   | PL B781 174    | V.V. Anashin <i>et al.</i>        | (KEDR Collab.)      | REFID=59013 |
| LEES          | 18E  | PR D98 112015  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     | REFID=59505 |
| ABLIKIM       | 17AF | PR D96 111101  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=58315 |
| ABLIKIM       | 17AJ | PR D96 112008  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=58322 |
| ABLIKIM       | 17AK | PR D96 112012  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=58324 |
| ABLIKIM       | 17E  | PL B770 217    | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=57903 |
| ABLIKIM       | 17I  | PRL 118 221802 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=57931 |
| ABLIKIM       | 17L  | PR D95 052003  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=57967 |
| ABLIKIM       | 17N  | PR D95 072004  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=57978 |
| ABLIKIM       | 17U  | PR D96 032001  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=58026 |
| ABLIKIM       | 17X  | PR D96 052003  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=58216 |
| DOBBS         | 17   | PR D96 092004  | S. Dobbs <i>et al.</i>            | (NWES, WAYN)        | REFID=58670 |
| LEES          | 17A  | PR D95 052001  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     | REFID=57966 |
| AAIJ          | 16Y  | JHEP 1605 132  | R. Aaij <i>et al.</i>             | (LHCb Collab.)      | REFID=57333 |
| ABLIKIM       | 16L  | PR D93 072003  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=57510 |
| ABLIKIM       | 15I  | PR D91 092006  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=56774 |
| ABLIKIM       | 15V  | PL B749 414    | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=56787 |
| ANASHIN       | 15   | PL B749 50     | V.V. Anashin <i>et al.</i>        | (KEDR Collab.)      | REFID=56792 |
| DOBBS         | 15   | PR D91 052006  | S. Dobbs <i>et al.</i>            | (NWES)              | REFID=56805 |
| LEES          | 15J  | PR D92 072008  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     | REFID=56988 |
| ABLIKIM       | 14G  | PR D89 112006  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=55898 |
| DOBBS         | 14   | PL B739 90     | S. Dobbs <i>et al.</i>            | (NWES, WAYN)        | REFID=56333 |
| ABLIKIM       | 13A  | PRL 110 022001 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=54834 |
| ABLIKIM       | 13D  | PR D87 012007  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=54879 |
| ABLIKIM       | 13F  | PR D87 052007  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=54920 |
| ABLIKIM       | 13M  | PR D87 092006  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=55386 |
| ABLIKIM       | 13R  | PR D88 032007  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=55402 |
| ABLIKIM       | 13S  | PR D88 032010  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=55403 |
| ABLIKIM       | 13W  | PR D88 112007  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=55634 |
| LEES          | 13I  | PR D87 112005  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     | REFID=55161 |
| LEES          | 13O  | PR D87 092005  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     | REFID=55293 |
| LEES          | 13Q  | PR D88 032013  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     | REFID=55404 |
| LEES          | 13Y  | PR D88 072009  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     | REFID=55589 |
| AAIJ          | 12H  | EPJ C72 1972   | R. Aaij <i>et al.</i>             | (LHCb Collab.)      | REFID=54056 |
| ABLIKIM       | 12D  | PRL 108 112003 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=54269 |
| ABLIKIM       | 12G  | PRL 109 042003 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=54272 |
| ABLIKIM       | 12H  | PL B710 594    | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=54273 |
| ABLIKIM       | 12L  | PR D86 072011  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=54739 |
| ABLIKIM       | 12M  | PR D86 092008  | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=54740 |
| ABLIKIM       | 12O  | PRL 109 172002 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=54742 |
| ABLIKIM       | 12Q  | CP C36 1040    | M. Ablikim <i>et al.</i>          | (BES II Collab.)    | REFID=54864 |
| ANASHIN       | 12   | PL B711 280    | V.V. Anashin <i>et al.</i>        | (KEDR Collab.)      | REFID=54038 |
| LEES          | 12E  | PR D85 112009  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     | REFID=54297 |
| LEES          | 12F  | PR D86 012008  | J.P. Lees <i>et al.</i>           | (BABAR Collab.)     | REFID=54298 |
| METREVELI     | 12   | PR D85 092007  | Z. Metreveli <i>et al.</i>        | (NWES, FLOR, WAYN+) | REFID=54304 |
| GE            | 11   | PR D84 032008  | J.Y. Ge <i>et al.</i>             | (CLEO Collab.)      | REFID=53960 |
| ABLIKIM       | 10B  | PRL 104 132002 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=53348 |
| ABLIKIM       | 10F  | PRL 105 261801 | M. Ablikim <i>et al.</i>          | (BESIII Collab.)    | REFID=53630 |
| ALEXANDER     | 10   | PR D82 092002  | J.P. Alexander <i>et al.</i>      | (CLEO Collab.)      | REFID=53525 |
| CRONIN-HEN... | 10   | PR D81 052002  | D. Cronin-Hennessey <i>et al.</i> | (CLEO Collab.)      | REFID=53233 |
| ADAMS         | 09   | PR D80 051106  | G.S. Adams <i>et al.</i>          | (CLEO Collab.)      | REFID=53103 |
| ARTUSO        | 09   | PR D80 112003  | M. Artuso <i>et al.</i>           | (CLEO Collab.)      | REFID=53206 |
| LIBBY         | 09   | PR D80 072002  | J. Libby <i>et al.</i>            | (CLEO Collab.)      | REFID=53124 |
| MITCHELL      | 09   | PRL 102 011801 | R.E. Mitchell <i>et al.</i>       | (CLEO Collab.)      | REFID=52676 |
| PEDLAR        | 09   | PR D79 111101  | T.K. Pedlar <i>et al.</i>         | (CLEO Collab.)      | REFID=52998 |
| ABLIKIM       | 08B  | PL B659 74     | M. Ablikim <i>et al.</i>          | (BES Collab.)       | REFID=52129 |
| ABLIKIM       | 08C  | PL B659 789    | M. Ablikim <i>et al.</i>          | (BES Collab.)       | REFID=52130 |
| DOBBS         | 08A  | PRL 101 182003 | S. Dobbs <i>et al.</i>            | (CLEO Collab.)      | REFID=52579 |
| MENDEZ        | 08   | PR D78 011102  | H. Mendez <i>et al.</i>           | (CLEO Collab.)      | REFID=52684 |
| PDG           | 08   | PL B667 1      | C. Amsler <i>et al.</i>           | (PDG Collab.)       | REFID=52166 |
| ABLIKIM       | 07C  | PL B648 149    | M. Ablikim <i>et al.</i>          | (BES Collab.)       | REFID=51636 |
| ABLIKIM       | 07D  | PRL 99 011802  | M. Ablikim <i>et al.</i>          | (BES II Collab.)    | REFID=51725 |
| ABLIKIM       | 07H  | PR D76 092003  | M. Ablikim <i>et al.</i>          | (BES Collab.)       | REFID=52046 |
| ANASHIN       | 07   | JETPL 85 347   | V.V. Anashin <i>et al.</i>        | (KEDR Collab.)      | REFID=51655 |

Translated from ZETFP 85 429.

|             |      |                             |                               |                         |                      |
|-------------|------|-----------------------------|-------------------------------|-------------------------|----------------------|
| ANDREOTTI   | 07   | PL B654 74                  | M. Andreotti <i>et al.</i>    | (Femilab E835 Collab.)  | REFID=51944          |
| AUBERT      | 07AK | PR D76 012008               | B. Aubert <i>et al.</i>       | (BABAR Collab.)         | REFID=51908          |
| AUBERT      | 07AU | PR D76 092005               | B. Aubert <i>et al.</i>       | (BABAR Collab.)         | REFID=52049          |
| Also        |      | PR D77 119902E (errat.)     | B. Aubert <i>et al.</i>       | (BABAR Collab.)         | REFID=52266          |
| AUBERT      | 07BD | PR D76 092006               | B. Aubert <i>et al.</i>       | (BABAR Collab.)         | REFID=52050          |
| PDG         | 07   | Unofficial 2007 WWW edition |                               | (PDG Collab.)           | REFID=52717; ERROR=8 |
| PEDLAR      | 07   | PR D75 011102               | T.K. Pedlar <i>et al.</i>     | (CLEO Collab.)          | REFID=51630          |
| ABLIKIM     | 06G  | PR D73 052004               | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=51048          |
| ABLIKIM     | 06I  | PR D74 012004               | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=51126          |
| ABLIKIM     | 06L  | PRL 97 121801               | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=51129          |
| ABLIKIM     | 06R  | PR D74 072001               | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=51447          |
| ABLIKIM     | 06W  | PR D74 112003               | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=51560          |
| ADAM        | 06   | PRL 96 082004               | N.E. Adam <i>et al.</i>       | (CLEO Collab.)          | REFID=50989          |
| AUBERT      | 06B  | PR D73 012005               | B. Aubert <i>et al.</i>       | (BABAR Collab.)         | REFID=51026          |
| AUBERT      | 06D  | PR D73 052003               | B. Aubert <i>et al.</i>       | (BABAR Collab.)         | REFID=51047          |
| AUBERT,BE   | 06D  | PR D74 091103               | B. Aubert <i>et al.</i>       | (BABAR Collab.)         | REFID=51511          |
| DOBBS       | 06A  | PR D74 011105               | S. Dobbs <i>et al.</i>        | (CLEO Collab.)          | REFID=51158          |
| ABLIKIM     | 05E  | PR D71 072006               | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=50757          |
| ABLIKIM     | 05H  | PR D72 012002               | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=50759          |
| ABLIKIM     | 05I  | PL B614 37                  | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=50758          |
| ABLIKIM     | 05J  | PL B619 247                 | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=50760          |
| ABLIKIM     | 05O  | PL B630 21                  | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=50846          |
| ADAM        | 05   | PRL 94 012005               | N.E. Adam <i>et al.</i>       | (CLEO Collab.)          | REFID=50451          |
| ADAM        | 05A  | PRL 94 232002               | N.E. Adam <i>et al.</i>       | (CLEO Collab.)          | REFID=50763          |
| ANDREOTTI   | 05   | PR D71 032006               | M. Andreotti <i>et al.</i>    | (FNAL E835 Collab.)     | REFID=50497          |
| AUBERT      | 05D  | PR D71 052001               | B. Aubert <i>et al.</i>       | (BABAR Collab.)         | REFID=50509          |
| BRIERE      | 05   | PRL 95 062001               | R.A. Briere <i>et al.</i>     | (CLEO Collab.)          | REFID=50785          |
| PEDLAR      | 05   | PR D72 051108               | T.K. Pedlar <i>et al.</i>     | (CLEO Collab.)          | REFID=50808          |
| ROSNER      | 05   | PRL 95 102003               | J.L. Rosner <i>et al.</i>     | (CLEO Collab.)          | REFID=50812          |
| ABLIKIM     | 04B  | PR D70 012003               | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=49741          |
| ABLIKIM     | 04K  | PR D70 112003               | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=50327          |
| ABLIKIM     | 04L  | PR D70 112007               | M. Ablikim <i>et al.</i>      | (BES Collab.)           | REFID=50328          |
| ATHAR       | 04   | PR D70 112002               | S.B. Athar <i>et al.</i>      | (CLEO Collab.)          | REFID=50331          |
| BAI         | 04B  | PRL 92 052001               | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=49608          |
| BAI         | 04C  | PR D69 072001               | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=49749          |
| BAI         | 04D  | PL B589 7                   | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=49750          |
| BAI         | 04G  | PR D70 012004               | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=49753          |
| BAI         | 04I  | PR D70 012006               | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=49755          |
| PDG         | 04   | PL B592 1                   | S. Eidelman <i>et al.</i>     | (PDG Collab.)           | REFID=49653          |
| SETH        | 04   | PR D69 097503               | K.K. Seth                     |                         | REFID=49779          |
| AULCHENKO   | 03   | PL B573 63                  | V.M. Aulchenko <i>et al.</i>  | (KEDR Collab.)          | REFID=49579          |
| BAI         | 03B  | PR D67 052002               | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=49186          |
| BAI         | 03C  | PR D67 032004               | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=49190          |
| AUBERT      | 02B  | PR D65 031101               | B. Aubert <i>et al.</i>       | (BABAR Collab.)         | REFID=48548          |
| BAI         | 02   | PR D65 052004               | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=48578          |
| BAI         | 02B  | PL B550 24                  | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=49171          |
| BAI         | 02C  | PRL 88 101802               | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=50506          |
| PDG         | 02   | PR D66 010001               | K. Hagiwara <i>et al.</i>     | (PDG Collab.)           | REFID=48632          |
| BAI         | 01   | PR D63 032002               | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=48003          |
| AMBROGIANI  | 00A  | PR D62 032004               | M. Ambrogiani <i>et al.</i>   | (FNAL E835 Collab.)     | REFID=47939          |
| ARTAMONOV   | 00   | PL B474 427                 | A.S. Artamonov <i>et al.</i>  |                         | REFID=47424          |
| BAI         | 00   | PRL 84 594                  | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=50503          |
| BAI         | 99C  | PRL 83 1918                 | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=47420          |
| BAI         | 98E  | PR D57 3854                 | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=46339          |
| BAI         | 98F  | PR D58 097101               | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=46340          |
| BAI         | 98J  | PRL 81 5080                 | J.Z. Bai <i>et al.</i>        | (BES Collab.)           | REFID=46554          |
| ARMSTRONG   | 97   | PR D55 1153                 | T.A. Armstrong <i>et al.</i>  | (E760 Collab.)          | REFID=45416          |
| GRIBUSHIN   | 96   | PR D53 4723                 | A. Gribushin <i>et al.</i>    | (E672 and E706 Collab.) | REFID=44739          |
| ARMSTRONG   | 93B  | PR D47 772                  | T.A. Armstrong <i>et al.</i>  | (FNAL E760 Collab.)     | REFID=43307          |
| ALEXANDER   | 89   | NP B320 45                  | J.P. Alexander <i>et al.</i>  | (LBL, MICH, SLAC)       | REFID=40345          |
| COHEN       | 87   | RMP 59 1121                 | E.R. Cohen, B.N. Taylor       | (RISC, NBS)             | REFID=11616          |
| GAISER      | 86   | PR D34 711                  | J. Gaiser <i>et al.</i>       | (Crystal Ball Collab.)  | REFID=22012          |
| KURAEV      | 85   | SJNP 41 466                 | E.A. Kuraev, V.S. Fadin       | (NOVO)                  | REFID=40033          |
| FRANKLIN    | 83   | Translated from YAF 41 733  |                               |                         |                      |
| EDWARDS     | 82C  | PRL 51 963                  | M.E.B. Franklin <i>et al.</i> | (LBL, SLAC)             | REFID=22216          |
| LEMOIGNE    | 82   | PL 113B 509                 | C. Edwards <i>et al.</i>      | (CIT, HARV, PRIN+)      | REFID=22173          |
| HIMEL       | 80   | PRL 44 920                  | Y. Lemoigne <i>et al.</i>     | (SACL, LOIC, SHMP+)     | REFID=22084          |
| OREGLIA     | 80   | PRL 45 959                  | T. Himel <i>et al.</i>        | (LBL, SLAC)             | REFID=22119          |
| SCHARRE     | 80   | PL 97B 329                  | M.J. Oreglia <i>et al.</i>    | (SLAC, CIT, HARV+)      | REFID=22207          |
| ZHOLENTZ    | 80   | PL 96B 214                  | D.L. Scharre <i>et al.</i>    | (SLAC, LBL)             | REFID=21329          |
| Also        |      | SJNP 34 814                 | A.A. Zholents <i>et al.</i>   | (NOVO)                  | REFID=10320          |
|             |      | Translated from YAF 34 1471 | A.A. Zholents <i>et al.</i>   | (NOVO)                  | REFID=10321          |
| BRANDELIK   | 79B  | NP B160 426                 | R. Brandelik <i>et al.</i>    | (DASP Collab.)          | REFID=22115          |
| BRANDELIK   | 79C  | ZPHY C1 233                 | R. Brandelik <i>et al.</i>    | (DASP Collab.)          | REFID=22114          |
| BARTEL      | 78B  | PL 79B 492                  | W. Bartel <i>et al.</i>       | (DESY, HEIDP)           | REFID=22111          |
| TANENBAUM   | 78   | PR D17 1731                 | W.M. Tanenbaum <i>et al.</i>  | (SLAC, LBL)             | REFID=22112          |
| BIDDICK     | 77   | PRL 38 1324                 | C.J. Biddick <i>et al.</i>    | (UCSD, UMD, PAVI+)      | REFID=22059          |
| BRAUNSCH... | 77   | PL 67B 249                  | W. Braunschweig <i>et al.</i> | (DASP Collab.)          | REFID=22197          |
| BURMESTER   | 77   | PL 66B 395                  | J. Burmester <i>et al.</i>    | (DESY, HAMB, SIEG+)     | REFID=22198          |
| FELDMAN     | 77   | PRPL 33C 285                | G.J. Feldman, M.L. Perl       | (LBL, SLAC)             | REFID=22062          |
| YAMADA      | 77   | Hamburg Conf. 69            | S. Yamada                     | (DASP Collab.)          | REFID=22064          |
| BARTEL      | 76   | PL 64B 483                  | W. Bartel <i>et al.</i>       | (DESY, HEIDP)           | REFID=22192          |
| TANENBAUM   | 76   | PRL 36 402                  | W.M. Tanenbaum <i>et al.</i>  | (SLAC, LBL) IG          | REFID=22194          |
| WHITAKER    | 76   | PRL 37 1596                 | J.S. Whitaker <i>et al.</i>   | (SLAC, LBL)             | REFID=22151          |
| ABRAMS      | 75   | Stanford Symp. 25           | G.S. Abrams                   | (LBL)                   | REFID=22176          |
| ABRAMS      | 75B  | PRL 34 1181                 | G.S. Abrams <i>et al.</i>     | (LBL, SLAC)             | REFID=22177          |
| BOYARSKI    | 75C  | Palermo Conf. 54            | A.M. Boyarski <i>et al.</i>   | (SLAC, LBL)             | REFID=22179          |
| HILGER      | 75   | PRL 35 625                  | E. Hilger <i>et al.</i>       | (STAN, PENN)            | REFID=22186          |
| LIBERMAN    | 75   | Stanford Symp. 55           | A.D. Liberman                 | (STAN)                  | REFID=22046          |
| LUTH        | 75   | PRL 35 1124                 | V. Luth <i>et al.</i>         | (SLAC, LBL) JPC         | REFID=22188          |
| WIIK        | 75   | Stanford Symp. 69           | B.H. Wiik                     | (DESY)                  | REFID=22050          |

$\psi(3770)$ 

$$J^{PC} = 0^-(1^--)$$

NODE=M053

 **$\psi(3770)$  MASS (MeV)**

NODE=M053M

OUR FIT includes measurements of  $m_{\psi(2S)}$ ,  $m_{\psi(3770)}$ , and  $m_{\psi(3770)} - m_{\psi(2S)}$ .

NODE=M053M

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

NODE=M053M

**3773.7±0.4 OUR FIT** Error includes scale factor of 1.4.**3778.1±0.7 OUR AVERAGE**3778.1±0.7±0.6 <sup>1</sup> AAIJ 19M LHCb  $pp \rightarrow D\bar{D} + \text{anything}$ 3779.2<sup>+1.8+0.6</sup><sub>-1.7-0.8</sub> <sup>2</sup> ANASHIN 12A KEDR  $e^+e^- \rightarrow D\bar{D}$ 3775.5±2.4±0.5 57 AUBERT 08B BABR  $B \rightarrow D\bar{D}K$ 3776 ±5 ±4 68 BRODZICKA 08 BELL  $B^+ \rightarrow D^0\bar{D}^0K^+$ 3778.8±1.9±0.9 AUBERT 07BE BABR  $e^+e^- \rightarrow D\bar{D}\gamma$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

3779.8±0.6 <sup>3</sup> SHAMOV 17 RVUE  $e^+e^- \rightarrow D\bar{D}$ , hadrons3772.0±1.9 <sup>4,5</sup> ABLIKIM 08D BES2  $e^+e^- \rightarrow \text{hadrons}$ 

3778.4±3.0±1.3 34 CHISTOV 04 BELL Sup. by BRODZICKA 08

<sup>1</sup> Measured in prompt hadroproduction.<sup>2</sup> Taking into account interference between the resonant and non-resonant  $D\bar{D}$  production.<sup>3</sup> From the joint analysis of the data on the  $D\bar{D}$  and inclusive hadronic cross sections in the  $\psi(3770)$  region from BaBar, Belle, BES-II, CLEO and KEDR.<sup>4</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the  $\psi(3770)$ ,  $\psi(4040)$ ,  $\psi(4160)$ , and  $\psi(4415)$  resonances. Phase angle fixed in the fit to  $\delta = 0^\circ$ .<sup>5</sup> Interference between the resonant and non-resonant  $D\bar{D}$  production not taken into account.

NODE=M053M;LINKAGE=B  
 NODE=M053M;LINKAGE=AN  
 NODE=M053M;LINKAGE=A

NODE=M053M;LINKAGE=AB

NODE=M053M;LINKAGE=NI

 **$m_{\psi(3770)} - m_{\psi(2S)}$** 

NODE=M053DM

OUR FIT includes measurements of  $m_{\psi(2S)}$ ,  $m_{\psi(3770)}$ , and  $m_{\psi(3770)} - m_{\psi(2S)}$ .

NODE=M053DM

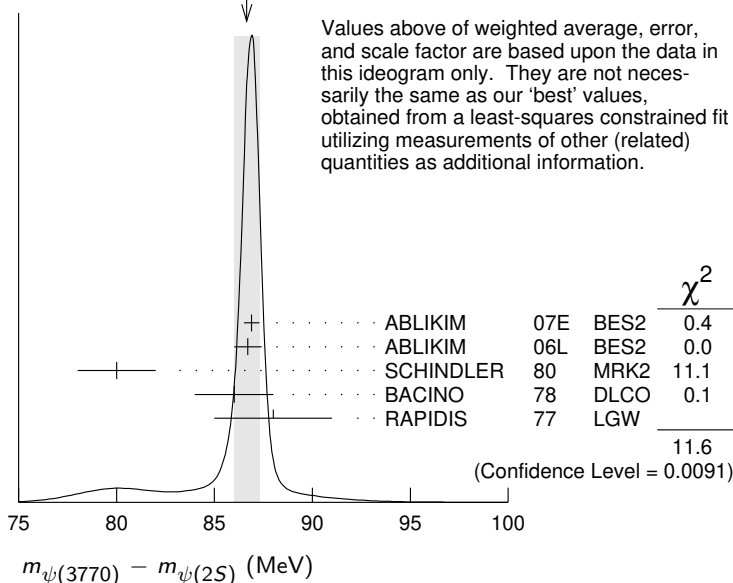
| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

NODE=M053DM

**87.6±0.4 OUR FIT** Error includes scale factor of 1.4.**86.6±0.7 OUR AVERAGE** Error includes scale factor of 2.0. See the ideogram below.86.9±0.4 <sup>1</sup> ABLIKIM 07E BES2  $e^+e^- \rightarrow \text{hadrons}$ 86.7±0.7 ABLIKIM 06L BES2  $e^+e^- \rightarrow \text{hadrons}$ 80 ±2 SCHINDLER 80 MRK2  $e^+e^-$ 86 ±2 <sup>2</sup> BACINO 78 DLCO  $e^+e^-$ 88 ±3 RAPIDIS 77 LGW  $e^+e^-$ <sup>1</sup> BES-II  $\psi(2S)$  mass subtracted (see ABLIKIM 06L).<sup>2</sup> SPEAR  $\psi(2S)$  mass subtracted (see SCHINDLER 80).

NODE=M053DM;LINKAGE=AK  
 NODE=M053DM;LINKAGE=S

WEIGHTED AVERAGE  
86.6±0.7 (Error scaled by 2.0)



### $\psi(3770)$ WIDTH

NODE=M053W

| VALUE (MeV)                                                                                    | EVTS | DOCUMENT ID            | TECN      | COMMENT                                       |
|------------------------------------------------------------------------------------------------|------|------------------------|-----------|-----------------------------------------------|
| <b>27.2± 1.0 OUR FIT</b>                                                                       |      |                        |           |                                               |
| <b>27.5± 0.9 OUR AVERAGE</b>                                                                   |      |                        |           |                                               |
| 24.9 <sup>+</sup> <sub>-</sub> 4.6 <sup>+</sup> <sub>-</sub> 4.0 <sup>-</sup> <sub>-</sub> 1.1 |      | <sup>1</sup> ANASHIN   | 12A KEDR  | $e^+e^- \rightarrow D\bar{D}$                 |
| 30.4± 8.5                                                                                      |      | <sup>2,3</sup> ABLIKIM | 08D BES2  | $e^+e^- \rightarrow \text{hadrons}$           |
| 27 ±10 ±5                                                                                      | 68   | BRODZICKA              | 08 BELL   | $B^+ \rightarrow D^0\bar{D}^0 K^+$            |
| 28.5± 1.2±0.2                                                                                  |      | <sup>3</sup> ABLIKIM   | 07E BES2  | $e^+e^- \rightarrow \text{hadrons}$           |
| 23.5± 3.7±0.9                                                                                  |      | AUBERT                 | 07BE BABR | $e^+e^- \rightarrow D\bar{D}\gamma$           |
| 26.9± 2.4±0.3                                                                                  |      | <sup>3</sup> ABLIKIM   | 06L BES2  | $e^+e^- \rightarrow \text{hadrons}$           |
| 24 ± 5                                                                                         |      | <sup>3</sup> SCHINDLER | 80 MRK2   | $e^+e^-$                                      |
| 24 ± 5                                                                                         |      | <sup>3</sup> BACINO    | 78 DLCO   | $e^+e^-$                                      |
| 28 ± 5                                                                                         |      | <sup>3</sup> RAPIDIS   | 77 LGW    | $e^+e^-$                                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                  |      |                        |           |                                               |
| 25.8± 1.3                                                                                      |      | <sup>4</sup> SHAMOV    | 17 RVUE   | $e^+e^- \rightarrow D\bar{D}, \text{hadrons}$ |

NODE=M053W

- <sup>1</sup> Taking into account interference between the resonant and non-resonant  $D\bar{D}$  production.
- <sup>2</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the  $\psi(3770)$ ,  $\psi(4040)$ ,  $\psi(4160)$ , and  $\psi(4415)$  resonances. Phase angle fixed in the fit to  $\delta = 0^\circ$ .
- <sup>3</sup> Interference between the resonant and non-resonant  $D\bar{D}$  production not taken into account.
- <sup>4</sup> From the joint analysis of the data on the  $D\bar{D}$  and inclusive hadronic cross sections in the  $\psi(3770)$  region from BaBar, Belle, BES-II, CLEO and KEDR.

NODE=M053W;LINKAGE=AN  
NODE=M053W;LINKAGE=AB

NODE=M053W;LINKAGE=NI

NODE=M053W;LINKAGE=A

### $\psi(3770)$ DECAY MODES

NODE=M053220;NODE=M053

In addition to the dominant decay mode to  $D\bar{D}$ ,  $\psi(3770)$  was found to decay into the final states containing the  $J/\psi$  (BAI 05, ADAM 06). ADAMS 06 and HUANG 06A searched for various decay modes with light hadrons and found a statistically significant signal for the decay to  $\phi\eta$  only (ADAMS 06).

NODE=M053

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ )      | Scale factor/<br>Confidence level |          |
|-------------------------------|-------------------------------------|-----------------------------------|----------|
| $\Gamma_1$ $D\bar{D}$         | (93 <sup>+8</sup> <sub>-9</sub> ) % | S=2.0                             | DESIG=2  |
| $\Gamma_2$ $D^0\bar{D}^0$     | (52 <sup>+4</sup> <sub>-5</sub> ) % | S=2.0                             | DESIG=5  |
| $\Gamma_3$ $D^+D^-$           | (41 ±4) %                           | S=2.0                             | DESIG=6  |
| $\Gamma_4$ $J/\psi\pi^+\pi^-$ | $(1.93 \pm 0.28) \times 10^{-3}$    |                                   | DESIG=4  |
| $\Gamma_5$ $J/\psi\pi^0\pi^0$ | $(8.0 \pm 3.0) \times 10^{-4}$      |                                   | DESIG=46 |
| $\Gamma_6$ $J/\psi\eta$       | $(9 \pm 4) \times 10^{-4}$          |                                   | DESIG=47 |
| $\Gamma_7$ $J/\psi\pi^0$      | $< 2.8 \times 10^{-4}$              | CL=90%                            | DESIG=48 |
| $\Gamma_8$ $e^+e^-$           | $(9.6 \pm 0.7) \times 10^{-6}$      | S=1.3                             | DESIG=1  |

## Decays to light hadrons

NODE=M053;CLUMP=H

|                 |                                     |                   |                  |        |           |
|-----------------|-------------------------------------|-------------------|------------------|--------|-----------|
| Г <sub>9</sub>  | $b_1(1235)\pi$                      | < 1.4             | $\times 10^{-5}$ | CL=90% | DESIG=20  |
| Г <sub>10</sub> | $\phi\eta'$                         | < 7               | $\times 10^{-4}$ | CL=90% | DESIG=17  |
| Г <sub>11</sub> | $\omega\eta'$                       | < 4               | $\times 10^{-4}$ | CL=90% | DESIG=16  |
| Г <sub>12</sub> | $\rho^0\eta'$                       | < 6               | $\times 10^{-4}$ | CL=90% | DESIG=15  |
| Г <sub>13</sub> | $\phi\eta$                          | ( 3.1 $\pm$ 0.7 ) | $\times 10^{-4}$ |        | DESIG=8   |
| Г <sub>14</sub> | $\omega\eta$                        | < 1.4             | $\times 10^{-5}$ | CL=90% | DESIG=14  |
| Г <sub>15</sub> | $\rho^0\eta$                        | < 5               | $\times 10^{-4}$ | CL=90% | DESIG=13  |
| Г <sub>16</sub> | $\phi\pi^0$                         | < 3               | $\times 10^{-5}$ | CL=90% | DESIG=12  |
| Г <sub>17</sub> | $\omega\pi^0$                       | < 6               | $\times 10^{-4}$ | CL=90% | DESIG=11  |
| Г <sub>18</sub> | $\pi^+\pi^-\pi^0$                   | < 5               | $\times 10^{-6}$ | CL=90% | DESIG=9   |
| Г <sub>19</sub> | $\rho\pi$                           | < 5               | $\times 10^{-6}$ | CL=90% | DESIG=10  |
| Г <sub>20</sub> | $K^+K^-$                            |                   |                  |        | DESIG=234 |
| Г <sub>21</sub> | $K^*(892)^+K^- + \text{c.c.}$       | < 1.4             | $\times 10^{-5}$ | CL=90% | DESIG=19  |
| Г <sub>22</sub> | $K^*(892)^0\bar{K}^0 + \text{c.c.}$ | < 1.2             | $\times 10^{-3}$ | CL=90% | DESIG=18  |
| Г <sub>23</sub> | $K_S^0 K_L^0$                       | < 1.2             | $\times 10^{-5}$ | CL=90% | DESIG=3   |
| Г <sub>24</sub> | $2(\pi^+\pi^-)$                     | < 1.12            | $\times 10^{-3}$ | CL=90% | DESIG=21  |
| Г <sub>25</sub> | $2(\pi^+\pi^-)\pi^0$                | < 1.06            | $\times 10^{-3}$ | CL=90% | DESIG=22  |
| Г <sub>26</sub> | $2(\pi^+\pi^-\pi^0)$                | < 5.85            | %                | CL=90% | DESIG=208 |
| Г <sub>27</sub> | $\omega\pi^+\pi^-$                  | < 6.0             | $\times 10^{-4}$ | CL=90% | DESIG=24  |
| Г <sub>28</sub> | $3(\pi^+\pi^-)$                     | < 9.1             | $\times 10^{-3}$ | CL=90% | DESIG=52  |
| Г <sub>29</sub> | $3(\pi^+\pi^-)\pi^0$                | < 1.37            | %                | CL=90% | DESIG=55  |
| Г <sub>30</sub> | $3(\pi^+\pi^-)2\pi^0$               | < 11.74           | %                | CL=90% | DESIG=210 |
| Г <sub>31</sub> | $\eta\pi^+\pi^-$                    | < 1.24            | $\times 10^{-3}$ | CL=90% | DESIG=23  |
| Г <sub>32</sub> | $\pi^+\pi^-2\pi^0$                  | < 8.9             | $\times 10^{-3}$ | CL=90% | DESIG=206 |
| Г <sub>33</sub> | $\rho^0\pi^+\pi^-$                  | < 6.9             | $\times 10^{-3}$ | CL=90% | DESIG=64  |
| Г <sub>34</sub> | $\eta 3\pi$                         | < 1.34            | $\times 10^{-3}$ | CL=90% | DESIG=25  |
| Г <sub>35</sub> | $\eta 2(\pi^+\pi^-)$                | < 2.43            | %                | CL=90% | DESIG=53  |
| Г <sub>36</sub> | $\eta\rho^0\pi^+\pi^-$              | < 1.45            | %                | CL=90% | DESIG=221 |
| Г <sub>37</sub> | $\eta' 3\pi$                        | < 2.44            | $\times 10^{-3}$ | CL=90% | DESIG=26  |
| Г <sub>38</sub> | $K^+K^-\pi^+\pi^-$                  | < 9.0             | $\times 10^{-4}$ | CL=90% | DESIG=27  |
| Г <sub>39</sub> | $\phi\pi^+\pi^-$                    | < 4.1             | $\times 10^{-4}$ | CL=90% | DESIG=28  |
| Г <sub>40</sub> | $K^+K^-2\pi^0$                      | < 4.2             | $\times 10^{-3}$ | CL=90% | DESIG=207 |
| Г <sub>41</sub> | $4(\pi^+\pi^-)$                     | < 1.67            | %                | CL=90% | DESIG=62  |
| Г <sub>42</sub> | $4(\pi^+\pi^-)\pi^0$                | < 3.06            | %                | CL=90% | DESIG=63  |
| Г <sub>43</sub> | $\phi f_0(980)$                     | < 4.5             | $\times 10^{-4}$ | CL=90% | DESIG=29  |
| Г <sub>44</sub> | $K^+K^-\pi^+\pi^-\pi^0$             | < 2.36            | $\times 10^{-3}$ | CL=90% | DESIG=30  |
| Г <sub>45</sub> | $K^+K^-\rho^0\pi^0$                 | < 8               | $\times 10^{-4}$ | CL=90% | DESIG=67  |
| Г <sub>46</sub> | $K^+K^-\rho^+\pi^-$                 | < 1.46            | %                | CL=90% | DESIG=68  |
| Г <sub>47</sub> | $\omega K^+K^-$                     | < 3.4             | $\times 10^{-4}$ | CL=90% | DESIG=32  |
| Г <sub>48</sub> | $\phi\pi^+\pi^-\pi^0$               | < 3.8             | $\times 10^{-3}$ | CL=90% | DESIG=69  |
| Г <sub>49</sub> | $K^{*0}K^-\pi^+\pi^0 + \text{c.c.}$ | < 1.62            | %                | CL=90% | DESIG=70  |
| Г <sub>50</sub> | $K^{*+}K^-\pi^+\pi^- + \text{c.c.}$ | < 3.23            | %                | CL=90% | DESIG=71  |
| Г <sub>51</sub> | $K^+K^-\pi^+\pi^-2\pi^0$            | < 2.67            | %                | CL=90% | DESIG=209 |
| Г <sub>52</sub> | $K^+K^-2(\pi^+\pi^-)$               | < 1.03            | %                | CL=90% | DESIG=57  |
| Г <sub>53</sub> | $K^+K^-2(\pi^+\pi^-)\pi^0$          | < 3.60            | %                | CL=90% | DESIG=58  |
| Г <sub>54</sub> | $\eta K^+K^-$                       | < 4.1             | $\times 10^{-4}$ | CL=90% | DESIG=31  |
| Г <sub>55</sub> | $\eta K^+K^-\pi^+\pi^-$             | < 1.24            | %                | CL=90% | DESIG=222 |
| Г <sub>56</sub> | $\rho^0 K^+K^-$                     | < 5.0             | $\times 10^{-3}$ | CL=90% | DESIG=65  |
| Г <sub>57</sub> | $2(K^+K^-)$                         | < 6.0             | $\times 10^{-4}$ | CL=90% | DESIG=33  |
| Г <sub>58</sub> | $\phi K^+K^-$                       | < 7.5             | $\times 10^{-4}$ | CL=90% | DESIG=34  |
| Г <sub>59</sub> | $2(K^+K^-)\pi^0$                    | < 2.9             | $\times 10^{-4}$ | CL=90% | DESIG=35  |
| Г <sub>60</sub> | $2(K^+K^-)\pi^+\pi^-$               | < 3.2             | $\times 10^{-3}$ | CL=90% | DESIG=59  |
| Г <sub>61</sub> | $K_S^0 K^-\pi^+$                    | < 3.2             | $\times 10^{-3}$ | CL=90% | DESIG=200 |
| Г <sub>62</sub> | $K_S^0 K^-\pi^+\pi^0$               | < 1.33            | %                | CL=90% | DESIG=201 |
| Г <sub>63</sub> | $K_S^0 K^-\rho^+$                   | < 6.6             | $\times 10^{-3}$ | CL=90% | DESIG=214 |
| Г <sub>64</sub> | $K_S^0 K^-2\pi^+\pi^-$              | < 8.7             | $\times 10^{-3}$ | CL=90% | DESIG=202 |
| Г <sub>65</sub> | $K_S^0 K^-\pi^+\rho^0$              | < 1.6             | %                | CL=90% | DESIG=215 |



|                 |                                   |        |                  |        |           |
|-----------------|-----------------------------------|--------|------------------|--------|-----------|
| Γ <sub>66</sub> | $K_S^0 K^- \pi^+ \eta$            | < 1.3  | %                | CL=90% | DESIG=216 |
| Γ <sub>67</sub> | $K_S^0 K^- 2\pi^+ \pi^- \pi^0$    | < 4.18 | %                | CL=90% | DESIG=203 |
| Γ <sub>68</sub> | $K_S^0 K^- 2\pi^+ \pi^- \eta$     | < 4.8  | %                | CL=90% | DESIG=217 |
| Γ <sub>69</sub> | $K_S^0 K^- \pi^+ 2(\pi^+ \pi^-)$  | < 1.22 | %                | CL=90% | DESIG=204 |
| Γ <sub>70</sub> | $K_S^0 K^- \pi^+ 2\pi^0$          | < 2.65 | %                | CL=90% | DESIG=205 |
| Γ <sub>71</sub> | $K_S^0 K^- K^+ K^- \pi^+$         | < 4.9  | $\times 10^{-3}$ | CL=90% | DESIG=218 |
| Γ <sub>72</sub> | $K_S^0 K^- K^+ K^- \pi^+ \pi^0$   | < 3.0  | %                | CL=90% | DESIG=219 |
| Γ <sub>73</sub> | $K_S^0 K^- K^+ K^- \pi^+ \eta$    | < 2.2  | %                | CL=90% | DESIG=220 |
| Γ <sub>74</sub> | $K_S^0 K^- \pi^+ + \text{c.c.}$   | < 9.7  | $\times 10^{-3}$ | CL=90% | DESIG=60  |
| Γ <sub>75</sub> | $p\bar{p}$                        |        |                  |        | DESIG=233 |
| Γ <sub>76</sub> | $p\bar{p}\pi^0$                   | < 4    | $\times 10^{-5}$ | CL=90% | DESIG=54  |
| Γ <sub>77</sub> | $p\bar{p}\pi^+ \pi^-$             | < 5.8  | $\times 10^{-4}$ | CL=90% | DESIG=36  |
| Γ <sub>78</sub> | $\Lambda\bar{\Lambda}$            | < 1.2  | $\times 10^{-4}$ | CL=90% | DESIG=42  |
| Γ <sub>79</sub> | $p\bar{p}\pi^+ \pi^- \pi^0$       | < 1.85 | $\times 10^{-3}$ | CL=90% | DESIG=37  |
| Γ <sub>80</sub> | $\omega p\bar{p}$                 | < 2.9  | $\times 10^{-4}$ | CL=90% | DESIG=39  |
| Γ <sub>81</sub> | $\Lambda\bar{\Lambda}\pi^0$       | < 7    | $\times 10^{-5}$ | CL=90% | DESIG=72  |
| Γ <sub>82</sub> | $p\bar{p}2(\pi^+ \pi^-)$          | < 2.6  | $\times 10^{-3}$ | CL=90% | DESIG=61  |
| Γ <sub>83</sub> | $\eta p\bar{p}$                   | < 5.4  | $\times 10^{-4}$ | CL=90% | DESIG=38  |
| Γ <sub>84</sub> | $\eta p\bar{p}\pi^+ \pi^-$        | < 3.3  | $\times 10^{-3}$ | CL=90% | DESIG=223 |
| Γ <sub>85</sub> | $\rho^0 p\bar{p}$                 | < 1.7  | $\times 10^{-3}$ | CL=90% | DESIG=66  |
| Γ <sub>86</sub> | $p\bar{p}K^+ K^-$                 | < 3.2  | $\times 10^{-4}$ | CL=90% | DESIG=40  |
| Γ <sub>87</sub> | $\eta p\bar{p}K^+ K^-$            | < 6.9  | $\times 10^{-3}$ | CL=90% | DESIG=224 |
| Γ <sub>88</sub> | $\pi^0 p\bar{p}K^+ K^-$           | < 1.2  | $\times 10^{-3}$ | CL=90% | DESIG=225 |
| Γ <sub>89</sub> | $\phi p\bar{p}$                   | < 1.3  | $\times 10^{-4}$ | CL=90% | DESIG=41  |
| Γ <sub>90</sub> | $\Lambda\bar{\Lambda}\pi^+ \pi^-$ | < 2.5  | $\times 10^{-4}$ | CL=90% | DESIG=43  |
| Γ <sub>91</sub> | $\Lambda\bar{p}K^+$               | < 2.8  | $\times 10^{-4}$ | CL=90% | DESIG=44  |
| Γ <sub>92</sub> | $\Lambda\bar{p}K^+ \pi^+ \pi^-$   | < 6.3  | $\times 10^{-4}$ | CL=90% | DESIG=45  |
| Γ <sub>93</sub> | $\Lambda\bar{\Lambda}\eta$        | < 1.9  | $\times 10^{-4}$ | CL=90% | DESIG=226 |
| Γ <sub>94</sub> | $\Sigma^+ \bar{\Sigma}^-$         | < 1.0  | $\times 10^{-4}$ | CL=90% | DESIG=227 |
| Γ <sub>95</sub> | $\Sigma^0 \bar{\Sigma}^0$         | < 4    | $\times 10^{-5}$ | CL=90% | DESIG=228 |
| Γ <sub>96</sub> | $\Xi^+ \bar{\Xi}^-$               | < 1.5  | $\times 10^{-4}$ | CL=90% | DESIG=229 |
| Γ <sub>97</sub> | $\Xi^0 \bar{\Xi}^0$               | < 1.4  | $\times 10^{-4}$ | CL=90% | DESIG=230 |

#### Radiative decays

|                  |                    |                     |                  |        |                               |
|------------------|--------------------|---------------------|------------------|--------|-------------------------------|
| Γ <sub>98</sub>  | $\gamma\chi_{c2}$  | < 6.4               | $\times 10^{-4}$ | CL=90% | NODE=M053;CLUMP=R<br>DESIG=51 |
| Γ <sub>99</sub>  | $\gamma\chi_{c1}$  | ( $2.49 \pm 0.23$ ) | $\times 10^{-3}$ |        | DESIG=50                      |
| Γ <sub>100</sub> | $\gamma\chi_{c0}$  | ( $6.9 \pm 0.6$ )   | $\times 10^{-3}$ |        | DESIG=49                      |
| Γ <sub>101</sub> | $\gamma\eta_c$     | < 7                 | $\times 10^{-4}$ | CL=90% | DESIG=231                     |
| Γ <sub>102</sub> | $\gamma\eta_c(2S)$ | < 9                 | $\times 10^{-4}$ | CL=90% | DESIG=232                     |
| Γ <sub>103</sub> | $\gamma\eta'$      | < 1.8               | $\times 10^{-4}$ | CL=90% | DESIG=213                     |
| Γ <sub>104</sub> | $\gamma\eta$       | < 1.5               | $\times 10^{-4}$ | CL=90% | DESIG=212                     |
| Γ <sub>105</sub> | $\gamma\pi^0$      | < 2                 | $\times 10^{-4}$ | CL=90% | DESIG=211                     |

#### CONSTRAINED FIT INFORMATION

An overall fit to the total width, a partial width, and 3 branching ratios uses 23 measurements and one constraint to determine 5 parameters. The overall fit has a  $\chi^2 = 20.1$  for 19 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$ , in percent, from the fit to parameters  $p_i$ , including the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

|          |       |       |       |
|----------|-------|-------|-------|
| $x_3$    | 99    |       |       |
| $x_8$    | 0     | 0     |       |
| $\Gamma$ | 0     | 0     | -44   |
|          | $x_2$ | $x_3$ | $x_8$ |

|                | Mode            | Rate (MeV)                       | Scale factor |         |
|----------------|-----------------|----------------------------------|--------------|---------|
| Γ <sub>2</sub> | $D^0 \bar{D}^0$ | $14.0 \pm 1.4$                   | 1.8          | DESIG=5 |
| Γ <sub>3</sub> | $D^+ D^-$       | $11.2 \pm 1.1$                   | 1.7          | DESIG=6 |
| Γ <sub>8</sub> | $e^+ e^-$       | $(2.62 \pm 0.18) \times 10^{-4}$ | 1.4          | DESIG=1 |

$\psi(3770)$  PARTIAL WIDTHS

NODE=M053225

 $\Gamma(e^+e^-)$  $\Gamma_8$ 

| VALUE (keV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

**0.262±0.018 OUR FIT** Error includes scale factor of 1.4.**0.256±0.016 OUR AVERAGE** Error includes scale factor of 1.2.0.154<sup>+0.079+0.021</sup><sub>-0.058-0.027</sub> 1,2 ANASHIN 12A KEDR  $e^+e^- \rightarrow D\bar{D}$ 0.22 ±0.05 3,4 ABLIKIM 08D BES2  $e^+e^- \rightarrow$  hadrons0.277±0.011±0.013 4 ABLIKIM 07E BES2  $e^+e^- \rightarrow$  hadrons0.203±0.003<sup>+0.041</sup><sub>-0.027</sub> 1.4M 4,5 BESSON 06 CLEO  $e^+e^- \rightarrow$  hadrons0.276±0.050 4 SCHINDLER 80 MRK2  $e^+e^-$ 0.18 ±0.06 4 BACINO 78 DLCO  $e^+e^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.196±0.018 6 SHAMOV 17 RVUE  $e^+e^- \rightarrow D\bar{D}$ , hadrons0.414<sup>+0.072+0.093</sup><sub>-0.080-0.028</sub> 2,7 ANASHIN 12A KEDR  $e^+e^- \rightarrow D\bar{D}$ 0.37 ±0.09 8 RAPIDIS 77 LGW  $e^+e^-$ <sup>1</sup> Solution I of the two solutions.<sup>2</sup> Taking into account interference between the resonant and non-resonant  $D\bar{D}$  production.<sup>3</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the  $\psi(3770)$ ,  $\psi(4040)$ ,  $\psi(4160)$ , and  $\psi(4415)$  resonances. Phase angle fixed in the fit to  $\delta = 0^\circ$ .<sup>4</sup> Interference between the resonant and non-resonant  $D\bar{D}$  production not taken into account.<sup>5</sup> BESSON 06 (as corrected in BESSON 10) measure  $\sigma(e^+e^- \rightarrow \psi(3770) \rightarrow \text{hadrons}) = 6.36 \pm 0.08^{+0.41}_{-0.30}$  nb at  $\sqrt{s} = 3773 \pm 1$  MeV, and obtain  $\Gamma_{ee}$  from the Born-level cross section calculated using  $\psi(3770)$  mass and width from our 2004 edition, PDG 04.<sup>6</sup> From the joint analysis of the data on the  $D\bar{D}$  and inclusive hadronic cross sections in the  $\psi(3770)$  region from BaBar, Belle, BES-II, CLEO and KEDR.<sup>7</sup> Solution II of the two solutions.<sup>8</sup> See also  $\Gamma(e^+e^-)/\Gamma_{\text{total}}$  below.NODE=M053W1  
NODE=M053W1

OCCUR=2

OCCUR=2

NODE=M053W1;LINKAGE=A1  
NODE=M053W1;LINKAGE=AN  
NODE=M053W1;LINKAGE=AB

NODE=M053W1;LINKAGE=NI

NODE=M053W1;LINKAGE=BE

NODE=M053W1;LINKAGE=B

NODE=M053W1;LINKAGE=A2

NODE=M053W1;LINKAGE=R

 $\psi(3770)$  BRANCHING RATIOS

NODE=M053230

 $\Gamma(D\bar{D})/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma = (\Gamma_2+\Gamma_3)/\Gamma$ 

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.93<sup>+0.08</sup><sub>-0.09</sub> OUR FIT** Error includes scale factor of 2.0.**0.93<sup>+0.08</sup><sub>-0.09</sub> OUR AVERAGE** Error includes scale factor of 2.1.0.849±0.056±0.018 1 ABLIKIM 08B BES2  $e^+e^- \rightarrow$  non- $D\bar{D}$ 1.033±0.014<sup>+0.048</sup><sub>-0.066</sub> 1.427M 2 BESSON 06 CLEO  $e^+e^- \rightarrow$  hadrons

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.836±0.049 3 SHAMOV 17 RVUE  $e^+e^- \rightarrow D\bar{D}$ , hadrons0.866±0.050±0.036 4,5 ABLIKIM 07K BES2  $e^+e^- \rightarrow$  non- $D\bar{D}$ 0.836±0.073±0.042 5 ABLIKIM 06L BES2  $e^+e^- \rightarrow D\bar{D}$ 0.855±0.017±0.058 5,6 ABLIKIM 06N BES2  $e^+e^- \rightarrow D\bar{D}$ <sup>1</sup> Neglecting interference.<sup>2</sup> Obtained by comparing a measurement of the total cross section (corrected in BESSON 10) with that of  $D\bar{D}$  reported by CLEO in DOBBS 07.<sup>3</sup> From the joint analysis of the data on the  $D\bar{D}$  and inclusive hadronic cross sections in the  $\psi(3770)$  region from BaBar, Belle, BES-II, CLEO and KEDR.<sup>4</sup> Using  $\sigma^{obs} = 7.07 \pm 0.58$  nb and neglecting interference.<sup>5</sup> Not independent of ABLIKIM 08B.<sup>6</sup> From a measurement of  $\sigma(e^+e^- \rightarrow D\bar{D})$  at  $\sqrt{s} = 3773$  MeV, using the  $\psi(3770)$  resonance parameters measured by ABLIKIM 06L.NODE=M053R1;LINKAGE=AI  
NODE=M053R1;LINKAGE=BE

NODE=M053R1;LINKAGE=A

NODE=M053R1;LINKAGE=AL

NODE=M053R1;LINKAGE=SU

NODE=M053R1;LINKAGE=AB

 $\Gamma(D^0\bar{D}^0)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.52<sup>+0.04</sup><sub>-0.05</sub> OUR FIT** Error includes scale factor of 2.0.

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.467±0.047±0.023 ABLIKIM 06L BES2  $e^+e^- \rightarrow D^0\bar{D}^0$ 0.499±0.013±0.038 1 ABLIKIM 06N BES2  $e^+e^- \rightarrow D^0\bar{D}^0$ <sup>1</sup> From a measurement of  $\sigma(e^+e^- \rightarrow D\bar{D})$  at  $\sqrt{s} = 3773$  MeV, using the  $\psi(3770)$  resonance parameters measured by ABLIKIM 06L.NODE=M053R46  
NODE=M053R46

NODE=M053R46;LINKAGE=AB

$\Gamma(D^+ D^-)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

**0.41 ±0.04 OUR FIT** Error includes scale factor of 2.0.

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                     |                      |     |      |                               |
|---------------------|----------------------|-----|------|-------------------------------|
| 0.369 ±0.037 ±0.028 | ABLIKIM              | 06L | BES2 | $e^+ e^- \rightarrow D^+ D^-$ |
| 0.357 ±0.011 ±0.034 | <sup>1</sup> ABLIKIM | 06N | BES2 | $e^+ e^- \rightarrow D^+ D^-$ |

<sup>1</sup> From a measurement of  $\sigma(e^+ e^- \rightarrow D \bar{D})$  at  $\sqrt{s} = 3773$  MeV, using the  $\psi(3770)$  resonance parameters measured by ABLIKIM 06L.NODE=M053R47  
NODE=M053R47

NODE=M053R47;LINKAGE=AB

 $\Gamma(D^0 \bar{D}^0)/\Gamma(D^+ D^-)$  $\Gamma_2/\Gamma_3$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**1.253 ±0.016 OUR FIT****1.253 ±0.016 OUR AVERAGE**

|                     |      |                      |      |      |                                             |
|---------------------|------|----------------------|------|------|---------------------------------------------|
| 1.252 ±0.009 ±0.013 | 5.3M | BONVICINI            | 14   | CLEO | $e^+ e^- \rightarrow D \bar{D}$             |
| 1.39 ±0.31 ±0.12    |      | PAKHLOVA             | 08   | BELL | $10.6 e^+ e^- \rightarrow D \bar{D} \gamma$ |
| 1.78 ±0.33 ±0.24    |      | AUBERT               | 07BE | BABR | $e^+ e^- \rightarrow D \bar{D} \gamma$      |
| 1.27 ±0.12 ±0.08    |      | ABLIKIM              | 06L  | BES2 | $e^+ e^- \rightarrow D \bar{D}$             |
| 2.43 ±1.50 ±0.43    | 34   | <sup>1</sup> CHISTOV | 04   | BELL | $B^+ \rightarrow \psi(3770) K^+$            |

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.258 ±0.016 ±0.014 <sup>2</sup> DOBBS 07 CLEO  $e^+ e^- \rightarrow D \bar{D}$ <sup>1</sup> See ADLER 88C for older measurements of this quantity.<sup>2</sup> Superseded by BONVICINI 14.NODE=M053R5  
NODE=M053R5NODE=M053R5;LINKAGE=CH  
NODE=M053R5;LINKAGE=DO $\Gamma(J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**1.93 ±0.28 OUR AVERAGE**

|                  |            |      |    |      |                                  |
|------------------|------------|------|----|------|----------------------------------|
| 1.89 ±0.20 ±0.20 | 231 ± 33   | ADAM | 06 | CLEO | $e^+ e^- \rightarrow \psi(3770)$ |
| 3.4 ±1.4 ±0.9    | 17.8 ± 4.8 | BAI  | 05 | BES2 | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R4  
NODE=M053R4 $\Gamma(J/\psi \pi^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**0.080 ±0.025 ±0.016** 39 ± 14 ADAM 06 CLEO  $e^+ e^- \rightarrow \psi(3770)$ NODE=M053R7  
NODE=M053R7 $\Gamma(J/\psi \eta)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**87 ±33 ±22** 22 ± 10 ADAM 06 CLEO  $e^+ e^- \rightarrow \psi(3770)$ NODE=M053R8  
NODE=M053R8 $\Gamma(J/\psi \pi^0)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

<28 90 <10 ADAM 06 CLEO  $e^+ e^- \rightarrow \psi(3770)$ NODE=M053R9  
NODE=M053R9 $\Gamma(e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-5}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

**0.96 ±0.07 OUR FIT** Error includes scale factor of 1.3.**1.3 ±0.2** RAPIDIS 77 LGW  $e^+ e^-$ NODE=M053R2  
NODE=M053R2

## ————— DECAYS TO LIGHT HADRONS —————

 $\Gamma(b_1(1235) \pi)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

<1.4 90 <sup>1</sup> ADAMS 06 CLEO  $e^+ e^- \rightarrow \psi(3770)$ <sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D \bar{D}) = 6.39 \pm 0.20$  nb.

NODE=M053250

NODE=M053R82  
NODE=M053R82

NODE=M053R82;LINKAGE=AD

 $\Gamma(\phi \eta')/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

<7 90 <sup>1</sup> ADAMS 06 CLEO  $e^+ e^- \rightarrow \psi(3770)$ <sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D \bar{D}) = 6.39 \pm 0.20$  nb.NODE=M053R83  
NODE=M053R83

NODE=M053R83;LINKAGE=AD

 $\Gamma(\omega \eta')/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

<4 90 <sup>1</sup> ADAMS 06 CLEO  $e^+ e^- \rightarrow \psi(3770)$ <sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D \bar{D}) = 6.39 \pm 0.20$  nb.NODE=M053R84  
NODE=M053R84

NODE=M053R84;LINKAGE=AD

$\Gamma(\rho^0\eta')/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN    | COMMENT                         |
|--------------------------|-----|--------------------|---------|---------------------------------|
| <6                       | 90  | <sup>1</sup> ADAMS | 06 CLEO | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20$  nb.

NODE=M053R85  
NODE=M053R85

NODE=M053R85;LINKAGE=AD

 $\Gamma(\phi\eta)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

**3.1±0.6±0.3** <sup>1</sup> ADAMS 06 CLEO  $3.773 e^+e^- \rightarrow \phi\eta$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<19 90 <sup>2</sup> ABLIKIM 07B BES2  $e^+e^- \rightarrow \psi(3770)$

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20$  nb.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R6  
NODE=M053R6

NODE=M053R6;LINKAGE=AD

NODE=M053R6;LINKAGE=AK

 $\Gamma(\omega\eta)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

<1.4 90 <sup>1</sup> ADAMS 06 CLEO  $e^+e^- \rightarrow \psi(3770)$

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20$  nb.

NODE=M053R86  
NODE=M053R86

NODE=M053R86;LINKAGE=AD

 $\Gamma(\rho^0\eta)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

<5 90 <sup>1</sup> ADAMS 06 CLEO  $e^+e^- \rightarrow \psi(3770)$

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20$  nb.

NODE=M053R87  
NODE=M053R87

NODE=M053R87;LINKAGE=AD

 $\Gamma(\phi\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

< 3 90 <sup>1</sup> ADAMS 06 CLEO  $e^+e^- \rightarrow \psi(3770)$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<50 90 <sup>2</sup> ABLIKIM 07B BES2  $e^+e^- \rightarrow \psi(3770)$

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20$  nb.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R11  
NODE=M053R11

NODE=M053R11;LINKAGE=AD

NODE=M053R11;LINKAGE=AK

 $\Gamma(\omega\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

<6 90 <sup>1</sup> ADAMS 06 CLEO  $e^+e^- \rightarrow \psi(3770)$

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20$  nb.

NODE=M053R88  
NODE=M053R88

NODE=M053R88;LINKAGE=AD

 $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

<5 90 <sup>1,2</sup> ADAMS 06 CLEO  $e^+e^- \rightarrow \psi(3770)$

<sup>1</sup> Data suggest possible destructive interference with continuum.

<sup>2</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20$  nb.

NODE=M053R89  
NODE=M053R89

NODE=M053R89;LINKAGE=AD

NODE=M053R89;LINKAGE=AS

 $\Gamma(\rho\pi)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

<5 90 <sup>1,2</sup> ADAMS 06 CLEO  $e^+e^- \rightarrow \psi(3770)$

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20$  nb.

<sup>2</sup> Data suggest possible destructive interference with continuum.

NODE=M053R90  
NODE=M053R90

NODE=M053R90;LINKAGE=AD

NODE=M053R90;LINKAGE=AS

 $\Gamma(K^+K^-)/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

$\sim 10^{-5}$  <sup>1</sup> DRUZHININ 15 RVUE  $e^+e^- \rightarrow \psi(3770)$

<sup>1</sup> DRUZHININ 15 uses BABAR and CLEO data taking into account interference of the processes  $e^+e^- \rightarrow K^+K^-$  and  $e^+e^- \rightarrow K_S^0 K_L^0$ .

NODE=M053R00  
NODE=M053R00

NODE=M053R00;LINKAGE=A

$\Gamma(K^*(892)^+ K^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID           | TECN | COMMENT                          |
|--------------------------|-----|-----------------------|------|----------------------------------|
| <1.4                     | 90  | <sup>1</sup> ADAMS 06 | CLEO | $e^+ e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20$  nb.

NODE=M053R91  
NODE=M053R91

NODE=M053R91;LINKAGE=AS

 $\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{22}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID           | TECN | COMMENT                          |
|--------------------------|-----|-----------------------|------|----------------------------------|
| <1.2                     | 90  | <sup>1</sup> ADAMS 06 | CLEO | $e^+ e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Comparing cross sections at  $\sqrt{s} = 3.773$  GeV and  $\sqrt{s} = 3.671$  GeV, neglecting interference, and using  $\sigma(\psi(3770) \rightarrow D\bar{D}) = 6.39 \pm 0.20$  nb.

NODE=M053R92  
NODE=M053R92

NODE=M053R92;LINKAGE=AD

 $\Gamma(K_S^0 K_L^0)/\Gamma_{\text{total}}$  $\Gamma_{23}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID                 | TECN | COMMENT                          |
|--------------------------|-----|-----------------------------|------|----------------------------------|
| < 1.2                    | 90  | <sup>1</sup> CRONIN-HEN..06 | CLEO | $e^+ e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                          |     |                                  |
|-----|----|--------------------------|-----|----------------------------------|
| <21 | 90 | <sup>2</sup> ABLIKIM 04F | BES | $e^+ e^- \rightarrow \psi(3770)$ |
|-----|----|--------------------------|-----|----------------------------------|

<sup>1</sup> Using  $\sigma(e^+ e^- \rightarrow \psi(3770) \rightarrow \text{hadrons}) = (6.38 \pm 0.08^{+0.41}_{-0.30})$  nb from BESSON 06 and  $B(K_S^0 \rightarrow \pi^+ \pi^-) = 0.6895 \pm 0.0014$ .

<sup>2</sup> Using  $B(K_S^0 \rightarrow \pi^+ \pi^-) = 0.6860 \pm 0.0027$ .

NODE=M053R3  
NODE=M053R3

NODE=M053R3;LINKAGE=CR

NODE=M053R3;LINKAGE=AB

 $\Gamma(2(\pi^+ \pi^-))/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID            | TECN | COMMENT                          |
|--------------------------|-----|------------------------|------|----------------------------------|
| <11.2                    | 90  | <sup>1</sup> HUANG 06A | CLEO | $e^+ e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                          |      |                                  |
|-----|----|--------------------------|------|----------------------------------|
| <48 | 90 | <sup>2</sup> ABLIKIM 07B | BES2 | $e^+ e^- \rightarrow \psi(3770)$ |
|-----|----|--------------------------|------|----------------------------------|

<sup>1</sup> Using  $\sigma_{\text{tot}}(e^+ e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R21  
NODE=M053R21

NODE=M053R21;LINKAGE=HU  
NODE=M053R21;LINKAGE=AK

 $\Gamma(2(\pi^+ \pi^-) \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID            | TECN | COMMENT                          |
|--------------------------|-----|------------------------|------|----------------------------------|
| <10.6                    | 90  | <sup>1</sup> HUANG 06A | CLEO | $e^+ e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                          |      |                                  |
|-----|----|--------------------------|------|----------------------------------|
| <62 | 90 | <sup>2</sup> ABLIKIM 07B | BES2 | $e^+ e^- \rightarrow \psi(3770)$ |
|-----|----|--------------------------|------|----------------------------------|

<sup>1</sup> Using  $\sigma_{\text{tot}}(e^+ e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R22  
NODE=M053R22

NODE=M053R22;LINKAGE=HU  
NODE=M053R22;LINKAGE=AK

 $\Gamma(2(\pi^+ \pi^- \pi^0))/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                          |
|--------------------------|-----|------|-------------|------|----------------------------------|
| <58.5                    | 90  | 305  | ABLIKIM 08N | BES2 | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R72  
NODE=M053R72

 $\Gamma(\omega \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID            | TECN | COMMENT                          |
|--------------------------|-----|------------------------|------|----------------------------------|
| < 6.0                    | 90  | <sup>1</sup> HUANG 06A | CLEO | $e^+ e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                          |      |                |
|-----|----|--------------------------|------|----------------|
| <55 | 90 | <sup>2</sup> ABLIKIM 07I | BES2 | $3.77 e^+ e^-$ |
|-----|----|--------------------------|------|----------------|

<sup>1</sup> Using  $\sigma_{\text{tot}}(e^+ e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R24  
NODE=M053R24

NODE=M053R24;LINKAGE=HU  
NODE=M053R24;LINKAGE=AK

 $\Gamma(3(\pi^+ \pi^-))/\Gamma_{\text{total}}$  $\Gamma_{28}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT                          |
|--------------------------|-----|--------------------------|------|----------------------------------|
| <91                      | 90  | <sup>1</sup> ABLIKIM 07B | BES2 | $e^+ e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R07  
NODE=M053R07

NODE=M053R07;LINKAGE=AK

$\Gamma(3(\pi^+\pi^-)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                         |
|--------------------------|-----|----------------------|----------|---------------------------------|
| <b>&lt;137</b>           | 90  | <sup>1</sup> ABLIKIM | 07B BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R10  
NODE=M053R10

NODE=M053R10;LINKAGE=AK

 $\Gamma(3(\pi^+\pi^-)2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTs | DOCUMENT ID | TECN     | COMMENT                         |
|--------------------------|-----|------|-------------|----------|---------------------------------|
| <b>&lt;117.4</b>         | 90  | 59   | ABLIKIM     | 08N BES2 | $e^+e^- \rightarrow \psi(3770)$ |

NODE=M053R74  
NODE=M053R74

 $\Gamma(\eta\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                         |
|--------------------------|-----|--------------------|----------|---------------------------------|
| <b>&lt;1.24</b>          | 90  | <sup>1</sup> HUANG | 06A CLEO | $e^+e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                      |          |                                 |
|------|----|----------------------|----------|---------------------------------|
| <2.3 | 90 | <sup>2</sup> ABLIKIM | 10D BES2 | $e^+e^- \rightarrow \psi(3770)$ |
|------|----|----------------------|----------|---------------------------------|

<sup>1</sup> Using  $\sigma_{tot}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R23  
NODE=M053R23

NODE=M053R23;LINKAGE=HU  
NODE=M053R23;LINKAGE=AK

 $\Gamma(\pi^+\pi^-2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTs | DOCUMENT ID | TECN     | COMMENT                         |
|--------------------------|-----|------|-------------|----------|---------------------------------|
| <b>&lt;8.9</b>           | 90  | 218  | ABLIKIM     | 08N BES2 | $e^+e^- \rightarrow \psi(3770)$ |

NODE=M053R70  
NODE=M053R70

 $\Gamma(\rho^0\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                         |
|--------------------------|-----|----------------------|----------|---------------------------------|
| <b>&lt;6.9</b>           | 90  | <sup>1</sup> ABLIKIM | 07F BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R53  
NODE=M053R53

NODE=M053R53;LINKAGE=AK

 $\Gamma(\eta 3\pi)/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                         |
|--------------------------|-----|--------------------|----------|---------------------------------|
| <b>&lt;13.4</b>          | 90  | <sup>1</sup> HUANG | 06A CLEO | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Using  $\sigma_{tot}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

NODE=M053R25  
NODE=M053R25

NODE=M053R25;LINKAGE=HU

 $\Gamma(\eta 2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                         |
|--------------------------|-----|----------------------|----------|---------------------------------|
| <b>&lt;243</b>           | 90  | <sup>1</sup> ABLIKIM | 07B BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R08  
NODE=M053R08

NODE=M053R08;LINKAGE=AK

 $\Gamma(\eta\rho^0\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                         |
|--------------------------|-----|----------------------|----------|---------------------------------|
| <b>&lt;1.45</b>          | 90  | <sup>1</sup> ABLIKIM | 10D BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R77  
NODE=M053R77

NODE=M053R77;LINKAGE=AK

 $\Gamma(\eta' 3\pi)/\Gamma_{\text{total}}$  $\Gamma_{37}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                         |
|--------------------------|-----|--------------------|----------|---------------------------------|
| <b>&lt;24.4</b>          | 90  | <sup>1</sup> HUANG | 06A CLEO | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Using  $\sigma_{tot}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

NODE=M053R26  
NODE=M053R26

NODE=M053R26;LINKAGE=HU

 $\Gamma(K^+K^-\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{38}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                         |
|--------------------------|-----|--------------------|----------|---------------------------------|
| <b>&lt; 9.0</b>          | 90  | <sup>1</sup> HUANG | 06A CLEO | $e^+e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                      |          |                                 |
|-----|----|----------------------|----------|---------------------------------|
| <48 | 90 | <sup>2</sup> ABLIKIM | 07B BES2 | $e^+e^- \rightarrow \psi(3770)$ |
|-----|----|----------------------|----------|---------------------------------|

<sup>1</sup> Using  $\sigma_{tot}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R27  
NODE=M053R27

NODE=M053R27;LINKAGE=HU  
NODE=M053R27;LINKAGE=AK

$\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{39}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID            | TECN | COMMENT                         |
|--------------------------|-----|------------------------|------|---------------------------------|
| < 4.1                    | 90  | <sup>1</sup> HUANG 06A | CLEO | $e^+e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                          |      |                                 |
|-----|----|--------------------------|------|---------------------------------|
| <16 | 90 | <sup>2</sup> ABLIKIM 07B | BES2 | $e^+e^- \rightarrow \psi(3770)$ |
|-----|----|--------------------------|------|---------------------------------|

<sup>1</sup> Using  $\sigma_{\text{tot}}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R28  
NODE=M053R28

NODE=M053R28;LINKAGE=HU  
NODE=M053R28;LINKAGE=AK

 $\Gamma(K^+K^-2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{40}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTs | DOCUMENT ID | TECN | COMMENT                         |
|--------------------------|-----|------|-------------|------|---------------------------------|
| <4.2                     | 90  | 14   | ABLIKIM 08N | BES2 | $e^+e^- \rightarrow \psi(3770)$ |

NODE=M053R71  
NODE=M053R71

 $\Gamma(4(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{41}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|--------------------------|-----|--------------------------|------|---------------------------------|
| <16.7                    | 90  | <sup>1</sup> ABLIKIM 07F | BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R50  
NODE=M053R50

NODE=M053R50;LINKAGE=AK

 $\Gamma(4(\pi^+\pi^-)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{42}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|--------------------------|-----|--------------------------|------|---------------------------------|
| <30.6                    | 90  | <sup>1</sup> ABLIKIM 07F | BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R52  
NODE=M053R52

NODE=M053R52;LINKAGE=AK

 $\Gamma(\phi f_0(980))/\Gamma_{\text{total}}$  $\Gamma_{43}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID            | TECN | COMMENT                         |
|--------------------------|-----|------------------------|------|---------------------------------|
| <4.5                     | 90  | <sup>1</sup> HUANG 06A | CLEO | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Using  $\sigma_{\text{tot}}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

NODE=M053R29  
NODE=M053R29

NODE=M053R29;LINKAGE=HU

 $\Gamma(K^+K^-\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{44}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID            | TECN | COMMENT                         |
|--------------------------|-----|------------------------|------|---------------------------------|
| < 23.6                   | 90  | <sup>1</sup> HUANG 06A | CLEO | $e^+e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                          |      |                                 |
|------|----|--------------------------|------|---------------------------------|
| <111 | 90 | <sup>2</sup> ABLIKIM 07B | BES2 | $e^+e^- \rightarrow \psi(3770)$ |
|------|----|--------------------------|------|---------------------------------|

<sup>1</sup> Using  $\sigma_{\text{tot}}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R30  
NODE=M053R30

NODE=M053R30;LINKAGE=HU  
NODE=M053R30;LINKAGE=AK

 $\Gamma(K^+K^-\rho^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{45}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT       |
|--------------------------|-----|--------------------------|------|---------------|
| <8                       | 90  | <sup>1</sup> ABLIKIM 07I | BES2 | $3.77 e^+e^-$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R58  
NODE=M053R58

NODE=M053R58;LINKAGE=AK

 $\Gamma(K^+K^-\rho^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{46}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT       |
|--------------------------|-----|--------------------------|------|---------------|
| <146                     | 90  | <sup>1</sup> ABLIKIM 07I | BES2 | $3.77 e^+e^-$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R59  
NODE=M053R59

NODE=M053R59;LINKAGE=AK

 $\Gamma(\omega K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{47}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID            | TECN | COMMENT                         |
|--------------------------|-----|------------------------|------|---------------------------------|
| < 3.4                    | 90  | <sup>1</sup> HUANG 06A | CLEO | $e^+e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                          |      |               |
|-----|----|--------------------------|------|---------------|
| <66 | 90 | <sup>2</sup> ABLIKIM 07I | BES2 | $3.77 e^+e^-$ |
|-----|----|--------------------------|------|---------------|

<sup>1</sup> Using  $\sigma_{\text{tot}}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R32  
NODE=M053R32

NODE=M053R32;LINKAGE=HU  
NODE=M053R32;LINKAGE=AK

$\Gamma(\phi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{48}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT        |
|--------------------------|-----|--------------------------|------|----------------|
| <38                      | 90  | <sup>1</sup> ABLIKIM 07I | BES2 | $3.77 e^+ e^-$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

NODE=M053R60  
NODE=M053R60

NODE=M053R60;LINKAGE=AK

 $\Gamma(K^{*0}K^-\pi^+\pi^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{49}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT        |
|--------------------------|-----|--------------------------|------|----------------|
| <162                     | 90  | <sup>1</sup> ABLIKIM 07I | BES2 | $3.77 e^+ e^-$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

NODE=M053R61  
NODE=M053R61

NODE=M053R61;LINKAGE=AK

 $\Gamma(K^{*+}K^-\pi^+\pi^- + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{50}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT        |
|--------------------------|-----|--------------------------|------|----------------|
| <323                     | 90  | <sup>1</sup> ABLIKIM 07I | BES2 | $3.77 e^+ e^-$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

NODE=M053R62  
NODE=M053R62

NODE=M053R62;LINKAGE=AK

 $\Gamma(K^+K^-\pi^+\pi^-2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{51}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                         |
|--------------------------|-----|------|-------------|------|---------------------------------|
| <26.7                    | 90  | 24   | ABLIKIM 08N | BES2 | $e^+e^- \rightarrow \psi(3770)$ |

NODE=M053R73  
NODE=M053R73

 $\Gamma(K^+K^-2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{52}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|--------------------------|-----|--------------------------|------|---------------------------------|
| <10.3                    | 90  | <sup>1</sup> ABLIKIM 07F | BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

NODE=M053R57  
NODE=M053R57

NODE=M053R57;LINKAGE=AK

 $\Gamma(K^+K^-2(\pi^+\pi^-)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{53}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|--------------------------|-----|--------------------------|------|---------------------------------|
| <36.0                    | 90  | <sup>1</sup> ABLIKIM 07F | BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

NODE=M053R51  
NODE=M053R51

NODE=M053R51;LINKAGE=AK

 $\Gamma(\eta K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{54}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID            | TECN | COMMENT                         |
|--------------------------|-----|------------------------|------|---------------------------------|
| < 4.1                    | 90  | <sup>1</sup> HUANG 06A | CLEO | $e^+e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                          |      |                                 |
|-----|----|--------------------------|------|---------------------------------|
| <31 | 90 | <sup>2</sup> ABLIKIM 10D | BES2 | $e^+e^- \rightarrow \psi(3770)$ |
|-----|----|--------------------------|------|---------------------------------|

<sup>1</sup> Using  $\sigma_{tot}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6 \text{ nb}$  at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

NODE=M053R31  
NODE=M053R31

NODE=M053R31;LINKAGE=HU  
NODE=M053R31;LINKAGE=AK

 $\Gamma(\eta K^+K^-\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{55}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|--------------------------|-----|--------------------------|------|---------------------------------|
| <1.24                    | 90  | <sup>1</sup> ABLIKIM 10D | BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

NODE=M053R78  
NODE=M053R78

NODE=M053R78;LINKAGE=AK

 $\Gamma(\rho^0 K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{56}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|--------------------------|-----|--------------------------|------|---------------------------------|
| <5.0                     | 90  | <sup>1</sup> ABLIKIM 07F | BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

NODE=M053R54  
NODE=M053R54

NODE=M053R54;LINKAGE=AK

 $\Gamma(2(K^+K^-))/\Gamma_{\text{total}}$  $\Gamma_{57}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID            | TECN | COMMENT                         |
|--------------------------|-----|------------------------|------|---------------------------------|
| < 6.0                    | 90  | <sup>1</sup> HUANG 06A | CLEO | $e^+e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                          |      |                                 |
|-----|----|--------------------------|------|---------------------------------|
| <17 | 90 | <sup>2</sup> ABLIKIM 07B | BES2 | $e^+e^- \rightarrow \psi(3770)$ |
|-----|----|--------------------------|------|---------------------------------|

<sup>1</sup> Using  $\sigma_{tot}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6 \text{ nb}$  at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38 \text{ nb}$ .

NODE=M053R33  
NODE=M053R33

NODE=M053R33;LINKAGE=HU  
NODE=M053R33;LINKAGE=AK



$\Gamma(\phi K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | DOCUMENT ID                   | TECN | COMMENT                          |
|-------------------------------------------------------------------------------|-----|-------------------------------|------|----------------------------------|
| <b>&lt; 7.5</b>                                                               | 90  | <sup>1</sup> HUANG 06A CLEO   |      | $e^+ e^- \rightarrow \psi(3770)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                               |      |                                  |
| <24                                                                           | 90  | <sup>2</sup> ABLIKIM 07B BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Using  $\sigma_{\text{tot}}(e^+ e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.NODE=M053R34  
NODE=M053R34NODE=M053R34;LINKAGE=HU  
NODE=M053R34;LINKAGE=AK $\Gamma(2(K^+ K^-)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{59}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | DOCUMENT ID                   | TECN | COMMENT                          |
|-------------------------------------------------------------------------------|-----|-------------------------------|------|----------------------------------|
| <b>&lt; 2.9</b>                                                               | 90  | <sup>1</sup> HUANG 06A CLEO   |      | $e^+ e^- \rightarrow \psi(3770)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                               |      |                                  |
| <46                                                                           | 90  | <sup>2</sup> ABLIKIM 07B BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Using  $\sigma_{\text{tot}}(e^+ e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.NODE=M053R35  
NODE=M053R35NODE=M053R35;LINKAGE=HU  
NODE=M053R35;LINKAGE=AK $\Gamma(2(K^+ K^-)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{60}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID                   | TECN | COMMENT                          |
|--------------------------|-----|-------------------------------|------|----------------------------------|
| <b>&lt;3.2</b>           | 90  | <sup>1</sup> ABLIKIM 07F BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{\text{obs}}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.NODE=M053R48  
NODE=M053R48

NODE=M053R48;LINKAGE=AK

 $\Gamma(K_S^0 K^- \pi^+)/\Gamma_{\text{total}}$  $\Gamma_{61}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTs | DOCUMENT ID      | TECN | COMMENT                          |
|--------------------------|-----|------|------------------|------|----------------------------------|
| <b>&lt;3.2</b>           | 90  | 18   | ABLIKIM 08M BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R64  
NODE=M053R64 $\Gamma(K_S^0 K^- \pi^+ \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{62}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTs | DOCUMENT ID      | TECN | COMMENT                          |
|--------------------------|-----|------|------------------|------|----------------------------------|
| <b>&lt;13.3</b>          | 90  | 40   | ABLIKIM 08M BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R65  
NODE=M053R65 $\Gamma(K_S^0 K^- \rho^+)/\Gamma_{\text{total}}$  $\Gamma_{63}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                          |
|--------------------------|-----|------------------|------|----------------------------------|
| <b>&lt;6.6</b>           | 90  | ABLIKIM 09C BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R15  
NODE=M053R15 $\Gamma(K_S^0 K^- 2\pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{64}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTs | DOCUMENT ID      | TECN | COMMENT                          |
|--------------------------|-----|------|------------------|------|----------------------------------|
| <b>&lt;8.7</b>           | 90  | 39   | ABLIKIM 08M BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R66  
NODE=M053R66 $\Gamma(K_S^0 K^- \pi^+ \rho^0)/\Gamma_{\text{total}}$  $\Gamma_{65}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                          |
|--------------------------|-----|------------------|------|----------------------------------|
| <b>&lt;1.6</b>           | 90  | ABLIKIM 09C BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R16  
NODE=M053R16 $\Gamma(K_S^0 K^- \pi^+ \eta)/\Gamma_{\text{total}}$  $\Gamma_{66}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                          |
|--------------------------|-----|------------------|------|----------------------------------|
| <b>&lt;1.3</b>           | 90  | ABLIKIM 09C BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R17  
NODE=M053R17 $\Gamma(K_S^0 K^- 2\pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{67}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTs | DOCUMENT ID      | TECN | COMMENT                          |
|--------------------------|-----|------|------------------|------|----------------------------------|
| <b>&lt;41.8</b>          | 90  | 23   | ABLIKIM 08M BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R67  
NODE=M053R67 $\Gamma(K_S^0 K^- 2\pi^+ \pi^- \eta)/\Gamma_{\text{total}}$  $\Gamma_{68}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID      | TECN | COMMENT                          |
|--------------------------|-----|------------------|------|----------------------------------|
| <b>&lt;4.8</b>           | 90  | ABLIKIM 09C BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R18  
NODE=M053R18 $\Gamma(K_S^0 K^- \pi^+ 2(\pi^+ \pi^-))/\Gamma_{\text{total}}$  $\Gamma_{69}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTs | DOCUMENT ID      | TECN | COMMENT                          |
|--------------------------|-----|------|------------------|------|----------------------------------|
| <b>&lt;12.2</b>          | 90  | 4    | ABLIKIM 08M BES2 |      | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R68  
NODE=M053R68

$\Gamma(K_S^0 K^- \pi^+ 2\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{70}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTs | DOCUMENT ID | TECN     | COMMENT                          |
|--------------------------|-----|------|-------------|----------|----------------------------------|
| <26.5                    | 90  | 17   | ABLIKIM     | 08M BES2 | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R69  
NODE=M053R69

 $\Gamma(K_S^0 K^- K^+ K^- \pi^+)/\Gamma_{\text{total}}$   $\Gamma_{71}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                          |
|--------------------------|-----|-------------|----------|----------------------------------|
| <4.9                     | 90  | ABLIKIM     | 09C BES2 | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R19  
NODE=M053R19

 $\Gamma(K_S^0 K^- K^+ K^- \pi^+ \pi^0)/\Gamma_{\text{total}}$   $\Gamma_{72}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                          |
|--------------------------|-----|-------------|----------|----------------------------------|
| <3.0                     | 90  | ABLIKIM     | 09C BES2 | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R75  
NODE=M053R75

 $\Gamma(K_S^0 K^- K^+ K^- \pi^+ \eta)/\Gamma_{\text{total}}$   $\Gamma_{73}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                          |
|--------------------------|-----|-------------|----------|----------------------------------|
| <2.2                     | 90  | ABLIKIM     | 09C BES2 | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R76  
NODE=M053R76

 $\Gamma(K^{*0} K^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{74}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                          |
|--------------------------|-----|----------------------|----------|----------------------------------|
| <9.7                     | 90  | <sup>1</sup> ABLIKIM | 07F BES2 | $e^+ e^- \rightarrow \psi(3770)$ |

NODE=M053R55  
NODE=M053R55

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R55;LINKAGE=AK

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$   $\Gamma_{75}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                     |     |                      |           |                                                  |
|---------------------|-----|----------------------|-----------|--------------------------------------------------|
| not seen            |     | <sup>1</sup> AAIJ    | 17AD LHCb | $pp \rightarrow B^+ X \rightarrow p\bar{p}K^+ X$ |
| $7.1^{+8.6}_{-2.9}$ | 684 | <sup>2</sup> ABLIKIM | 14L BES3  | $e^+ e^- \rightarrow \psi(3770)$                 |
| $310 \pm 30$        | 684 | <sup>3</sup> ABLIKIM | 14L BES3  | $e^+ e^- \rightarrow \psi(3770)$                 |

OCCUR=2

<sup>1</sup> AAIJ 17AD reports  $B(B^+ \rightarrow \psi(3770)K^+ \rightarrow p\bar{p}K^+)/B(B^+ \rightarrow J/\psi K^+ \rightarrow p\bar{p}K^+) < 0.09$  (0.10) at 90% (95%) CL.

NODE=M053R98;LINKAGE=C

<sup>2</sup> Solution I of two equivalent solutions in a fit with a resonance interfering with continuum.

NODE=M053R98;LINKAGE=A

<sup>3</sup> Solution II of two equivalent solutions in a fit with a resonance interfering with continuum.

NODE=M053R98;LINKAGE=B

 $\Gamma(p\bar{p}\pi^0)/\Gamma_{\text{total}}$   $\Gamma_{76}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID            | TECN     | COMMENT                          |
|--------------------------|-----|------------------------|----------|----------------------------------|
| < 0.4                    | 90  | <sup>1,2</sup> ABLIKIM | 14o BES3 | $e^+ e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                      |    |                        |          |                                  |
|----------------------|----|------------------------|----------|----------------------------------|
| $59^{+3}_{-2} \pm 5$ |    | <sup>1,3</sup> ABLIKIM | 14o BES3 | $e^+ e^- \rightarrow \psi(3770)$ |
| <12                  | 90 | <sup>4</sup> ABLIKIM   | 07B BES2 | $e^+ e^- \rightarrow \psi(3770)$ |

OCCUR=2

<sup>1</sup> Calculated by the authors using  $\sigma(e^+ e^- \rightarrow \psi(3770) \rightarrow \text{hadrons}) = 6.36 \pm 0.08^{+0.41}_{-0.30}$  nb from BESSON 10.

NODE=M053R09;LINKAGE=A

<sup>2</sup> Solution I of two equivalent solutions in a fit with a resonance interfering with continuum.

NODE=M053R09;LINKAGE=B

<sup>3</sup> Solution II of two equivalent solutions in a fit with a resonance interfering with continuum.

NODE=M053R09;LINKAGE=C

<sup>4</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R09;LINKAGE=AK

 $\Gamma(p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{77}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                          |
|--------------------------|-----|--------------------|----------|----------------------------------|
| < 5.8                    | 90  | <sup>1</sup> HUANG | 06A CLEO | $e^+ e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                      |          |                                  |
|-----|----|----------------------|----------|----------------------------------|
| <16 | 90 | <sup>2</sup> ABLIKIM | 07B BES2 | $e^+ e^- \rightarrow \psi(3770)$ |
|-----|----|----------------------|----------|----------------------------------|

<sup>1</sup> Using  $\sigma_{tot}(e^+ e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

NODE=M053R36;LINKAGE=HU

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R36;LINKAGE=AK

 $\Gamma(\Lambda\bar{\Lambda})/\Gamma_{\text{total}}$   $\Gamma_{78}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                          |
|--------------------------|-----|--------------------|----------|----------------------------------|
| <1.2                     | 90  | <sup>1</sup> HUANG | 06A CLEO | $e^+ e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|    |    |                      |          |                                  |
|----|----|----------------------|----------|----------------------------------|
| <4 | 90 | <sup>2</sup> ABLIKIM | 07F BES2 | $e^+ e^- \rightarrow \psi(3770)$ |
|----|----|----------------------|----------|----------------------------------|

<sup>1</sup> Using  $\sigma_{tot}(e^+ e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

NODE=M053R42;LINKAGE=HU

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+ e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R42;LINKAGE=AK

$\Gamma(p\bar{p}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{79}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                            | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <b>&lt;18.5</b>                                                                                                                                                                     | 90  | <sup>1</sup> HUANG 06A   | CLEO | $e^+e^- \rightarrow \psi(3770)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                       |     |                          |      |                                 |
| <73                                                                                                                                                                                 | 90  | <sup>2</sup> ABLIKIM 07B | BES2 | $e^+e^- \rightarrow \psi(3770)$ |
| <sup>1</sup> Using $\sigma_{\text{tot}}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$ nb at the resonance.                                                                          |     |                          |      |                                 |
| <sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$ nb. |     |                          |      |                                 |

NODE=M053R37  
 NODE=M053R37

NODE=M053R37;LINKAGE=HU  
 NODE=M053R37;LINKAGE=AK

 $\Gamma(\omega p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{80}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                   | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <b>&lt; 2.9</b>                                                                                            | 90  | <sup>1</sup> HUANG 06A   | CLEO | $e^+e^- \rightarrow \psi(3770)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                              |     |                          |      |                                 |
| <30                                                                                                        | 90  | <sup>2</sup> ABLIKIM 07I | BES2 | $3.77 e^+e^-$                   |
| <sup>1</sup> Using $\sigma_{\text{tot}}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$ nb at the resonance. |     |                          |      |                                 |
| <sup>2</sup> Using $\sigma^{\text{obs}} = 7.15 \pm 0.27 \pm 0.27$ nb and neglecting interference.          |     |                          |      |                                 |

NODE=M053R39  
 NODE=M053R39

NODE=M053R39;LINKAGE=HU  
 NODE=M053R39;LINKAGE=AB

 $\Gamma(\Lambda\bar{\Lambda}\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{81}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                            | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <b>&lt; 0.7</b>                                                                                                                                                                     | 90  | <sup>1</sup> ABLIKIM 13Q | BES3 | $e^+e^- \rightarrow \psi(3770)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                       |     |                          |      |                                 |
| <12                                                                                                                                                                                 | 90  | <sup>2</sup> ABLIKIM 07I | BES2 | $3.77 e^+e^-$                   |
| <sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected.                                                                                   |     |                          |      |                                 |
| <sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$ nb. |     |                          |      |                                 |

NODE=M053R63  
 NODE=M053R63

NODE=M053R63;LINKAGE=A  
 NODE=M053R63;LINKAGE=AK

 $\Gamma(p\bar{p}2(\pi^+\pi^-))/\Gamma_{\text{total}}$  $\Gamma_{82}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                            | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <b>&lt;2.6</b>                                                                                                                                                                      | 90  | <sup>1</sup> ABLIKIM 07F | BES2 | $e^+e^- \rightarrow \psi(3770)$ |
| <sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$ nb. |     |                          |      |                                 |

NODE=M053R49  
 NODE=M053R49

NODE=M053R49;LINKAGE=AK

 $\Gamma(\eta p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{83}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                            | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <b>&lt; 5.4</b>                                                                                                                                                                     | 90  | <sup>1</sup> HUANG 06A   | CLEO | $e^+e^- \rightarrow \psi(3770)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                       |     |                          |      |                                 |
| <11                                                                                                                                                                                 | 90  | <sup>2</sup> ABLIKIM 10D | BES2 | $e^+e^- \rightarrow \psi(3770)$ |
| <sup>1</sup> Using $\sigma_{\text{tot}}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$ nb at the resonance.                                                                          |     |                          |      |                                 |
| <sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$ nb. |     |                          |      |                                 |

NODE=M053R38  
 NODE=M053R38

NODE=M053R38;LINKAGE=HU  
 NODE=M053R38;LINKAGE=AK

 $\Gamma(\eta p\bar{p}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{84}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                            | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <b>&lt;3.3</b>                                                                                                                                                                      | 90  | <sup>1</sup> ABLIKIM 10D | BES2 | $e^+e^- \rightarrow \psi(3770)$ |
| <sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$ nb. |     |                          |      |                                 |

NODE=M053R79  
 NODE=M053R79

NODE=M053R79;LINKAGE=AK

 $\Gamma(\rho^0 p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{85}/\Gamma$ 

| VALUE (units $10^{-3}$ )                                                                                                                                                            | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <b>&lt;1.7</b>                                                                                                                                                                      | 90  | <sup>1</sup> ABLIKIM 07F | BES2 | $e^+e^- \rightarrow \psi(3770)$ |
| <sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$ nb. |     |                          |      |                                 |

NODE=M053R56  
 NODE=M053R56

NODE=M053R56;LINKAGE=AK

 $\Gamma(p\bar{p}K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{86}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                            | CL% | DOCUMENT ID              | TECN | COMMENT                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|---------------------------------|
| <b>&lt; 3.2</b>                                                                                                                                                                     | 90  | <sup>1</sup> HUANG 06A   | CLEO | $e^+e^- \rightarrow \psi(3770)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                       |     |                          |      |                                 |
| <11                                                                                                                                                                                 | 90  | <sup>2</sup> ABLIKIM 07B | BES2 | $e^+e^- \rightarrow \psi(3770)$ |
| <sup>1</sup> Using $\sigma_{\text{tot}}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$ nb at the resonance.                                                                          |     |                          |      |                                 |
| <sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using $\sigma^{\text{obs}}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$ nb. |     |                          |      |                                 |

NODE=M053R40  
 NODE=M053R40

NODE=M053R40;LINKAGE=HU  
 NODE=M053R40;LINKAGE=AK

$\Gamma(\eta\rho\bar{p}K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{87}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                         |
|--------------------------|-----|----------------------|----------|---------------------------------|
| <b>&lt;6.9</b>           | 90  | <sup>1</sup> ABLIKIM | 10D BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R80  
NODE=M053R80

NODE=M053R80;LINKAGE=AK

 $\Gamma(\pi^0\rho\bar{p}K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{88}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                         |
|--------------------------|-----|----------------------|----------|---------------------------------|
| <b>&lt;1.2</b>           | 90  | <sup>1</sup> ABLIKIM | 10D BES2 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R81  
NODE=M053R81

NODE=M053R81;LINKAGE=AK

 $\Gamma(\phi\rho\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{89}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                         |
|--------------------------|-----|--------------------|----------|---------------------------------|
| <b>&lt;1.3</b>           | 90  | <sup>1</sup> HUANG | 06A CLEO | $e^+e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|    |    |                      |          |                                 |
|----|----|----------------------|----------|---------------------------------|
| <9 | 90 | <sup>2</sup> ABLIKIM | 07B BES2 | $e^+e^- \rightarrow \psi(3770)$ |
|----|----|----------------------|----------|---------------------------------|

<sup>1</sup> Using  $\sigma_{tot}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R41  
NODE=M053R41

NODE=M053R41;LINKAGE=HU  
NODE=M053R41;LINKAGE=AK

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{90}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                         |
|--------------------------|-----|--------------------|----------|---------------------------------|
| <b>&lt; 2.5</b>          | 90  | <sup>1</sup> HUANG | 06A CLEO | $e^+e^- \rightarrow \psi(3770)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                      |          |                                 |
|-------|----|----------------------|----------|---------------------------------|
| < 4.7 | 90 | <sup>2</sup> ABLIKIM | 13Q BES3 | $e^+e^- \rightarrow \psi(3770)$ |
|-------|----|----------------------|----------|---------------------------------|

|     |    |                      |          |                                 |
|-----|----|----------------------|----------|---------------------------------|
| <39 | 90 | <sup>3</sup> ABLIKIM | 07F BES2 | $e^+e^- \rightarrow \psi(3770)$ |
|-----|----|----------------------|----------|---------------------------------|

<sup>1</sup> Using  $\sigma_{tot}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

<sup>2</sup> Assuming that interference effects between resonance and continuum can be neglected.

<sup>3</sup> Assuming that interference effects between resonance and continuum can be neglected and using  $\sigma^{obs}(e^+e^- \rightarrow \psi(3770)) = 7.15 \pm 0.38$  nb.

NODE=M053R43  
NODE=M053R43

NODE=M053R43;LINKAGE=HU  
NODE=M053R43;LINKAGE=A  
NODE=M053R43;LINKAGE=AK

 $\Gamma(\Lambda\bar{p}K^+)/\Gamma_{\text{total}}$  $\Gamma_{91}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                         |
|--------------------------|-----|--------------------|----------|---------------------------------|
| <b>&lt;2.8</b>           | 90  | <sup>1</sup> HUANG | 06A CLEO | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Using  $\sigma_{tot}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

NODE=M053R44  
NODE=M053R44

NODE=M053R44;LINKAGE=HU

 $\Gamma(\Lambda\bar{p}K^+\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{92}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                         |
|--------------------------|-----|--------------------|----------|---------------------------------|
| <b>&lt;6.3</b>           | 90  | <sup>1</sup> HUANG | 06A CLEO | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Using  $\sigma_{tot}(e^+e^- \rightarrow \psi(3770)) = 7.9 \pm 0.6$  nb at the resonance.

NODE=M053R45  
NODE=M053R45

NODE=M053R45;LINKAGE=HU

 $\Gamma(\Lambda\bar{\Lambda}\eta)/\Gamma_{\text{total}}$  $\Gamma_{93}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                         |
|--------------------------|-----|----------------------|----------|---------------------------------|
| <b>&lt;1.9</b>           | 90  | <sup>1</sup> ABLIKIM | 13Q BES3 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected.

NODE=M053R93  
NODE=M053R93

NODE=M053R93;LINKAGE=A

 $\Gamma(\Sigma^+\bar{\Sigma}^-)/\Gamma_{\text{total}}$  $\Gamma_{94}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                         |
|--------------------------|-----|----------------------|----------|---------------------------------|
| <b>&lt;1.0</b>           | 90  | <sup>1</sup> ABLIKIM | 13Q BES3 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected.

NODE=M053R94  
NODE=M053R94

NODE=M053R94;LINKAGE=A

 $\Gamma(\Sigma^0\bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{95}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                         |
|--------------------------|-----|----------------------|----------|---------------------------------|
| <b>&lt;0.4</b>           | 90  | <sup>1</sup> ABLIKIM | 13Q BES3 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected.

NODE=M053R95  
NODE=M053R95

NODE=M053R95;LINKAGE=A

 $\Gamma(\Xi^+\bar{\Xi}^-)/\Gamma_{\text{total}}$  $\Gamma_{96}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                         |
|--------------------------|-----|----------------------|----------|---------------------------------|
| <b>&lt;1.5</b>           | 90  | <sup>1</sup> ABLIKIM | 13Q BES3 | $e^+e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected.

NODE=M053R96  
NODE=M053R96

NODE=M053R96;LINKAGE=A

$\Gamma(\Xi^0 \Xi^0)/\Gamma_{\text{total}}$  $\Gamma_{97}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                          |
|--------------------------|-----|----------------------|----------|----------------------------------|
| <b>&lt;1.4</b>           | 90  | <sup>1</sup> ABLIKIM | 13Q BES3 | $e^+ e^- \rightarrow \psi(3770)$ |

<sup>1</sup> Assuming that interference effects between resonance and continuum can be neglected.

NODE=M053R97  
NODE=M053R97

NODE=M053R97;LINKAGE=A

NODE=M053240

### RADIATIVE DECAYS

 $\Gamma(\gamma\chi_{c2})/\Gamma_{\text{total}}$  $\Gamma_{98}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                                          |
|--------------------------|-----|----------------------|----------|------------------------------------------------------------------|
| <b>&lt;0.64</b>          | 90  | <sup>1</sup> ABLIKIM | 15J BES3 | $e^+ e^- \rightarrow \psi(3770) \rightarrow \gamma\gamma J/\psi$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<2.0 90 <sup>2</sup> BRIERE 06 CLEO  $e^+ e^- \rightarrow \psi(3770) \rightarrow \gamma + \text{hadrons}$

<0.9 90 <sup>3</sup> COAN 06A CLEO  $e^+ e^- \rightarrow \psi(3770) \rightarrow \gamma\gamma J/\psi$

<sup>1</sup> This limit is equivalent to  $(0.25 \pm 0.21 \pm 0.18) \times 10^{-3}$  branching fraction value.

<sup>2</sup> Uses  $B(\psi(2S) \rightarrow \gamma\chi_{c2}) = 9.22 \pm 0.11 \pm 0.46\%$  from ATHAR 04,  $\psi(2S)$  mass and width from PDG 04, and  $\Gamma_{ee}(\psi(2S)) = 2.54 \pm 0.03 \pm 0.11$  keV from ADAM 06.

<sup>3</sup> Using  $\Gamma_{ee}(\psi(2S)) = (2.54 \pm 0.03 \pm 0.11)$  keV from ADAM 06 and taking  $\sigma(e^+ e^- \rightarrow D\bar{D})$  from HE 05 for  $\sigma(e^+ e^- \rightarrow \psi(3770))$ .

NODE=M053R03  
NODE=M053R03

NODE=M053R03;LINKAGE=A  
NODE=M053R03;LINKAGE=BR

NODE=M053R03;LINKAGE=CO

 $\Gamma(\gamma\chi_{c1})/\Gamma_{\text{total}}$  $\Gamma_{99}/\Gamma$ 

| VALUE (units $10^{-3}$ )       | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------------|------|-------------|------|---------|
| <b>2.49 ± 0.23 OUR AVERAGE</b> |      |             |      |         |

1.98 ± 0.78 ± 0.05 202 <sup>1</sup> ABLIKIM 16B BES3  $e^+ e^- \rightarrow \psi(3770) \rightarrow \gamma + \text{hadrons}$

2.48 ± 0.15 ± 0.23 0.6k ABLIKIM 15J BES3  $e^+ e^- \rightarrow \psi(3770) \rightarrow \gamma\gamma J/\psi$

2.4 ± 0.8 ± 0.2 <sup>2</sup> ABLIKIM 14H BES3  $e^+ e^- \rightarrow \psi(3770) \rightarrow K_S^0 K^\pm \pi^\mp$

2.9 ± 0.5 ± 0.4 <sup>3</sup> BRIERE 06 CLEO  $e^+ e^- \rightarrow \psi(3770) \rightarrow \gamma + \text{hadrons}, \gamma\gamma J/\psi$

• • • We do not use the following data for averages, fits, limits, etc. • • •

3.9 ± 1.4 ± 0.6 54 <sup>4</sup> BRIERE 06 CLEO  $e^+ e^- \rightarrow \psi(3770) \rightarrow \gamma + \text{hadrons}$

2.8 ± 0.5 ± 0.4 53 <sup>5</sup> COAN 06A CLEO  $e^+ e^- \rightarrow \psi(3770) \rightarrow \gamma\gamma J/\psi$

<sup>1</sup> ABLIKIM 16B reports  $(1.94 \pm 0.42 \pm 0.64) \times 10^{-3}$  from a measurement of  $[\Gamma(\psi(3770) \rightarrow \gamma\chi_{c1})/\Gamma_{\text{total}}] / [B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.55 \pm 0.31) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c1}(1P)) = (9.75 \pm 0.24) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> ABLIKIM 14H reports  $[\Gamma(\psi(3770) \rightarrow \gamma\chi_{c1})/\Gamma_{\text{total}}] \times [B(\chi_{c1}(1P) \rightarrow K_S^0 K^\pm \pi^\mp)] = (8.51 \pm 2.39 \pm 1.42) \times 10^{-6}$  which we divide by our best value  $B(\chi_{c1}(1P) \rightarrow K_S^0 K^\pm \pi^\mp) = 0.00349 \pm 0.00029$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. We have calculated the best value of  $B(\chi_{c1}(1P) \rightarrow K_S^0 K^\pm \pi^\mp)$  as 1/2 of  $B(\chi_{c1}(1P) \rightarrow \bar{K}^0 K^+ \pi^- + \text{c.c.}) = (7.0 \pm 0.6) \times 10^{-3}$ .

<sup>3</sup> Averages the two measurements from COAN 06A and BRIERE 06.

<sup>4</sup> Uses  $B(\psi(2S) \rightarrow \gamma\chi_{c1}) = 9.07 \pm 0.11 \pm 0.54\%$  from ATHAR 04,  $\psi(2S)$  mass and width from PDG 04, and  $\Gamma_{ee}(\psi(2S)) = 2.54 \pm 0.03 \pm 0.11$  keV from ADAM 06.

<sup>5</sup> Using  $\Gamma_{ee}(\psi(2S)) = (2.54 \pm 0.03 \pm 0.11)$  keV from ADAM 06 and taking  $\sigma(e^+ e^- \rightarrow D\bar{D})$  from HE 05 for  $\sigma(e^+ e^- \rightarrow \psi(3770))$ .

NODE=M053R02  
NODE=M053R02

OCCUR=2

NODE=M053R02;LINKAGE=A

NODE=M053R02;LINKAGE=AB

NODE=M053R02;LINKAGE=BI  
NODE=M053R02;LINKAGE=BR

NODE=M053R02;LINKAGE=CO

 $\Gamma(\gamma\chi_{c1})/\Gamma(J/\psi\pi^+\pi^-)$  $\Gamma_{99}/\Gamma_4$ 

| VALUE                     | EVTS    | DOCUMENT ID       | TECN     | COMMENT                                                          |
|---------------------------|---------|-------------------|----------|------------------------------------------------------------------|
| <b>1.49 ± 0.31 ± 0.26</b> | 53 ± 10 | <sup>1</sup> COAN | 06A CLEO | $e^+ e^- \rightarrow \psi(3770) \rightarrow \gamma\gamma J/\psi$ |

<sup>1</sup> Using  $B(\psi(3770) \rightarrow J/\psi\pi^+\pi^-) = (1.89 \pm 0.20 \pm 0.20) \times 10^{-3}$  from ADAM 06.

NODE=M053R04  
NODE=M053R04

NODE=M053R04;LINKAGE=CO

$\Gamma(\gamma\chi_{c0})/\Gamma_{\text{total}}$  $\Gamma_{100}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**6.9±0.6 OUR AVERAGE**

|             |      |   |         |          |                                                                     |
|-------------|------|---|---------|----------|---------------------------------------------------------------------|
| 6.7±0.7±0.1 | 2.2k | 1 | ABLIKIM | 16B BES3 | $e^+e^- \rightarrow \psi(3770) \rightarrow \gamma + \text{hadrons}$ |
| 7.3±0.7±0.6 | 274  |   | BRIERE  | 06 CLEO  | $e^+e^- \rightarrow \psi(3770) \rightarrow \gamma + \text{hadrons}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |   |      |          |                                                                 |
|------|----|---|------|----------|-----------------------------------------------------------------|
| < 44 | 90 | 2 | COAN | 06A CLEO | $e^+e^- \rightarrow \psi(3770) \rightarrow \gamma\gamma J/\psi$ |
|------|----|---|------|----------|-----------------------------------------------------------------|

<sup>1</sup> ABLIKIM 16B reports  $(6.88 \pm 0.28 \pm 0.67) \times 10^{-3}$  from a measurement of  $[\Gamma(\psi(3770) \rightarrow \gamma\chi_{c0})/\Gamma_{\text{total}}] / [B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P))]$  assuming  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.99 \pm 0.27) \times 10^{-2}$ , which we rescale to our best value  $B(\psi(2S) \rightarrow \gamma\chi_{c0}(1P)) = (9.79 \pm 0.20) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Using  $\Gamma_{ee}(\psi(2S)) = (2.54 \pm 0.03 \pm 0.11)$  keV from ADAM 06 and taking  $\sigma(e^+e^- \rightarrow D\bar{D})$  from HE 05 for  $\sigma(e^+e^- \rightarrow \psi(3770))$ .

NODE=M053R01  
NODE=M053R01

NODE=M053R01;LINKAGE=B

NODE=M053R01;LINKAGE=CO

 $\Gamma(\gamma\chi_{c0})/\Gamma(\gamma\chi_{c2})$  $\Gamma_{100}/\Gamma_{98}$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|    |    |   |        |         |                                 |
|----|----|---|--------|---------|---------------------------------|
| >8 | 90 | 1 | BRIERE | 06 CLEO | $e^+e^- \rightarrow \psi(3770)$ |
|----|----|---|--------|---------|---------------------------------|

<sup>1</sup> Not independent of other results in BRIERE 06.

NODE=M053R06  
NODE=M053R06

NODE=M053R06;LINKAGE=BR

 $\Gamma(\gamma\chi_{c0})/\Gamma(\gamma\chi_{c1})$  $\Gamma_{100}/\Gamma_{99}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |   |        |         |                                 |
|---------|---|--------|---------|---------------------------------|
| 2.5±0.6 | 1 | BRIERE | 06 CLEO | $e^+e^- \rightarrow \psi(3770)$ |
|---------|---|--------|---------|---------------------------------|

<sup>1</sup> Not independent of other results in BRIERE 06.

NODE=M053R05  
NODE=M053R05

NODE=M053R05;LINKAGE=BR

 $\Gamma(\gamma\eta_c)/\Gamma_{\text{total}}$  $\Gamma_{101}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN |
|-------|-----|-------------|------|
|-------|-----|-------------|------|

|                       |    |   |                  |
|-----------------------|----|---|------------------|
| <7 × 10 <sup>-4</sup> | 90 | 1 | ABLIKIM 14H BES3 |
|-----------------------|----|---|------------------|

<sup>1</sup> ABLIKIM 14H reports  $[\Gamma(\psi(3770) \rightarrow \gamma\eta_c)/\Gamma_{\text{total}}] \times [B(\eta_c(1S) \rightarrow K_S^0 K^\pm \pi^\mp)] < 16 \times 10^{-6}$  which we divide by our best value  $B(\eta_c(1S) \rightarrow K_S^0 K^\pm \pi^\mp) = 2.42 \times 10^{-2}$ . We have calculated the best value of  $B(\eta_c(1S) \rightarrow K_S^0 K^\pm \pi^\mp)$  as 1/3 of  $B(\eta_c(1S) \rightarrow K\bar{K}\pi) = 7.3 \times 10^{-2}$ .

NODE=M053R99  
NODE=M053R99

NODE=M053R99;LINKAGE=AB

 $\Gamma(\gamma\eta_c(2S))/\Gamma_{\text{total}}$  $\Gamma_{102}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN |
|-------|-----|-------------|------|
|-------|-----|-------------|------|

|                       |    |   |                  |
|-----------------------|----|---|------------------|
| <9 × 10 <sup>-4</sup> | 90 | 1 | ABLIKIM 14H BES3 |
|-----------------------|----|---|------------------|

<sup>1</sup> ABLIKIM 14H reports  $[\Gamma(\psi(3770) \rightarrow \gamma\eta_c(2S))/\Gamma_{\text{total}}] \times [B(\eta_c(2S) \rightarrow K_S^0 K^\pm \pi^\mp)] < 5.6 \times 10^{-6}$  which we divide by our best value  $B(\eta_c(2S) \rightarrow K_S^0 K^\pm \pi^\mp) = 6 \times 10^{-3}$ . We have calculated the best value of  $B(\eta_c(2S) \rightarrow K_S^0 K^\pm \pi^\mp)$  as 1/3 of  $B(\eta_c(2S) \rightarrow K\bar{K}\pi) = 1.9 \times 10^{-2}$ .

NODE=M053R20  
NODE=M053R20

NODE=M053R20;LINKAGE=AB

 $\Gamma(\gamma\eta')/\Gamma_{\text{total}}$  $\Gamma_{103}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|      |    |   |                |                                 |
|------|----|---|----------------|---------------------------------|
| <1.8 | 90 | 1 | PEDLAR 09 CLE3 | $\psi(2S) \rightarrow \gamma X$ |
|------|----|---|----------------|---------------------------------|

<sup>1</sup> Assuming maximal destructive interference between  $\psi(3770)$  and continuum sources.

NODE=M053R14  
NODE=M053R14

NODE=M053R14;LINKAGE=PE

 $\Gamma(\gamma\eta)/\Gamma_{\text{total}}$  $\Gamma_{104}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|      |    |   |                |                                 |
|------|----|---|----------------|---------------------------------|
| <1.5 | 90 | 1 | PEDLAR 09 CLE3 | $\psi(2S) \rightarrow \gamma X$ |
|------|----|---|----------------|---------------------------------|

<sup>1</sup> Assuming maximal destructive interference between  $\psi(3770)$  and continuum sources.

NODE=M053R13  
NODE=M053R13

NODE=M053R13;LINKAGE=PE

 $\Gamma(\gamma\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{105}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|    |    |  |                |                                 |
|----|----|--|----------------|---------------------------------|
| <2 | 90 |  | PEDLAR 09 CLE3 | $\psi(2S) \rightarrow \gamma X$ |
|----|----|--|----------------|---------------------------------|

NODE=M053R12  
NODE=M053R12

$\psi(3770)$  REFERENCES

NODE=M053

|               |      |                         |                                  |                    |             |
|---------------|------|-------------------------|----------------------------------|--------------------|-------------|
| AAIJ          | 19M  | JHEP 1907 035           | R. Aaij <i>et al.</i>            | (LHCb Collab.)     | REFID=59697 |
| AAIJ          | 17AD | PL B769 305             | R. Aaij <i>et al.</i>            | (LHCb Collab.)     | REFID=57896 |
| SHAMOV        | 17   | PL B769 187             | A.G. Shamov, K.Yu. Todyshev      |                    | REFID=57900 |
| ABLIKIM       | 16B  | PL B753 103             | M. Ablikim <i>et al.</i>         | (BESIII Collab.)   | REFID=57126 |
| ABLIKIM       | 15J  | PR D91 092009           | M. Ablikim <i>et al.</i>         | (BESIII Collab.)   | REFID=56775 |
| DRUZHININ     | 15   | PR D92 054024           | V.P. Druzhinin                   | (NOVO)             | REFID=56962 |
| ABLIKIM       | 14H  | PR D89 112005           | M. Ablikim <i>et al.</i>         | (BESIII Collab.)   | REFID=55899 |
| ABLIKIM       | 14L  | PL B735 101             | M. Ablikim <i>et al.</i>         | (BESIII Collab.)   | REFID=55903 |
| ABLIKIM       | 14O  | PR D90 032007           | M. Ablikim <i>et al.</i>         | (BESIII Collab.)   | REFID=55906 |
| BONVICINI     | 14   | PR D89 072002           | G. Bonvicini <i>et al.</i>       | (CLEO Collab.)     | REFID=55798 |
| ABLIKIM       | 13Q  | PR D87 112011           | Ablikim M. <i>et al.</i>         | (BESIII Collab.)   | REFID=55393 |
| ANASHIN       | 12A  | PL B711 292             | V.V. Anashin <i>et al.</i>       | (KEDR Collab.)     | REFID=54055 |
| ABLIKIM       | 10D  | EPJ C66 11              | M. Ablikim <i>et al.</i>         | (BES II Collab.)   | REFID=53350 |
| BESSION       | 10   | PRL 104 159901 (errat.) | D. Besson <i>et al.</i>          | (CLEO Collab.)     | REFID=53245 |
| ABLIKIM       | 09C  | EPJ C64 243             | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=53134 |
| PEDLAR        | 09   | PR D79 111101           | T.K. Pedlar <i>et al.</i>        | (CLEO Collab.)     | REFID=52998 |
| ABLIKIM       | 08B  | PL B659 74              | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=52129 |
| ABLIKIM       | 08D  | PL B660 315             | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=52142 |
| ABLIKIM       | 08M  | PL B670 179             | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=52569 |
| ABLIKIM       | 08N  | PL B652 184             | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=52570 |
| AUBERT        | 08B  | PR D77 011102           | B. Aubert <i>et al.</i>          | (BABAR Collab.)    | REFID=52120 |
| BRODZICKA     | 08   | PRL 100 092001          | J. Brodzicka <i>et al.</i>       | (BELLE Collab.)    | REFID=52144 |
| PAKHLOVA      | 08   | PR D77 011103           | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)    | REFID=52132 |
| ABLIKIM       | 07B  | PL B650 111             | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=51704 |
| ABLIKIM       | 07E  | PL B652 238             | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=51882 |
| ABLIKIM       | 07F  | PL B656 30              | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=51940 |
| ABLIKIM       | 07I  | EPJ C52 805             | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=52045 |
| ABLIKIM       | 07K  | PR D76 122002           | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=52073 |
| AUBERT        | 07BE | PR D76 111105           | B. Aubert <i>et al.</i>          | (BABAR Collab.)    | REFID=52074 |
| DOBBS         | 07   | PR D76 112001           | S. Dobbs <i>et al.</i>           | (CLEO Collab.)     | REFID=52075 |
| ABLIKIM       | 06L  | PRL 97 121801           | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=51129 |
| ABLIKIM       | 06N  | PL B641 145             | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=51131 |
| ADAM          | 06   | PRL 96 082004           | N.E. Adam <i>et al.</i>          | (CLEO Collab.)     | REFID=50989 |
| ADAMS         | 06   | PR D73 012002           | G.S. Adams <i>et al.</i>         | (CLEO Collab.)     | REFID=50990 |
| BESSION       | 06   | PRL 96 092002           | D. Besson <i>et al.</i>          | (CLEO Collab.)     | REFID=51041 |
| Also          |      | PRL 104 159901 (errat.) | D. Besson <i>et al.</i>          | (CLEO Collab.)     | REFID=53245 |
| BRIERE        | 06   | PR D74 031106           | R.A. Briere <i>et al.</i>        | (CLEO Collab.)     | REFID=51149 |
| COAN          | 06A  | PRL 96 182002           | T.E. Coan <i>et al.</i>          | (CLEO Collab.)     | REFID=51155 |
| CRONIN-HEN... | 06   | PR D74 012005           | D. Cronin-Hennessy <i>et al.</i> | (CLEO Collab.)     | REFID=51156 |
| HUANG         | 06A  | PRL 96 032003           | G.S. Huang <i>et al.</i>         | (CLEO Collab.)     | REFID=50999 |
| BAI           | 05   | PL B605 63              | J.Z. Bai <i>et al.</i>           | (BES Collab.)      | REFID=50332 |
| HE            | 05   | PRL 95 121801           | Q. He <i>et al.</i>              | (CLEO Collab.)     | REFID=50924 |
| Also          |      | PRL 96 199903 (errat.)  | Q. He <i>et al.</i>              | (CLEO Collab.)     | REFID=51211 |
| ABLIKIM       | 04F  | PR D70 077101           | M. Ablikim <i>et al.</i>         | (BES Collab.)      | REFID=50185 |
| ATHAR         | 04   | PR D70 112002           | S.B. Athar <i>et al.</i>         | (CLEO Collab.)     | REFID=50331 |
| CHISTOV       | 04   | PRL 93 051803           | R. Chistov <i>et al.</i>         | (BELLE Collab.)    | REFID=50002 |
| PDG           | 04   | PL B592 1               | S. Eidelman <i>et al.</i>        | (PDG Collab.)      | REFID=49653 |
| BAI           | 02C  | PRL 88 101802           | J.Z. Bai <i>et al.</i>           | (BES Collab.)      | REFID=50506 |
| ADLER         | 88C  | PRL 60 89               | J. Adler <i>et al.</i>           | (Mark III Collab.) | REFID=40361 |
| SCHINDLER     | 80   | PR D21 2716             | R.H. Schindler <i>et al.</i>     | (Mark II Collab.)  | REFID=22222 |
| BACINO        | 78   | PRL 40 671              | W.J. Bacino <i>et al.</i>        | (SLAC, UCLA, UCI)  | REFID=11437 |
| RAPIDIS       | 77   | PRL 39 526              | P.A. Rapidis <i>et al.</i>       | (LGW Collab.)      | REFID=22220 |

$\psi_2(3823)$ 
 $I^G(J^{PC}) = 0^-(2^{--})$   
 $I, J, P$  need confirmation.
was  $\psi(3823)$ ,  $X(3823)$ 

Seen by BHARDWAJ 13 in  $B \rightarrow \chi_{c1} \gamma K$  and ABLIKIM 15S in  $e^+ e^- \rightarrow \pi^+ \pi^- \gamma \chi_{c1}$  decays as a narrow peak in the invariant mass distribution of the  $\chi_{c1} \gamma$  system. Properties consistent with the  $\psi_2(1^3D_2)$   $c\bar{c}$  state.

NODE=M212

NODE=M212

 $\psi_2(3823)$  MASS

NODE=M212M

| VALUE (MeV)                                    | EVTS | DOCUMENT ID | TECN | COMMENT                                                                     |
|------------------------------------------------|------|-------------|------|-----------------------------------------------------------------------------|
| <b>3823.7 <math>\pm</math> 0.5 OUR AVERAGE</b> |      |             |      | Error includes scale factor of 1.1. [3822.2 $\pm$ 1.2 MeV OUR 2020 AVERAGE] |

NODE=M212M

NEW

|                               |             |                       |          |                                                    |
|-------------------------------|-------------|-----------------------|----------|----------------------------------------------------|
| 3824.08 $\pm$ 0.53 $\pm$ 0.14 | 137         | <sup>1</sup> AAIJ     | 20S LHCb | $B^+ \rightarrow J/\psi \pi^+ \pi^- K^+$           |
| 3821.7 $\pm$ 1.3 $\pm$ 0.7    | 19 $\pm$ 5  | <sup>2</sup> ABLIKIM  | 15S BES3 | $e^+ e^- \rightarrow \pi^+ \pi^- \chi_{c1} \gamma$ |
| 3823.1 $\pm$ 1.8 $\pm$ 0.7    | 33 $\pm$ 10 | <sup>3</sup> BHARDWAJ | 13 BELL  | $B^\pm \rightarrow \chi_{c1} \gamma K^\pm$         |

<sup>1</sup> Using the measured  $m_{\psi_2(3823)} - m_{\psi(2S)} = 137.98 \pm 0.53 \pm 0.14$  MeV.

NODE=M212M;LINKAGE=C

<sup>2</sup> From a simultaneous unbinned maximum likelihood fit of  $e^+ e^- \rightarrow \pi^+ \pi^- \chi_{c1} \gamma$  data (the  $\pi^+ \pi^-$  recoil mass) taken at  $\sqrt{s}$  values of 4.23, 4.26, 4.36, 4.42, and 4.60 GeV to simulated events including both  $\psi(2S) \rightarrow \chi_{c1} \gamma$  and  $\psi_2(3823) \rightarrow \chi_{c1} \gamma$  together, with floating mass scale offset for  $\psi(2S)$ , floating  $\psi_2(3823)$  mass, and zero  $\psi_2(3823)$  width, resulting in a significance of  $5.9\sigma$  when including systematic uncertainties.

NODE=M212M;LINKAGE=B

<sup>3</sup> From a simultaneous fit to  $B^\pm \rightarrow (\chi_{c1} \gamma) K^\pm$  and  $B^0 \rightarrow (\chi_{c1} \gamma) K_S^0$  with significance  $4.0\sigma$  including systematics. Corrected for the measured  $\psi(2S)$  mass using  $B \rightarrow \psi(2S) K \rightarrow (\gamma \chi_{c1}) K$  decays.

NODE=M212M;LINKAGE=A

 $m_{\psi_2(3823)} = m_{\psi(2S)}$ NODE=M212A00  
NODE=M212A00

| VALUE (MeV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                              |     |                   |          |                                          |
|------------------------------|-----|-------------------|----------|------------------------------------------|
| 137.98 $\pm$ 0.53 $\pm$ 0.14 | 137 | <sup>1</sup> AAIJ | 20S LHCb | $B^+ \rightarrow J/\psi \pi^+ \pi^- K^+$ |
|------------------------------|-----|-------------------|----------|------------------------------------------|

<sup>1</sup> AAIJ 20S also reports  $m_{\chi_{c1}(3872)} - m_{\psi_2(3823)} = 47.50 \pm 0.53 \pm 0.13$  MeV.

NODE=M212A00;LINKAGE=A

 $\psi_2(3823)$  WIDTH

NODE=M212W

| VALUE (MeV) | CL% | DOCUMENT ID | TECN | COMMENT |
|-------------|-----|-------------|------|---------|
|-------------|-----|-------------|------|---------|

< **5.2 (CL = 90%)** [ $< 16$  MeV (CL = 90%) OUR 2020 BEST LIMIT]

NODE=M212W

< **5.2** 90 <sup>1</sup> AAIJ 20S LHCb  $B^+ \rightarrow J/\psi \pi^+ \pi^- K^+$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

<16 90 <sup>2</sup> ABLIKIM 15S BES3  $e^+ e^- \rightarrow \pi^+ \pi^- \chi_{c1} \gamma$ <24 90 <sup>3</sup> BHARDWAJ 13 BELL  $B^\pm \rightarrow \chi_{c1} \gamma K^\pm$ <sup>1</sup> AAIJ 20S also provides a limit of  $< 6.6$  MeV with 95% CL.

NODE=M212W;LINKAGE=C

<sup>2</sup> From a fit of  $e^+ e^- \rightarrow \pi^+ \pi^- \chi_{c1} \gamma$  data (the  $\pi^+ \pi^-$  recoil mass) taken at  $\sqrt{s}$  values of 4.23, 4.26, 4.36, 4.42, and 4.60 GeV to a Breit-Wigner function with the mass fixed from the likelihood fit above, Gaussian resolution smearing, and floating width.

NODE=M212W;LINKAGE=B

<sup>3</sup> From a simultaneous fit to  $B^\pm \rightarrow (\chi_{c1} \gamma) K^\pm$  and  $B^0 \rightarrow (\chi_{c1} \gamma) K_S^0$  with significance  $4.0\sigma$  including systematics.

NODE=M212W;LINKAGE=A

 $\psi_2(3823)$  DECAY MODES

NODE=M212215;NODE=M212

| Mode                                | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------|--------------------------------|
| $\Gamma_1$ $J/\psi(1S) \pi^+ \pi^-$ | seen                           |
| $\Gamma_2$ $\chi_{c1} \gamma$       | seen                           |
| $\Gamma_3$ $\chi_{c2} \gamma$       | not seen                       |

DESIG=3

DESIG=1

DESIG=2

 $\psi_2(3823)$  BRANCHING RATIOS

NODE=M212225

 $\Gamma(J/\psi(1S) \pi^+ \pi^-)/\Gamma_{\text{total}}$   $\Gamma_1/\Gamma$ 

| VALUE | EVTS         | DOCUMENT ID | TECN     | COMMENT                                  |
|-------|--------------|-------------|----------|------------------------------------------|
| seen  | 137 $\pm$ 26 | AAIJ        | 20S LHCb | $B^+ \rightarrow J/\psi \pi^+ \pi^- K^+$ |

NODE=M212R00

NODE=M212R00



| $\Gamma(\chi_{c1}\gamma)/\Gamma_{\text{total}}$                                                                                                                                                                 | $\Gamma_2/\Gamma$                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| VALUE                                                                                                                                                                                                           | DOCUMENT ID TECN COMMENT                                                            |
| seen                                                                                                                                                                                                            | 33 $\pm$ 10 <sup>1</sup> BHARDWAJ 13 BELL $B^\pm \rightarrow \chi_{c1}\gamma K^\pm$ |
| <sup>1</sup> BHARDWAJ 13 reports $B(B^\pm \rightarrow \psi_2(3823)K^\pm) \times B(\psi_2(3823) \rightarrow \gamma\chi_{c1}) = (9.7 \pm 2.8 \pm 1.1) \times 10^{-6}$ with statistical significance $3.8\sigma$ . |                                                                                     |

NODE=M212R01  
NODE=M212R01

NODE=M212R01;LINKAGE=A

| $\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$                                                                                                                                                                                                                                                                                                                                                                                                                                                  | $\Gamma_3/\Gamma$                                                            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | DOCUMENT ID TECN COMMENT                                                     |
| not seen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <sup>1</sup> ABLIKIM 15S BES3 $e^+e^- \rightarrow \pi^+\pi^-\chi_{c2}\gamma$ |
| not seen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <sup>2</sup> BHARDWAJ 13 BELL $B^\pm \rightarrow \chi_{c2}\gamma K^\pm$      |
| <sup>1</sup> From a simultaneous unbinned maximum likelihood fit of $e^+e^- \rightarrow \pi^+\pi^-\chi_{c2}\gamma$ data (the $\pi^+\pi^-$ recoil mass) taken at $\sqrt{s}$ values of 4.23, 4.26, 4.36, 4.42, and 4.60 GeV to simulated events including both $\psi(2S) \rightarrow \chi_{c2}\gamma$ and $\psi_2(3823) \rightarrow \chi_{c2}\gamma$ together, with floating mass scale offset for $\psi(2S)$ , $\psi_2(3823)$ mass floating (fixed to that above), and zero $\psi_2(3823)$ width. |                                                                              |
| <sup>2</sup> BHARDWAJ 13 reports $B(B^\pm \rightarrow \psi_2(3823)K^\pm) \times B(\psi_2(3823) \rightarrow \gamma\chi_{c2}) < 3.6 \times 10^{-6}$ at 90% CL.                                                                                                                                                                                                                                                                                                                                     |                                                                              |

NODE=M212R02  
NODE=M212R02

NODE=M212R02;LINKAGE=B

NODE=M212R02;LINKAGE=A

| $\Gamma(\chi_{c2}\gamma)/\Gamma(\chi_{c1}\gamma)$                             | $\Gamma_3/\Gamma_2$                                                             |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| VALUE                                                                         | CL% DOCUMENT ID TECN COMMENT                                                    |
| <b>&lt;0.41</b>                                                               | 90 BHARDWAJ 13 BELL $B^\pm \rightarrow \chi_{c1/c2}\gamma K^\pm$                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                                                 |
| <0.42                                                                         | 90 <sup>1</sup> ABLIKIM 15S BES3 $e^+e^- \rightarrow \pi^+\pi^-\chi_{c1}\gamma$ |

NODE=M212R03  
NODE=M212R03

NODE=M212R03;LINKAGE=A

<sup>1</sup> From a simultaneous unbinned maximum likelihood fit of  $e^+e^- \rightarrow \pi^+\pi^-\chi_{c1(2)}\gamma$  data (the  $\pi^+\pi^-$  recoil mass) taken at  $\sqrt{s}$  values of 4.23, 4.26, 4.36, 4.42, and 4.60 GeV to simulated events including both  $\psi(2S) \rightarrow \chi_{c1(2)}\gamma$  and  $\psi_2(3823) \rightarrow \chi_{c1(2)}\gamma$  together, with floating mass scale offset for  $\psi(2S)$ ,  $\psi_2(3823)$  mass floating (fixed to that above), and zero  $\psi_2(3823)$  width.

### $\psi_2(3823)$ REFERENCES

|          |     |                |                           |                  |
|----------|-----|----------------|---------------------------|------------------|
| AAIJ     | 20S | JHEP 2008 123  | R. Aaij <i>et al.</i>     | (LHCb Collab.)   |
| ABLIKIM  | 15S | PRL 115 011803 | M. Ablikim <i>et al.</i>  | (BESIII Collab.) |
| BHARDWAJ | 13  | PRL 111 032001 | V. Bhardwaj <i>et al.</i> | (BELLE Collab.)  |

NODE=M212

REFID=60526  
REFID=56784  
REFID=55412

NODE=M241

|                                                                   |                             |
|-------------------------------------------------------------------|-----------------------------|
| $\psi_3(3842)$                                                    | $I^G(J^{PC}) = 0^-(3^{--})$ |
|                                                                   | $J, P$ need confirmation.   |
| $J^P$ has not been measured, $3^-$ is the quark model prediction. |                             |

NODE=M241

### $\psi_3(3842)$ MASS

NODE=M241M

| VALUE (MeV)                                                | DOCUMENT ID TECN COMMENT                                  |
|------------------------------------------------------------|-----------------------------------------------------------|
| <b>3842.71 <math>\pm</math> 0.16 <math>\pm</math> 0.12</b> | AAIJ 19M LHCB $pp \rightarrow D\bar{D} + \text{anything}$ |

NODE=M241M

### $\psi_3(3842)$ WIDTH

NODE=M241W

| VALUE (MeV)                                             | DOCUMENT ID TECN COMMENT                                  |
|---------------------------------------------------------|-----------------------------------------------------------|
| <b>2.79 <math>\pm</math> 0.51 <math>\pm</math> 0.35</b> | AAIJ 19M LHCB $pp \rightarrow D\bar{D} + \text{anything}$ |

NODE=M241W

### $\psi_3(3842)$ DECAY MODES

NODE=M241215;NODE=M241

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $D^+D^-$       | seen                           |
| $\Gamma_2$ $D^0\bar{D}^0$ | seen                           |

DESIG=1

DESIG=2

### $\psi_3(3842)$ BRANCHING RATIOS

NODE=M241225

| $\Gamma(D^+D^-)/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$                                         |
|----------------------------------------|-----------------------------------------------------------|
| VALUE                                  | DOCUMENT ID TECN COMMENT                                  |
| seen                                   | AAIJ 19M LHCB $pp \rightarrow D\bar{D} + \text{anything}$ |

NODE=M241R01  
NODE=M241R01

| $\Gamma(D^0\bar{D}^0)/\Gamma_{\text{total}}$ |             |      |         | $\Gamma_2/\Gamma$                           |
|----------------------------------------------|-------------|------|---------|---------------------------------------------|
| VALUE                                        | DOCUMENT ID | TECN | COMMENT |                                             |
| seen                                         | AAIJ        | 19M  | LHCB    | $pp \rightarrow D\bar{D} + \text{anything}$ |

NODE=M241R02  
NODE=M241R02

$\psi_3(3842)$  REFERENCES

NODE=M241  
REFID=59697  
NODE=M237

|      |     |               |                       |                |
|------|-----|---------------|-----------------------|----------------|
| AAIJ | 19M | JHEP 1907 035 | R. Aaij <i>et al.</i> | (LHCb Collab.) |
|------|-----|---------------|-----------------------|----------------|

$\chi_{c0}(3860)$

$$I^G(J^{PC}) = 0^+(0^{++})$$

OMITTED FROM SUMMARY TABLE  
The assignment  $J^P = 0^+$  is preferred over  $2^+$  by 2.5 sigma.  
Observed by CHILIKIN 17 using full amplitude analysis of the process  
 $e^+e^- \rightarrow J/\psi D\bar{D}$ , where  $D = D^0, D^+$ .

NODE=M237

$\chi_{c0}(3860)$  MASS

NODE=M237M

| VALUE (MeV)              | DOCUMENT ID | TECN | COMMENT |                                      |
|--------------------------|-------------|------|---------|--------------------------------------|
| $3862^{+26+40}_{-32-13}$ | CHILIKIN    | 17   | BELL    | $e^+e^- \rightarrow J/\psi D\bar{D}$ |

NODE=M237M

$\chi_{c0}(3860)$  WIDTH

NODE=M237W

| VALUE (MeV)              | DOCUMENT ID | TECN | COMMENT |                                      |
|--------------------------|-------------|------|---------|--------------------------------------|
| $201^{+154+88}_{-67-82}$ | CHILIKIN    | 17   | BELL    | $e^+e^- \rightarrow J/\psi D\bar{D}$ |

NODE=M237W

$\chi_{c0}(3860)$  DECAY MODES

NODE=M237215;NODE=M237

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1 \quad D^0\bar{D}^0$ | seen                           |
| $\Gamma_2 \quad D^+D^-$       | seen                           |

DESIG=1  
DESIG=2

$\chi_{c0}(3860)$  BRANCHING RATIOS

NODE=M237220

| $\Gamma(D^0\bar{D}^0)/\Gamma_{\text{total}}$ |             |      |         | $\Gamma_1/\Gamma$                        |
|----------------------------------------------|-------------|------|---------|------------------------------------------|
| VALUE                                        | DOCUMENT ID | TECN | COMMENT |                                          |
| seen                                         | CHILIKIN    | 17   | BELL    | $e^+e^- \rightarrow J/\psi D^0\bar{D}^0$ |

NODE=M237R00  
NODE=M237R00

| $\Gamma(D^+D^-)/\Gamma_{\text{total}}$ |             |      |         | $\Gamma_2/\Gamma$                  |
|----------------------------------------|-------------|------|---------|------------------------------------|
| VALUE                                  | DOCUMENT ID | TECN | COMMENT |                                    |
| seen                                   | CHILIKIN    | 17   | BELL    | $e^+e^- \rightarrow J/\psi D^+D^-$ |

NODE=M237R01  
NODE=M237R01

$\chi_{c0}(3860)$  REFERENCES

NODE=M237  
REFID=57995

|          |    |               |                           |                     |
|----------|----|---------------|---------------------------|---------------------|
| CHILIKIN | 17 | PR D95 112003 | K. Chilikin <i>et al.</i> | (BELLE Collab.) JPC |
|----------|----|---------------|---------------------------|---------------------|

$\chi_{c1}(3872)$ 

$$J^G(J^{PC}) = 0^+(1^{++})$$

also known as  $X(3872)$ 

This state shows properties different from a conventional  $q\bar{q}$  state.  
A candidate for an exotic structure. See the review on non- $q\bar{q}$  states.

First observed by CHOI 03 in  $B \rightarrow K\pi^+\pi^- J/\psi(1S)$  decays as a narrow peak in the invariant mass distribution of the  $\pi^+\pi^- J/\psi(1S)$  final state. Isovector hypothesis excluded by AUBERT 05B and CHOI 11.

AAIJ 13Q perform a full five-dimensional amplitude analysis of the angular correlations between the decay products in  $B^+ \rightarrow \chi_{c1}(3872)K^+$  decays, where  $\chi_{c1}(3872) \rightarrow J/\psi\pi^+\pi^-$  and  $J/\psi \rightarrow \mu^+\mu^-$ , which unambiguously gives the  $J^{PC} = 1^{++}$  assignment under the assumption that the  $\pi^+\pi^-$  and  $J/\psi$  are in an  $S$ -wave. AAIJ 15AO extend this analysis with more data to limit  $D$ -wave contributions to  $< 4\%$  at 95% CL.

See the review on "Spectroscopy of Mesons Containing Two Heavy Quarks."

 **$\chi_{c1}(3872)$  MASS FROM  $J/\psi X$  MODE**

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID                | TECN      | COMMENT                                       |
|-------------------------------------------------------------------------------|-------|----------------------------|-----------|-----------------------------------------------|
| <b><math>3871.65 \pm 0.06</math> OUR AVERAGE</b>                              |       |                            |           |                                               |
| [3871.69 $\pm$ 0.17 MeV OUR 2020 AVERAGE]                                     |       |                            |           |                                               |
| 3871.64 $\pm$ 0.06 $\pm$ 0.01                                                 | 19.8k | <sup>1</sup> AAIJ          | 20S LHCb  | $B^+ \rightarrow J/\psi\pi^+\pi^-K^+$         |
| 3871.9 $\pm$ 0.7 $\pm$ 0.2                                                    | 20    | ABLIKIM                    | 14 BES3   | $e^+e^- \rightarrow J/\psi\pi^+\pi^-\gamma$   |
| 3871.95 $\pm$ 0.48 $\pm$ 0.12                                                 | 0.6k  | AAIJ                       | 12H LHCb  | $pp \rightarrow J/\psi\pi^+\pi^-X$            |
| 3871.85 $\pm$ 0.27 $\pm$ 0.19                                                 | 170   | <sup>2</sup> CHOI          | 11 BELL   | $B \rightarrow K\pi^+\pi^- J/\psi$            |
| 3873 $\pm$ 1.8 $\pm$ 1.3                                                      | 27    | <sup>3</sup> DEL-AMO-SA... | 10B BABR  | $B \rightarrow \omega J/\psi K$               |
| 3871.61 $\pm$ 0.16 $\pm$ 0.19                                                 | 6k    | <sup>3,4</sup> AALTONEN    | 09AU CDF2 | $p\bar{p} \rightarrow J/\psi\pi^+\pi^-X$      |
| 3871.4 $\pm$ 0.6 $\pm$ 0.1                                                    | 93.4  | AUBERT                     | 08Y BABR  | $B^+ \rightarrow K^+ J/\psi\pi^+\pi^-$        |
| 3868.7 $\pm$ 1.5 $\pm$ 0.4                                                    | 9.4   | AUBERT                     | 08Y BABR  | $B^0 \rightarrow K_S^0 J/\psi\pi^+\pi^-$      |
| 3871.8 $\pm$ 3.1 $\pm$ 3.0                                                    | 522   | <sup>3,5</sup> ABAZOV      | 04F D0    | $p\bar{p} \rightarrow J/\psi\pi^+\pi^-X$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                            |           |                                               |
| 3871.695 $\pm$ 0.067 $\pm$ 0.068                                              | 15.6k | <sup>6</sup> AAIJ          | 20AD LHCb | $pp \rightarrow J/\psi\pi^+\pi^-X$            |
| 3871.59 $\pm$ 0.06 $\pm$ 0.03                                                 | 4.2k  | <sup>7</sup> AAIJ          | 20S LHCb  | $B^+ \rightarrow J/\psi\pi^+\pi^-K^+$         |
| 3873.3 $\pm$ 1.1 $\pm$ 1.0                                                    | 45    | <sup>8</sup> ABLIKIM       | 19V BES   | $e^+e^- \rightarrow \gamma\omega J/\psi$      |
| 3860.0 $\pm$ 10.4                                                             | 13.6  | <sup>3,9</sup> AGHASYAN    | 18A COMP  | $\gamma^* N \rightarrow X\pi^\pm N'$          |
| 3868.6 $\pm$ 1.2 $\pm$ 0.2                                                    | 8     | <sup>10</sup> AUBERT       | 06 BABR   | $B^0 \rightarrow K_S^0 J/\psi\pi^+\pi^-$      |
| 3871.3 $\pm$ 0.6 $\pm$ 0.1                                                    | 61    | <sup>10</sup> AUBERT       | 06 BABR   | $B^- \rightarrow K^- J/\psi\pi^+\pi^-$        |
| 3873.4 $\pm$ 1.4                                                              | 25    | <sup>11</sup> AUBERT       | 05R BABR  | $B^+ \rightarrow K^+ J/\psi\pi^+\pi^-$        |
| 3871.3 $\pm$ 0.7 $\pm$ 0.4                                                    | 730   | <sup>3,12</sup> ACOSTA     | 04 CDF2   | $p\bar{p} \rightarrow J/\psi\pi^+\pi^-X$      |
| 3872.0 $\pm$ 0.6 $\pm$ 0.5                                                    | 36    | <sup>13</sup> CHOI         | 03 BELL   | $B \rightarrow K\pi^+\pi^- J/\psi$            |
| 3836 $\pm$ 13                                                                 | 58    | <sup>3,14</sup> ANTONIAZZI | 94 E705   | $300\pi^\pm Li \rightarrow J/\psi\pi^+\pi^-X$ |

<sup>1</sup> Calculated from  $m_{\chi_{c1}(3872)} - m_{\psi(2S)} = 185.54 \pm 0.06$  MeV obtained by combining the data with  $\chi_{c1}(3872)$  produced in  $B^+$  decays from AAIJ 20S and inclusive  $b$ -hadron decays from AAIJ 20AD and using  $m_{\psi(2S)} = 3686.097$  MeV. Breit-Wigner parametrization.

<sup>2</sup> The mass difference for the  $\chi_{c1}(3872)$  produced in  $B^+$  and  $B^0$  decays is  $(-0.71 \pm 0.96 \pm 0.19)$  MeV.

<sup>3</sup> Width consistent with detector resolution.

<sup>4</sup> A possible equal mixture of two states with a mass difference greater than 3.6 MeV/ $c^2$  is excluded at 95% CL.

<sup>5</sup> Calculated from the corresponding  $m_{\chi_{c1}(3872)} - m_{J/\psi}$  using  $m_{J/\psi} = 3096.916$  MeV.

NODE=M176

NODE=M176

NODE=M176M

NODE=M176M  
NEW

OCCUR=2

OCCUR=2

OCCUR=2

NODE=M176M;LINKAGE=F

NODE=M176M;LINKAGE=CO

NODE=M176M;LINKAGE=AC

NODE=M176M;LINKAGE=AA

NODE=M176M;LINKAGE=AB

- <sup>6</sup> Using  $\chi_{c1}(3872)$  produced in inclusive  $b$ -hadron decays and  $m_{\psi(2S)} = 3686.097 \pm 0.010$  MeV. Breit-Wigner parametrization. Superseded by the combined value in AAIJ 20S.
- <sup>7</sup> Using Breit-Wigner parametrization. Superseded by the combined value in AAIJ 20S.
- <sup>8</sup> Fit with fixed width and including two resonances,  $X(3915)$  and  $X(3960)$ .
- <sup>9</sup> Could be a different state.
- <sup>10</sup> Calculated from the corresponding  $m_{\chi_{c1}(3872)} - m_{\psi(2S)}$  using  $m_{\psi(2S)} = 3686.093$  MeV. Superseded by AUBERT 08Y.
- <sup>11</sup> Calculated from the corresponding  $m_{\chi_{c1}(3872)} - m_{\psi(2S)}$  using  $m_{\psi(2S)} = 3685.96$  MeV. Superseded by AUBERT 06.
- <sup>12</sup> Superseded by AALTONEN 09AU.
- <sup>13</sup> Superseded by CHOI 11.
- <sup>14</sup> A lower mass value can be due to an incorrect momentum scale for soft pions.

### $\chi_{c1}(3872)$ MASS FROM $\bar{D}^{*0} D^0$ MODE

| VALUE (MeV)                                                                                                                                                                                                                                                                                                                                                                                                      | EVTS       | DOCUMENT ID            | TECN     | COMMENT                               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------|----------|---------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                    |            |                        |          |                                       |
| $3872.9^{+0.6+0.4}_{-0.4-0.5}$                                                                                                                                                                                                                                                                                                                                                                                   | 50         | <sup>1,2</sup> AUSHEV  | 10 BELL  | $B \rightarrow \bar{D}^{*0} D^0 K$    |
| $3875.1^{+0.7}_{-0.5} \pm 0.5$                                                                                                                                                                                                                                                                                                                                                                                   | $33 \pm 6$ | <sup>2</sup> AUBERT    | 08B BABR | $B \rightarrow \bar{D}^{*0} D^0 K$    |
| $3875.2 \pm 0.7^{+0.9}_{-1.8}$                                                                                                                                                                                                                                                                                                                                                                                   | $24 \pm 6$ | <sup>2,3</sup> GOKHROO | 06 BELL  | $B \rightarrow D^0 \bar{D}^0 \pi^0 K$ |
| <sup>1</sup> Calculated from the measured $m_{\chi_{c1}(3872)} - m_{D^{*0}} - m_{\bar{D}^0} = 1.1^{+0.6+0.1}_{-0.4-0.3}$ MeV.<br><sup>2</sup> Experiments report $D^{*0} \bar{D}^0$ invariant mass above $D^{*0} \bar{D}^0$ threshold because $D^{*0}$ decay products are kinematically constrained to the $D^{*0}$ mass, even though the $D^{*0}$ may decay off-shell.<br><sup>3</sup> Superseded by AUSHEV 10. |            |                        |          |                                       |

### $m_{\chi_{c1}(3872)} - m_{J/\psi}$

| VALUE (MeV)                               | EVTS | DOCUMENT ID | TECN   | COMMENT                                     |
|-------------------------------------------|------|-------------|--------|---------------------------------------------|
| <b><math>774.9 \pm 3.1 \pm 3.0</math></b> | 522  | ABAZOV      | 04F D0 | $p\bar{p} \rightarrow J/\psi \pi^+ \pi^- X$ |

### $m_{\chi_{c1}(3872)} - m_{\psi(2S)}$

| VALUE (MeV)                                                                                                                                                                                                                                                                                                                                                                                    | EVTS  | DOCUMENT ID         | TECN      | COMMENT                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------|-----------|------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                  |       |                     |           |                                          |
| $185.598 \pm 0.067 \pm 0.068$                                                                                                                                                                                                                                                                                                                                                                  | 15.6k | <sup>1</sup> AAIJ   | 20AD LHCb | $pp \rightarrow J/\psi \pi^+ \pi^- X$    |
| $185.54 \pm 0.06$                                                                                                                                                                                                                                                                                                                                                                              | 19.8k | <sup>2</sup> AAIJ   | 20S LHCb  | $pp \rightarrow J/\psi \pi^+ \pi^- X$    |
| $187.4 \pm 1.4$                                                                                                                                                                                                                                                                                                                                                                                | 25    | <sup>3</sup> AUBERT | 05R BABR  | $B^+ \rightarrow K^+ J/\psi \pi^+ \pi^-$ |
| <sup>1</sup> Using $\chi_{c1}(3872)$ produced in inclusive $b$ -hadron decays. Breit-Wigner parametrization. Superseded by the combined value in AAIJ 20S.<br><sup>2</sup> Combining $m_{\chi_{c1}(3872)} - m_{\psi(2S)} = 185.49 \pm 0.06 \pm 0.03$ MeV from AAIJ 20S and the measured mass difference from AAIJ 20AD. Breit-Wigner parametrization.<br><sup>3</sup> Superseded by AUBERT 06. |       |                     |           |                                          |

### $\chi_{c1}(3872)$ WIDTH

| VALUE (MeV)                                                                   | CL% EVTS                                                                        | DOCUMENT ID       | TECN      | COMMENT                                         |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------------------|-----------|-------------------------------------------------|
| <b><math>1.19 \pm 0.21</math> OUR AVERAGE</b>                                 | Error includes scale factor of 1.1. $[3.0^{+2.1}_{-1.7}]$ MeV OUR 2009 AVERAGE] |                   |           |                                                 |
| $1.39 \pm 0.24 \pm 0.10$                                                      | 15.6k                                                                           | <sup>1</sup> AAIJ | 20AD LHCb | $pp \rightarrow J/\psi \pi^+ \pi^- X$           |
| $0.96^{+0.19}_{-0.18} \pm 0.21$                                               | 4.2k                                                                            | <sup>2</sup> AAIJ | 20S LHCb  | $B^+ \rightarrow J/\psi \pi^+ \pi^- K^+$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                                                                                 |                   |           |                                                 |
| <2.4                                                                          | 90                                                                              | ABLIKIM           | 14 BES3   | $e^+ e^- \rightarrow J/\psi \pi^+ \pi^- \gamma$ |
| <1.2                                                                          | 90                                                                              | CHOI              | 11 BELL   | $B \rightarrow K \pi^+ \pi^- J/\psi$            |
| <3.3                                                                          | 90                                                                              | AUBERT            | 08Y BABR  | $B^+ \rightarrow K^+ J/\psi \pi^+ \pi^-$        |
| <4.1                                                                          | 90 69                                                                           | AUBERT            | 06 BABR   | $B \rightarrow K \pi^+ \pi^- J/\psi$            |
| <2.3                                                                          | 90 36                                                                           | <sup>3</sup> CHOI | 03 BELL   | $B \rightarrow K \pi^+ \pi^- J/\psi$            |

- <sup>1</sup> Using  $\chi_{c1}(3872)$  produced in inclusive  $b$ -hadron decays. Breit-Wigner parametrization.
- <sup>2</sup> Using Breit-Wigner parametrization. Partially overlapping dataset with that of AAIJ 20AD.
- <sup>3</sup> Superseded by CHOI 11.

NODE=M176M;LINKAGE=D

NODE=M176M;LINKAGE=E  
 NODE=M176M;LINKAGE=B  
 NODE=M176M;LINKAGE=A  
 NODE=M176M;LINKAGE=AE

NODE=M176M;LINKAGE=AU

NODE=M176M;LINKAGE=AT  
 NODE=M176M;LINKAGE=CH  
 NODE=M176M;LINKAGE=AN

NODE=M176MD0

NODE=M176MD0

NODE=M176MD0;LINKAGE=AS  
 NODE=M176MD0;LINKAGE=AU

NODE=M176MD0;LINKAGE=GO

NODE=M176DM

NODE=M176DM

NODE=M176DM2

NODE=M176DM2

NODE=M176DM2;LINKAGE=A

NODE=M176DM2;LINKAGE=E

NODE=M176DM2;LINKAGE=AU

NODE=M176W

NODE=M176W

NEW

OCCUR=3

OCCUR=2

NODE=M176W;LINKAGE=E

NODE=M176W;LINKAGE=F

NODE=M176W;LINKAGE=CH

**$\chi_{c1}(3872)$  WIDTH FROM  $\bar{D}^{*0} D^0$  MODE**

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                             |            |                     |     |      |                                    |
|-----------------------------|------------|---------------------|-----|------|------------------------------------|
| $3.9^{+2.8+0.2}_{-1.4-1.1}$ | 50         | <sup>1</sup> AUSHEV | 10  | BELL | $B \rightarrow \bar{D}^{*0} D^0 K$ |
| $3.0^{+1.9}_{-1.4} \pm 0.9$ | $33 \pm 6$ | AUBERT              | 08B | BABR | $B \rightarrow \bar{D}^{*0} D^0 K$ |

<sup>1</sup>With a measured value of  $B(B \rightarrow \chi_{c1}(3872) K) \times B(\chi_{c1}(3872) \rightarrow D^{*0} \bar{D}^0) = (0.80 \pm 0.20 \pm 0.10) \times 10^{-4}$ , assumed to be equal for both charged and neutral modes.

NODE=M176WD0  
NODE=M176WD0

NODE=M176WD0;LINKAGE=AU

 **$\chi_{c1}(3872)$  DECAY MODES**

NODE=M176215;NODE=M176

| Mode                                      | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|-------------------------------------------|--------------------------------|------------------|
| $\Gamma_1$ $e^+ e^-$                      | $< 3.2 \times 10^{-6}$         | 90%              |
| $\Gamma_2$ $\pi^+ \pi^- J/\psi(1S)$       | $(3.4 \pm 0.7) \%$             |                  |
| $\Gamma_3$ $\pi^+ \pi^- \pi^0 J/\psi(1S)$ | not seen                       |                  |
| $\Gamma_4$ $\omega \eta_c(1S)$            | $< 30 \%$                      | 90%              |
| $\Gamma_5$ $\omega J/\psi(1S)$            | $(3.9 \pm 1.6) \%$             |                  |
| $\Gamma_6$ $\phi \phi$                    | not seen                       |                  |
| $\Gamma_7$ $D^0 \bar{D}^0 \pi^0$          | $(44^{+16}_{-18}) \%$          |                  |
| $\Gamma_8$ $\bar{D}^{*0} D^0$             | $(33 \pm 8) \%$                |                  |
| $\Gamma_9$ $\gamma \gamma$                | $< 10 \%$                      | 90%              |
| $\Gamma_{10}$ $D^0 \bar{D}^0$             | $< 26 \%$                      | 90%              |
| $\Gamma_{11}$ $D^+ D^-$                   | $< 17 \%$                      | 90%              |
| $\Gamma_{12}$ $\pi^0 \chi_{c2}$           | $< 4 \%$                       | 90%              |
| $\Gamma_{13}$ $\pi^0 \chi_{c1}$           | $(3.0^{+1.3}_{-1.1}) \%$       |                  |
| $\Gamma_{14}$ $\pi^0 \chi_{c0}$           | $< 70 \%$                      | 90%              |
| $\Gamma_{15}$ $\pi^+ \pi^- \eta_c(1S)$    | $< 13 \%$                      | 90%              |
| $\Gamma_{16}$ $\pi^+ \pi^- \chi_{c1}$     | $< 6 \times 10^{-3}$           | 90%              |
| $\Gamma_{17}$ $p \bar{p}$                 | $< 2.2 \times 10^{-5}$         | 95%              |

DESIG=1

DESIG=2

DESIG=25

DESIG=24

DESIG=13

DESIG=26

DESIG=8

DESIG=12

DESIG=5

DESIG=6

DESIG=7

DESIG=20

DESIG=18

DESIG=19

DESIG=14

DESIG=17

DESIG=16

**Radiative decays**

|                                      |                                |     |
|--------------------------------------|--------------------------------|-----|
| $\Gamma_{18}$ $\gamma D^+ D^-$       | $< 3.4 \%$                     | 90% |
| $\Gamma_{19}$ $\gamma \bar{D}^0 D^0$ | $< 5 \%$                       | 90% |
| $\Gamma_{20}$ $\gamma J/\psi$        | $(7.7 \pm 2.5) \times 10^{-3}$ |     |
| $\Gamma_{21}$ $\gamma \chi_{c1}$     | $< 8 \times 10^{-3}$           | 90% |
| $\Gamma_{22}$ $\gamma \chi_{c2}$     | $< 2.9 \%$                     | 90% |
| $\Gamma_{23}$ $\gamma \psi(2S)$      | $(4.1 \pm 1.4) \%$             |     |

NODE=M176;CLUMP=B

DESIG=21

DESIG=23

DESIG=9

DESIG=3

DESIG=15

DESIG=11

**C-violating decays**

|                             |            |     |
|-----------------------------|------------|-----|
| $\Gamma_{24}$ $\eta J/\psi$ | $< 1.6 \%$ | 90% |
|-----------------------------|------------|-----|

NODE=M176;CLUMP=A

DESIG=4

 **$\chi_{c1}(3872)$  PARTIAL WIDTHS**

NODE=M176220

 **$\Gamma(e^+ e^-)$**  **$\Gamma_1$** 

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |    |                      |     |      |                                                          |
|---------|----|----------------------|-----|------|----------------------------------------------------------|
| $< 4.3$ | 90 | <sup>1</sup> ABLIKIM | 15v | BES3 | $4.0\text{--}4.4 e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$ |
| $< 280$ | 90 | <sup>2</sup> YUAN    | 04  | RVUE | $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$                 |

<sup>1</sup>ABLIKIM 15v reports this limit from the measurement of  $\Gamma(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) \times \Gamma(\chi_{c1}(3872) \rightarrow e^+ e^-) / \Gamma < 0.13$  eV using  $\Gamma(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) / \Gamma = 3\%$ .

<sup>2</sup>Using BAI 98E data on  $e^+ e^- \rightarrow \pi^+ \pi^- \ell^+ \ell^-$ . Assuming that  $\Gamma(\pi^+ \pi^- J/\psi)$  of  $\chi_{c1}(3872)$  is the same as that of  $\psi(2S)$  (85.4 keV).

NODE=M176W1  
NODE=M176W1

NODE=M176W1;LINKAGE=B

NODE=M176W1;LINKAGE=A

$\chi_{c1}(3872) \Gamma(i) \Gamma(e^+ e^-) / \Gamma(\text{total})$ 

NODE=M176230

$$\Gamma(\pi^+ \pi^- J/\psi(1S)) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}} \quad \Gamma_2 \Gamma_1 / \Gamma$$

NODE=M176G1  
NODE=M176G1

| VALUE (eV)                                                                    | CL% | DOCUMENT ID           | TECN     | COMMENT                                               |
|-------------------------------------------------------------------------------|-----|-----------------------|----------|-------------------------------------------------------|
| < 0.13                                                                        | 90  | ABLIKIM               | 15V BES3 | 4.0–4.4 $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                       |          |                                                       |
| < 6.2                                                                         | 90  | <sup>1,2</sup> AUBERT | 05D BABR | 10.6 $e^+ e^- \rightarrow K^+ K^- \pi^+ \pi^- \gamma$ |
| < 8.3                                                                         | 90  | <sup>2</sup> DOBBS    | 05 CLE3  | $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$              |
| < 10                                                                          | 90  | <sup>3</sup> YUAN     | 04 RVUE  | $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$              |

<sup>1</sup> Using  $B(\chi_{c1}(3872) \rightarrow J/\psi \pi^+ \pi^-) \cdot B(J/\psi \rightarrow \mu^+ \mu^-) \cdot \Gamma(\chi_{c1}(3872) \rightarrow e^+ e^-) < 0.37$  eV from AUBERT 05D and  $B(J/\psi \rightarrow \mu^+ \mu^-) = 0.0588 \pm 0.0010$  from the PDG 04.

NODE=M176G1;LINKAGE=AU

<sup>2</sup> Assuming  $\chi_{c1}(3872)$  has  $J^{PC} = 1^{--}$ .

NODE=M176G1;LINKAGE=DO

<sup>3</sup> Using BAI 98E data on  $e^+ e^- \rightarrow \pi^+ \pi^- \ell^+ \ell^-$ . From theoretical calculation of the production cross section and using  $B(J/\psi \rightarrow \mu^+ \mu^-) = (5.88 \pm 0.10)\%$ .

NODE=M176G1;LINKAGE=A

 $\chi_{c1}(3872) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$ 

NODE=M176232

$$\Gamma(\pi^+ \pi^- J/\psi(1S)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_2 \Gamma_9 / \Gamma$$

NODE=M176H1  
NODE=M176H1

| VALUE (eV) | CL% | DOCUMENT ID        | TECN    | COMMENT                                         |
|------------|-----|--------------------|---------|-------------------------------------------------|
| < 12.9     | 90  | <sup>1</sup> DOBBS | 05 CLE3 | $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi \gamma$ |

<sup>1</sup> Assuming  $\chi_{c1}(3872)$  has positive C parity and spin 0.

NODE=M176H1;LINKAGE=DO

$$\Gamma(\omega J/\psi(1S)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_5 \Gamma_9 / \Gamma$$

NODE=M176G01  
NODE=M176G01

| VALUE (eV) | CL% | DOCUMENT ID       | TECN      | COMMENT                                     |
|------------|-----|-------------------|-----------|---------------------------------------------|
| < 1.7      | 90  | <sup>1</sup> LEES | 12AD BABR | $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$ |

<sup>1</sup> Assuming  $\chi_{c1}(3872)$  has spin 2.

NODE=M176G01;LINKAGE=LE

$$\Gamma(\pi^+ \pi^- \eta_c(1S)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}} \quad \Gamma_{15} \Gamma_9 / \Gamma$$

NODE=M176G02  
NODE=M176G02

| VALUE (eV) | CL% | DOCUMENT ID | TECN      | COMMENT                                          |
|------------|-----|-------------|-----------|--------------------------------------------------|
| < 11.1     | 90  | LEES        | 12AE BABR | $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \eta_c$ |

 $\chi_{c1}(3872)$  BRANCHING RATIOS

NODE=M176235

$$\Gamma(\pi^+ \pi^- J/\psi(1S)) / \Gamma_{\text{total}} \quad \Gamma_2 / \Gamma$$

NODE=M176R6  
NODE=M176R6

| VALUE                                                                         | EVS | DOCUMENT ID           | TECN     | COMMENT                                  |
|-------------------------------------------------------------------------------|-----|-----------------------|----------|------------------------------------------|
| <b>0.034 ± 0.007 OUR AVERAGE</b>                                              |     |                       |          |                                          |
| 0.034 ± 0.002 ± 0.006                                                         |     | <sup>1</sup> AAIJ     | 20S LHCb | $B^+ \rightarrow J/\psi \pi^+ \pi^- K^+$ |
| 0.036 ± 0.007 ± 0.007                                                         | 93  | <sup>2,3</sup> AUBERT | 08Y BABR | $B \rightarrow \chi_{c1}(3872) K$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                       |          |                                          |
| seen                                                                          | 151 | <sup>4</sup> BALA     | 15 BELL  | $B \rightarrow \chi_{c1}(3872) K \pi$    |
| 0.055 ± 0.017 ± 0.010                                                         | 30  | <sup>5</sup> AUBERT   | 05R BABR | $B^+ \rightarrow K^+ \pi^+ \pi^- J/\psi$ |
| 0.058 ± 0.013 ± 0.011                                                         | 36  | <sup>6</sup> CHOI     | 03 BELL  | $B^+ \rightarrow K^+ \pi^+ \pi^- J/\psi$ |

SYCLP=A

SYCLP=A

SYCLP=A

<sup>1</sup> AAIJ 20S reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] = (7.95 \pm 0.15 \pm 0.33) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M176R6;LINKAGE=E

<sup>2</sup> AUBERT 08Y reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] = (8.4 \pm 1.5 \pm 0.7) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M176R6;LINKAGE=AB

<sup>3</sup> superseded by LEES 20C

<sup>4</sup> BALA 15 reports  $B(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi) \times B(B^0 \rightarrow \chi_{c1}(3872) K^+ \pi^-) = (7.9 \pm 1.3 \pm 0.4) \times 10^{-6}$  and  $B(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi) \times B(B^+ \rightarrow \chi_{c1}(3872) K^0 \pi^+) = (10.6 \pm 3.0 \pm 0.9) \times 10^{-6}$ .

NODE=M176R6;LINKAGE=C

NODE=M176R6;LINKAGE=A

<sup>5</sup> Superseded by AUBERT 08Y. AUBERT 05R reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] = (1.28 \pm 0.41) \times 10^{-5}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M176R6;LINKAGE=AE

<sup>6</sup> CHOI 03 reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] / [B(B^+ \rightarrow \psi(2S) K^+)] / [B(\psi(2S) \rightarrow J/\psi(1S) \pi^+ \pi^-)] =$

NODE=M176R6;LINKAGE=CH

$0.063 \pm 0.012 \pm 0.007$  which we multiply or divide by our best values  $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = (2.3 \pm 0.4) \times 10^{-4}$ ,  $B(B^+ \rightarrow \psi(2S)K^+) = (6.24 \pm 0.20) \times 10^{-4}$ ,  $B(\psi(2S) \rightarrow J/\psi(1S)\pi^+\pi^-) = (34.68 \pm 0.30) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best values.

### $\Gamma(\pi^+\pi^-\pi^0 J/\psi(1S))/\Gamma_{\text{total}}$

$\Gamma_3/\Gamma$

| VALUE                                                                                                                                                                     | DOCUMENT ID           | TECN | COMMENT                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|-------------------------------------|
| not seen                                                                                                                                                                  | <sup>1</sup> WANG 11B | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |
| <b>not seen</b>                                                                                                                                                           | <sup>2</sup> SHEN 10A | BELL | $\Upsilon(1S) \rightarrow \gamma X$ |
| <sup>1</sup> WANG 11B reports $B(\Upsilon(2S) \rightarrow \gamma \chi_{c1}(3872)) \times B(\chi_{c1} \rightarrow \pi^+\pi^-\pi^0 J/\psi) < 2.4 \times 10^{-6}$ at 95% CL. |                       |      |                                     |
| <sup>2</sup> SHEN 10A reports $B(\Upsilon(1S) \rightarrow \gamma \chi_{c1}(3872)) \times B(\chi_{c1} \rightarrow \pi^+\pi^-\pi^0 J/\psi) < 2.8 \times 10^{-6}$ at 95% CL. |                       |      |                                     |

NODE=M176R25  
NODE=M176R25

NODE=M176R25;LINKAGE=B

NODE=M176R25;LINKAGE=A

### $\Gamma(\omega\eta_c(1S))/\Gamma_{\text{total}}$

$\Gamma_4/\Gamma$

| VALUE                                                                                                                                                                                                                                                                                  | CL% | DOCUMENT ID                | TECN | COMMENT                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------------|------|------------------------------------|
| <b>&lt;0.29</b>                                                                                                                                                                                                                                                                        | 90  | <sup>1</sup> VINOKUROVA 15 | BELL | $B^+ \rightarrow \omega\eta_c K^+$ |
| <sup>1</sup> VINOKUROVA 15 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \omega\eta_c(1S))/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] < 6.9 \times 10^{-5}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = 2.3 \times 10^{-4}$ . |     |                            |      |                                    |

NODE=M176R24  
NODE=M176R24

NODE=M176R24;LINKAGE=A

### $\Gamma(\omega J/\psi(1S))/\Gamma_{\text{total}}$

$\Gamma_5/\Gamma$

| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | EVTS       | DOCUMENT ID                  | TECN | COMMENT                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------------|------|-------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                              |      |                                     |
| $0.026 \pm 0.010 \pm 0.005$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | $21 \pm 7$ | <sup>1</sup> DEL-AMO-SA..10B | BABR | $B^+ \rightarrow \omega J/\psi K^+$ |
| <sup>1</sup> DEL-AMO-SANCHEZ 10B reports $[\Gamma(\chi_{c1}(3872) \rightarrow \omega J/\psi(1S))/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] = (6 \pm 2 \pm 1) \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. DEL-AMO-SANCHEZ 10B also reports $B(B^0 \rightarrow \chi_{c1}(3872)K^0) \times B(\chi_{c1}(3872) \rightarrow J/\psi\omega) = (6 \pm 3 \pm 1) \times 10^{-6}$ . |            |                              |      |                                     |

NODE=M176R14  
NODE=M176R14

NODE=M176R14;LINKAGE=DE

### $\Gamma(\omega J/\psi(1S))/\Gamma(\pi^+\pi^- J/\psi(1S))$

$\Gamma_5/\Gamma_2$

| VALUE                                                                                                                                                                                                                                                 | DOCUMENT ID                         | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------|------------------------------------------|
| <b><math>1.1 \pm 0.4</math> OUR AVERAGE</b>                                                                                                                                                                                                           | Error includes scale factor of 1.7. |      |                                          |
| $1.6^{+0.4}_{-0.3} \pm 0.2$                                                                                                                                                                                                                           | <sup>1</sup> ABLIKIM 19V            | BES  | $e^+e^- \rightarrow \gamma\omega J/\psi$ |
| $0.8 \pm 0.3$                                                                                                                                                                                                                                         | <sup>2</sup> DEL-AMO-SA..10B        | BABR | $B \rightarrow \omega J/\psi K$          |
| <sup>1</sup> Fit with fixed width and including two resonances, X(3915) and X(3960).                                                                                                                                                                  |                                     |      |                                          |
| <sup>2</sup> Statistical and systematic errors added in quadrature. Uses the values of $B(B \rightarrow \chi_{c1}(3872)K) \times B(\chi_{c1}(3872) \rightarrow J/\psi\pi^+\pi^-)$ reported in AUBERT 08Y, taking into account the common systematics. |                                     |      |                                          |

NODE=M176R15  
NODE=M176R15

NODE=M176R15;LINKAGE=A  
NODE=M176R15;LINKAGE=DE

### $\Gamma(\phi\phi)/\Gamma_{\text{total}}$

$\Gamma_6/\Gamma$

| VALUE                                                                                                                                                           | DOCUMENT ID            | TECN | COMMENT          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------|------------------|
| <b>not seen</b>                                                                                                                                                 | <sup>1</sup> AAIJ 17BB | LHCB | $pp$ at 7, 8 TeV |
| <sup>1</sup> AAIJ 17BB reports $B(b \rightarrow \chi_{c1}(3872)\text{anything}) \times B(\chi_{c1}(3872) \rightarrow \phi\phi) < 4.5 \times 10^{-7}$ at 95% CL. |                        |      |                  |

NODE=M176R26  
NODE=M176R26

NODE=M176R26;LINKAGE=A

### $\Gamma(D^0\bar{D}^0\pi^0)/\Gamma_{\text{total}}$

$\Gamma_7/\Gamma$

| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                                          | CL%                        | EVTS                    | DOCUMENT ID | TECN                                    | COMMENT |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------|-------------|-----------------------------------------|---------|
| <b><math>0.44^{+0.16}_{-0.18} \pm 0.08</math></b>                                                                                                                                                                                                                                                                                                                                                                                              | [>0.4 OUR 2020 BEST LIMIT] |                         |             |                                         |         |
| <b><math>0.44^{+0.16}_{-0.18} \pm 0.08</math></b>                                                                                                                                                                                                                                                                                                                                                                                              | 17                         | <sup>1</sup> GOKHROO 06 | BELL        | $B^+ \rightarrow D^0\bar{D}^0\pi^0 K^+$ |         |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                  |                            |                         |             |                                         |         |
| <0.26                                                                                                                                                                                                                                                                                                                                                                                                                                          | 90                         | <sup>2</sup> CHISTOV 04 | BELL        | Sup. by GOKHROO 06                      |         |
| <sup>1</sup> GOKHROO 06 reports $[\Gamma(\chi_{c1}(3872) \rightarrow D^0\bar{D}^0\pi^0)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] = (1.02 \pm 0.31^{+0.21}_{-0.29}) \times 10^{-4}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |                            |                         |             |                                         |         |
| <sup>2</sup> CHISTOV 04 reports $[\Gamma(\chi_{c1}(3872) \rightarrow D^0\bar{D}^0\pi^0)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] < 0.6 \times 10^{-4}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = 2.3 \times 10^{-4}$ .                                                                                                                                                           |                            |                         |             |                                         |         |

NODE=M176R12  
NODE=M176R12

NODE=M176R12;LINKAGE=GO

NODE=M176R12;LINKAGE=A

$\Gamma(D^0 \bar{D}^0 \pi^0) / \Gamma(\pi^+ \pi^- J/\psi(1S))$  $\Gamma_7/\Gamma_2$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |         |          |                                              |
|-------|----|---------|----------|----------------------------------------------|
| <1.16 | 90 | ABLIKIM | 20W BES3 | $e^+ e^- \rightarrow \gamma \chi_{c1}(3872)$ |
|-------|----|---------|----------|----------------------------------------------|

NODE=M176R17  
NODE=M176R17

 $\Gamma(\bar{D}^{*0} D^0) / \Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.33±0.08±0.06** [ $>0.30$  OUR 2020 BEST LIMIT]

|                       |                |                     |         |                                        |
|-----------------------|----------------|---------------------|---------|----------------------------------------|
| <b>0.33±0.08±0.06</b> | $41^{+9}_{-8}$ | <sup>1</sup> AUSHEV | 10 BELL | $B^+ \rightarrow D^{*0} \bar{D}^0 K^+$ |
|-----------------------|----------------|---------------------|---------|----------------------------------------|

NODE=M176R13  
NODE=M176R13

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |            |                     |          |                                        |
|----------------|------------|---------------------|----------|----------------------------------------|
| 0.71±0.25±0.13 | $27 \pm 6$ | <sup>2</sup> AUBERT | 08B BABR | $B^+ \rightarrow \bar{D}^{*0} D^0 K^+$ |
|----------------|------------|---------------------|----------|----------------------------------------|

SYCLP=A

SYCLP=A

<sup>1</sup> AUSHEV 10 reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \bar{D}^{*0} D^0) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] = (0.77 \pm 0.16 \pm 0.10) \times 10^{-4}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M176R13;LINKAGE=AS

<sup>2</sup> AUBERT 08B reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \bar{D}^{*0} D^0) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] = (1.67 \pm 0.36 \pm 0.47) \times 10^{-4}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M176R13;LINKAGE=AU

 $\Gamma(\bar{D}^{*0} D^0) / \Gamma(\pi^+ \pi^- J/\psi(1S))$  $\Gamma_8/\Gamma_2$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

|                   |    |         |          |                                              |
|-------------------|----|---------|----------|----------------------------------------------|
| <b>11.77±3.09</b> | 50 | ABLIKIM | 20W BES3 | $e^+ e^- \rightarrow \gamma \chi_{c1}(3872)$ |
|-------------------|----|---------|----------|----------------------------------------------|

NODE=M176R16  
NODE=M176R16

 $\Gamma(\gamma\gamma) / \Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                 |    |                    |         |                                  |
|-----------------|----|--------------------|---------|----------------------------------|
| <b>&lt;0.10</b> | 90 | <sup>1</sup> WICHT | 08 BELL | $e^+ e^- \rightarrow \gamma(4S)$ |
|-----------------|----|--------------------|---------|----------------------------------|

NODE=M176R09  
NODE=M176R09

<sup>1</sup> WICHT 08 reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma\gamma) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] < 2.4 \times 10^{-5}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = 2.3 \times 10^{-4}$ .

NODE=M176R09;LINKAGE=A

 $\Gamma(D^0 \bar{D}^0) / \Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                 |    |                      |         |                                 |
|-----------------|----|----------------------|---------|---------------------------------|
| <b>&lt;0.26</b> | 90 | <sup>1</sup> CHISTOV | 04 BELL | $B \rightarrow K D^0 \bar{D}^0$ |
|-----------------|----|----------------------|---------|---------------------------------|

NODE=M176R3  
NODE=M176R3

<sup>1</sup> CHISTOV 04 reports  $[\Gamma(\chi_{c1}(3872) \rightarrow D^0 \bar{D}^0) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] < 6 \times 10^{-5}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = 2.3 \times 10^{-4}$ .

NODE=M176R3;LINKAGE=A

 $\Gamma(D^+ D^-) / \Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                 |    |                      |         |                           |
|-----------------|----|----------------------|---------|---------------------------|
| <b>&lt;0.17</b> | 90 | <sup>1</sup> CHISTOV | 04 BELL | $B \rightarrow K D^+ D^-$ |
|-----------------|----|----------------------|---------|---------------------------|

NODE=M176R4  
NODE=M176R4

<sup>1</sup> CHISTOV 04 reports  $[\Gamma(\chi_{c1}(3872) \rightarrow D^+ D^-) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] < 4 \times 10^{-5}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = 2.3 \times 10^{-4}$ .

NODE=M176R4;LINKAGE=A

 $\Gamma(\pi^0 \chi_{c2}) / \Gamma(\pi^+ \pi^- J/\psi(1S))$  $\Gamma_{12}/\Gamma_2$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                |    |         |          |                                              |
|----------------|----|---------|----------|----------------------------------------------|
| <b>&lt;1.1</b> | 90 | ABLIKIM | 19U BES3 | $e^+ e^- \rightarrow \gamma \chi_{c1}(3872)$ |
|----------------|----|---------|----------|----------------------------------------------|

NODE=M176R06  
NODE=M176R06

 $\Gamma(\pi^0 \chi_{c1}) / \Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |                       |         |                                           |
|--------|----|-----------------------|---------|-------------------------------------------|
| <0.035 | 90 | <sup>1</sup> BHARDWAJ | 19 BELL | $B^\pm \rightarrow \pi^0 \chi_{c1} K^\pm$ |
|--------|----|-----------------------|---------|-------------------------------------------|

<sup>1</sup> BHARDWAJ 19 reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \pi^0 \chi_{c1}) / \Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872) K^+)] < 8.1 \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872) K^+) = 2.3 \times 10^{-4}$ .

NODE=M176R23  
NODE=M176R23

NODE=M176R23;LINKAGE=A

 $\Gamma(\pi^0 \chi_{c1}) / \Gamma(\pi^+ \pi^- J/\psi(1S))$  $\Gamma_{13}/\Gamma_2$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

|                                           |      |         |          |                                              |
|-------------------------------------------|------|---------|----------|----------------------------------------------|
| <b><math>88^{+33}_{-27} \pm 10</math></b> | 10.8 | ABLIKIM | 19U BES3 | $e^+ e^- \rightarrow \gamma \chi_{c1}(3872)$ |
|-------------------------------------------|------|---------|----------|----------------------------------------------|

NODE=M176R05  
NODE=M176R05

 $\Gamma(\pi^0 \chi_{c0}) / \Gamma(\pi^+ \pi^- J/\psi(1S))$  $\Gamma_{14}/\Gamma_2$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|               |    |         |          |                                              |
|---------------|----|---------|----------|----------------------------------------------|
| <b>&lt;19</b> | 90 | ABLIKIM | 19U BES3 | $e^+ e^- \rightarrow \gamma \chi_{c1}(3872)$ |
|---------------|----|---------|----------|----------------------------------------------|

NODE=M176R04  
NODE=M176R04



$\Gamma(\pi^+\pi^-\eta_c(1S))/\Gamma_{\text{total}}$   $\Gamma_{15}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                      | CL% | DOCUMENT ID                | TECN | COMMENT                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----------------------------|------|----------------------------------------|
| <b>&lt;0.13</b>                                                                                                                                                                                                                                                                            | 90  | <sup>1</sup> VINOKUROVA 15 | BELL | $B^+ \rightarrow \pi^+\pi^-\eta_c K^+$ |
| <sup>1</sup> VINOKUROVA 15 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \pi^+\pi^-\eta_c(1S))/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] < 3.0 \times 10^{-5}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = 2.3 \times 10^{-4}$ . |     |                            |      |                                        |

NODE=M176R22  
NODE=M176R22

NODE=M176R22;LINKAGE=A

 $\Gamma(\pi^+\pi^-\chi_{c1})/\Gamma_{\text{total}}$   $\Gamma_{16}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                   | CL% | DOCUMENT ID                    | TECN | COMMENT                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------------|------|-------------------------------------------|
| <b>&lt;6 × 10<sup>-3</sup> (CL = 90%)</b>                                                                                                                                                                                                                                               |     | [not seen OUR 2020 BEST LIMIT] |      |                                           |
| <b>&lt;6 × 10<sup>-3</sup></b>                                                                                                                                                                                                                                                          | 90  | <sup>1</sup> BHARDWAJ 16       | BELL | $B^+ \rightarrow \pi^+\pi^-\chi_{c1} K^+$ |
| <sup>1</sup> BHARDWAJ 16 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \pi^+\pi^-\chi_{c1})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] < 1.5 \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = 2.3 \times 10^{-4}$ . |     |                                |      |                                           |

NODE=M176R00  
NODE=M176R00

NODE=M176R00;LINKAGE=A

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$   $\Gamma_{17}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                      | CL% | DOCUMENT ID                    | TECN      | COMMENT                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------------|-----------|--------------------------------|
| <b>&lt;2.2 × 10<sup>-5</sup> (CL = 95%)</b>                                                                                                                                                                                                                                |     | [not seen OUR 2020 BEST LIMIT] |           |                                |
| <b>&lt;2.1 × 10<sup>-5</sup></b>                                                                                                                                                                                                                                           | 95  | <sup>1</sup> AAIJ              | 17AD LHCb | $B^+ \rightarrow p\bar{p} K^+$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                              |     |                                |           |                                |
| <b>&lt;7 × 10<sup>-5</sup></b>                                                                                                                                                                                                                                             | 95  | <sup>2</sup> AAIJ              | 13s LHCb  | $B^+ \rightarrow p\bar{p} K^+$ |
| <sup>1</sup> AAIJ 17AD reports $[\Gamma(\chi_{c1}(3872) \rightarrow p\bar{p})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] < 0.5 \times 10^{-8}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = 2.3 \times 10^{-4}$ . |     |                                |           |                                |
| <sup>2</sup> AAIJ 13s reports $[\Gamma(\chi_{c1}(3872) \rightarrow p\bar{p})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] < 1.7 \times 10^{-8}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = 2.3 \times 10^{-4}$ .  |     |                                |           |                                |

NODE=M176R03  
NODE=M176R03

SYCLP=A

SYCLP=A

NODE=M176R03;LINKAGE=C

NODE=M176R03;LINKAGE=B

### Radiative decays

 $\Gamma(\gamma D^+ D^-)/\Gamma(\pi^+\pi^- J/\psi(1S))$   $\Gamma_{18}/\Gamma_2$ 

| VALUE           | CL% | DOCUMENT ID | TECN     | COMMENT                                    |
|-----------------|-----|-------------|----------|--------------------------------------------|
| <b>&lt;0.99</b> | 90  | ABLIKIM     | 20W BES3 | $e^+e^- \rightarrow \gamma\chi_{c1}(3872)$ |

NODE=M176410

NODE=M176R20  
NODE=M176R20

 $\Gamma(\gamma \bar{D}^0 D^0)/\Gamma(\pi^+\pi^- J/\psi(1S))$   $\Gamma_{19}/\Gamma_2$ 

| VALUE           | CL% | DOCUMENT ID | TECN     | COMMENT                                    |
|-----------------|-----|-------------|----------|--------------------------------------------|
| <b>&lt;1.58</b> | 90  | ABLIKIM     | 20W BES3 | $e^+e^- \rightarrow \gamma\chi_{c1}(3872)$ |

NODE=M176R21  
NODE=M176R21

 $\Gamma(\gamma J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{20}/\Gamma$ 

| VALUE                                                      | EVTS | DOCUMENT ID              | TECN | COMMENT                                 |
|------------------------------------------------------------|------|--------------------------|------|-----------------------------------------|
| <b>0.0076<sup>+0.0021</sup><sub>-0.0019</sub> ± 0.0014</b> |      | <sup>1</sup> BHARDWAJ 11 | BELL | $B^\pm \rightarrow \gamma J/\psi K^\pm$ |

NODE=M176R7  
NODE=M176R7  
SYCLP=A

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |    |                         |          |                                     |
|--------------------------|----|-------------------------|----------|-------------------------------------|
| 0.0119 ± 0.0034 ± 0.0022 | 20 | <sup>2</sup> AUBERT     | 09B BABR | $B^+ \rightarrow \gamma J/\psi K^+$ |
| 0.014 ± 0.004 ± 0.003    | 19 | <sup>3</sup> AUBERT, BE | 06M BABR | $B^+ \rightarrow \gamma J/\psi K^+$ |

SYCLP=A

SYCLP=A

<sup>1</sup> BHARDWAJ 11 reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma J/\psi)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] = (1.78^{+0.48}_{-0.44} \pm 0.12) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M176R7;LINKAGE=BA

<sup>2</sup> AUBERT 09B reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma J/\psi)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] = (2.8 \pm 0.8 \pm 0.1) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M176R7;LINKAGE=AB

<sup>3</sup> Superseded by AUBERT 09B. AUBERT, BE 06M reports  $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma J/\psi)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] = (3.3 \pm 1.0 \pm 0.3) \times 10^{-6}$  which we divide by our best value  $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M176R7;LINKAGE=AU

 $\Gamma(\gamma J/\psi)/\Gamma(\pi^+\pi^- J/\psi(1S))$   $\Gamma_{20}/\Gamma_2$ 

| VALUE              | DOCUMENT ID | TECN     | COMMENT                                    |
|--------------------|-------------|----------|--------------------------------------------|
| <b>0.79 ± 0.28</b> | ABLIKIM     | 20W BES3 | $e^+e^- \rightarrow \gamma\chi_{c1}(3872)$ |

NODE=M176R18  
NODE=M176R18

$\Gamma(\gamma\chi_{c1})/\Gamma_{\text{total}}$ 

| VALUE                                                                                                                                                                                                                                                                               | CL% | DOCUMENT ID              | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------------|------|------------------------------------------------|
| $<8 \times 10^{-3}$                                                                                                                                                                                                                                                                 | 90  | <sup>1</sup> BHARDWAJ 13 | BELL | $B^{\pm} \rightarrow \chi_{c1} \gamma K^{\pm}$ |
| <sup>1</sup> BHARDWAJ 13 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma\chi_{c1})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] < 1.9 \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = 2.3 \times 10^{-4}$ . |     |                          |      |                                                |

 $\Gamma_{21}/\Gamma$ NODE=M176R08  
NODE=M176R08

NODE=M176R08;LINKAGE=B

 $\Gamma(\gamma\chi_{c1})/\Gamma(\pi^+\pi^-J/\psi(1S))$ 

| VALUE   | CL% | DOCUMENT ID | TECN | COMMENT                           |
|---------|-----|-------------|------|-----------------------------------|
| $<0.89$ | 90  | CHOI 03     | BELL | $B \rightarrow K\pi^+\pi^-J/\psi$ |

 $\Gamma_{21}/\Gamma_2$ NODE=M176R1  
NODE=M176R1 $\Gamma(\gamma\chi_{c2})/\Gamma_{\text{total}}$ 

| VALUE                                                                                                                                                                                                                                                                               | CL%                            | DOCUMENT ID              | TECN | COMMENT                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|--------------------------|------|------------------------------------------------|
| $<0.029$ (CL = 90%)                                                                                                                                                                                                                                                                 | [not seen OUR 2019 BEST LIMIT] |                          |      |                                                |
| $<0.029$                                                                                                                                                                                                                                                                            | 90                             | <sup>1</sup> BHARDWAJ 13 | BELL | $B^{\pm} \rightarrow \chi_{c2} \gamma K^{\pm}$ |
| <sup>1</sup> BHARDWAJ 13 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma\chi_{c2})/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] < 6.7 \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = 2.3 \times 10^{-4}$ . |                                |                          |      |                                                |

 $\Gamma_{22}/\Gamma$ NODE=M176R01  
NODE=M176R01

NODE=M176R01;LINKAGE=B

 $\Gamma(\gamma\psi(2S))/\Gamma_{\text{total}}$ 

| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                             | EVTS       | DOCUMENT ID              | TECN      | COMMENT                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------------|-----------|-------------------------------------|
| $0.041 \pm 0.012 \pm 0.007$                                                                                                                                                                                                                                                                                                                                                                                                       | $25 \pm 7$ | <sup>1</sup> AUBERT 09B  | BABR      | $B^+ \rightarrow \gamma\psi(2S)K^+$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                     |            |                          |           |                                     |
| seen                                                                                                                                                                                                                                                                                                                                                                                                                              | $36 \pm 9$ | <sup>2</sup> AAIJ        | 14AH LHCb | $B^+ \rightarrow \gamma\psi(2S)K^+$ |
| not seen                                                                                                                                                                                                                                                                                                                                                                                                                          |            | <sup>3</sup> BHARDWAJ 11 | BELL      | $B^+ \rightarrow \gamma\psi(2S)K^+$ |
| <sup>1</sup> AUBERT 09B reports $[\Gamma(\chi_{c1}(3872) \rightarrow \gamma\psi(2S))/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] = (9.5 \pm 2.7 \pm 0.6) \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = (2.3 \pm 0.4) \times 10^{-4}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |            |                          |           |                                     |
| <sup>2</sup> From $36.4 \pm 9.0$ events of $\chi_{c1}(3872) \rightarrow J/\psi\gamma$ decays with a statistical significance of $4.4\sigma$ .                                                                                                                                                                                                                                                                                     |            |                          |           |                                     |
| <sup>3</sup> BHARDWAJ 11 reports $B(B^+ \rightarrow K^+\chi_{c1}(3872)) \times B(\chi_{c1} \rightarrow \gamma\psi(2S)) < 3.45 \times 10^{-6}$ at 90% CL.                                                                                                                                                                                                                                                                          |            |                          |           |                                     |

 $\Gamma_{23}/\Gamma$ NODE=M176R10  
NODE=M176R10

NODE=M176R10;LINKAGE=AU

NODE=M176R10;LINKAGE=A

NODE=M176R10;LINKAGE=BH

 $\Gamma(\gamma\psi(2S))/\Gamma(\pi^+\pi^-J/\psi(1S))$ 

| VALUE   | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|---------|-----|-------------|------|--------------------------------------------|
| $<0.42$ | 90  | ABLIKIM 20W | BES3 | $e^+e^- \rightarrow \gamma\chi_{c1}(3872)$ |

 $\Gamma_{23}/\Gamma_2$ NODE=M176R19  
NODE=M176R19 $\Gamma(\gamma\psi(2S))/\Gamma(\gamma J/\psi)$ 

| VALUE                                                                                                                                         | CL%         | EVTS              | DOCUMENT ID | TECN | COMMENT                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|-------------|------|-------------------------------------|
| $2.6 \pm 0.6$                                                                                                                                 | OUR AVERAGE |                   |             |      |                                     |
| $2.46 \pm 0.64 \pm 0.29$                                                                                                                      | $36 \pm 9$  | <sup>1</sup> AAIJ | 14AH LHCb   | BABR | $B^+ \rightarrow \gamma\psi(2S)K^+$ |
| $3.4 \pm 1.4$                                                                                                                                 |             | AUBERT 09B        | BABR        |      | $B^+ \rightarrow \gamma c\bar{c}K'$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                 |             |                   |             |      |                                     |
| $<2.1$                                                                                                                                        | 90          | BHARDWAJ 11       | BELL        |      | $B^+ \rightarrow \gamma\psi(2S)K^+$ |
| <sup>1</sup> From $36.4 \pm 9.0$ events of $\chi_{c1}(3872) \rightarrow J/\psi\gamma$ decays with a statistical significance of $4.4\sigma$ . |             |                   |             |      |                                     |

 $\Gamma_{23}/\Gamma_{20}$ NODE=M176R11  
NODE=M176R11

NODE=M176R11;LINKAGE=A

## C-violating decays

 $\Gamma(\eta J/\psi)/\Gamma_{\text{total}}$ 

| VALUE                                                                                                                                                                                                                                                                           | CL%                                   | DOCUMENT ID                | TECN | COMMENT                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|----------------------------|------|------------------------------|
| $<0.016$ (CL = 90%)                                                                                                                                                                                                                                                             | [<0.4 (CL = 90%) OUR 2020 BEST LIMIT] |                            |      |                              |
| $<0.016$                                                                                                                                                                                                                                                                        | 90                                    | <sup>1,2</sup> IWASHITA 14 | BELL | $B \rightarrow K\eta J/\psi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                   |                                       |                            |      |                              |
| $<0.033$                                                                                                                                                                                                                                                                        | 90                                    | <sup>3</sup> AUBERT 04Y    | BABR | $B \rightarrow K\eta J/\psi$ |
| <sup>1</sup> IWASHITA 14 reports $[\Gamma(\chi_{c1}(3872) \rightarrow \eta J/\psi)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] < 3.8 \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = 2.3 \times 10^{-4}$ . |                                       |                            |      |                              |
| <sup>2</sup> IWASHITA 14 also scans the $\eta J/\psi$ mass range 3.8–4.75 GeV and sets upper limits for $B(B^{\pm} \rightarrow \chi_{c1}(3872)K^{\pm}) \times B(\chi_{c1}(3872) \rightarrow \eta J/\psi)$ in 5 MeV intervals.                                                   |                                       |                            |      |                              |
| <sup>3</sup> AUBERT 04Y reports $[\Gamma(\chi_{c1}(3872) \rightarrow \eta J/\psi)/\Gamma_{\text{total}}] \times [B(B^+ \rightarrow \chi_{c1}(3872)K^+)] < 7.7 \times 10^{-6}$ which we divide by our best value $B(B^+ \rightarrow \chi_{c1}(3872)K^+) = 2.3 \times 10^{-4}$ .  |                                       |                            |      |                              |

 $\Gamma_{24}/\Gamma$ NODE=M176R2  
NODE=M176R2

NODE=M176R2;LINKAGE=A

NODE=M176R2;LINKAGE=C

NODE=M176R2;LINKAGE=D

$\chi_{c1}$ (3872) REFERENCES

NODE=M176

|               |      |                   |                                  |                   |             |
|---------------|------|-------------------|----------------------------------|-------------------|-------------|
| AAIJ          | 20AD | PR D102 092005    | R. Aaij <i>et al.</i>            | (LHCb Collab.)    | REFID=60673 |
| AAIJ          | 20S  | JHEP 2008 123     | R. Aaij <i>et al.</i>            | (LHCb Collab.)    | REFID=60526 |
| ABLIKIM       | 20W  | PRL 124 242001    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)  | REFID=60570 |
| LEES          | 20C  | PRL 124 152001    | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   | REFID=60554 |
| ABLIKIM       | 19U  | PRL 122 202001    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)  | REFID=59786 |
| ABLIKIM       | 19V  | PRL 122 232002    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)  | REFID=59796 |
| BHARDWAJ      | 19   | PR D99 111101     | V. Bhardwaj <i>et al.</i>        | (BELLE Collab.)   | REFID=59884 |
| AGHASYAN      | 18A  | PL B783 334       | M. Aghasyan <i>et al.</i>        | (COMPASS Collab.) | REFID=59036 |
| AAIJ          | 17AD | PL B769 305       | R. Aaij <i>et al.</i>            | (LHCb Collab.)    | REFID=57896 |
| AAIJ          | 17BB | EPJ C77 609       | R. Aaij <i>et al.</i>            | (LHCb Collab.)    | REFID=58191 |
| BHARDWAJ      | 16   | PR D93 052016     | V. Bhardwaj <i>et al.</i>        | (BELLE Collab.)   | REFID=57272 |
| AAIJ          | 15AO | PR D92 011102     | R. Aaij <i>et al.</i>            | (LHCb Collab.)    | REFID=56771 |
| ABLIKIM       | 15V  | PL B749 414       | M. Ablikim <i>et al.</i>         | (BESIII Collab.)  | REFID=56787 |
| BALA          | 15   | PR D91 051101     | A. Bala <i>et al.</i>            | (BELLE Collab.)   | REFID=56408 |
| VINOKUROVA    | 15   | JHEP 1506 132     | A. Vinokurova <i>et al.</i>      | (BELLE Collab.)   | REFID=56706 |
| Also          | JHEP | 1702 088 (errat.) | A. Vinokurava <i>et al.</i>      | (BELLE Collab.)   | REFID=57795 |
| AAIJ          | 14AH | NP B886 665       | R. Aaij <i>et al.</i>            | (LHCb Collab.)    | REFID=55897 |
| ABLIKIM       | 14   | PRL 112 092001    | M. Ablikim <i>et al.</i>         | (BESIII Collab.)  | REFID=55647 |
| IWASHITA      | 14   | PTEP 2014 043C01  | T. Iwashita <i>et al.</i>        | (BELLE Collab.)   | REFID=55925 |
| AAIJ          | 13Q  | PRL 110 222001    | R. Aaij <i>et al.</i>            | (LHCb Collab.) JP | REFID=54985 |
| AAIJ          | 13S  | EPJ C73 2462      | R. Aaij <i>et al.</i>            | (LHCb Collab.)    | REFID=55008 |
| BHARDWAJ      | 13   | PRL 111 032001    | V. Bhardwaj <i>et al.</i>        | (BELLE Collab.)   | REFID=55412 |
| AAIJ          | 12H  | EPJ C72 1972      | R. Aaij <i>et al.</i>            | (LHCb Collab.)    | REFID=54056 |
| LEES          | 12AD | PR D86 072002     | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   | REFID=54751 |
| LEES          | 12AE | PR D86 092005     | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   | REFID=54752 |
| BHARDWAJ      | 11   | PRL 107 091803    | V. Bhardwaj <i>et al.</i>        | (BELLE Collab.)   | REFID=53779 |
| CHOI          | 11   | PR D84 052004     | S.-K. Choi <i>et al.</i>         | (BELLE Collab.)   | REFID=53934 |
| WANG          | 11B  | PR D84 071107     | X.L. Wang <i>et al.</i>          | (BELLE Collab.)   | REFID=53939 |
| AUSHEV        | 10   | PR D81 031103     | T. Aushev <i>et al.</i>          | (BELLE Collab.)   | REFID=53225 |
| DEL-AMO-SA... | 10B  | PR D82 011101     | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)   | REFID=53362 |
| SHEN          | 10A  | PR D82 051504     | C.P. Shen <i>et al.</i>          | (BELLE Collab.)   | REFID=53545 |
| AALTONEN      | 09AU | PRL 103 152001    | T. Aaltonen <i>et al.</i>        | (CDF Collab.)     | REFID=53098 |
| AUBERT        | 09B  | PRL 102 132001    | B. Aubert <i>et al.</i>          | (BABAR Collab.)   | REFID=52722 |
| AUBERT        | 08B  | PR D77 011102     | B. Aubert <i>et al.</i>          | (BABAR Collab.)   | REFID=52120 |
| AUBERT        | 08Y  | PR D77 111101     | B. Aubert <i>et al.</i>          | (BABAR Collab.)   | REFID=52265 |
| WICHT         | 08   | PL B662 323       | J. Wicht <i>et al.</i>           | (BELLE Collab.)   | REFID=52204 |
| AUBERT        | 06   | PR D73 011101     | B. Aubert <i>et al.</i>          | (BABAR Collab.)   | REFID=51017 |
| AUBERT,BE     | 06M  | PR D74 071101     | B. Aubert <i>et al.</i>          | (BABAR Collab.)   | REFID=51454 |
| GOKHROO       | 06   | PRL 97 162002     | G. Gokhroo <i>et al.</i>         | (BELLE Collab.)   | REFID=51432 |
| AUBERT        | 05B  | PR D71 031501     | B. Aubert <i>et al.</i>          | (BABAR Collab.)   | REFID=50498 |
| AUBERT        | 05D  | PR D71 052001     | B. Aubert <i>et al.</i>          | (BABAR Collab.)   | REFID=50509 |
| AUBERT        | 05R  | PR D71 071103     | B. Aubert <i>et al.</i>          | (BABAR Collab.)   | REFID=50627 |
| DOBBS         | 05   | PRL 94 032004     | S. Dobbs <i>et al.</i>           | (CLEO Collab.)    | REFID=50458 |
| ABAZOV        | 04F  | PRL 93 162002     | V.M. Abazov <i>et al.</i>        | (D0 Collab.)      | REFID=50200 |
| ACOSTA        | 04   | PRL 93 072001     | D. Acosta <i>et al.</i>          | (CDF Collab.)     | REFID=49742 |
| AUBERT        | 04Y  | PRL 93 041801     | B. Aubert <i>et al.</i>          | (BABAR Collab.)   | REFID=49997 |
| CHISTOV       | 04   | PRL 93 051803     | R. Chistov <i>et al.</i>         | (BELLE Collab.)   | REFID=50002 |
| PDG           | 04   | PL B592 1         | S. Eidelman <i>et al.</i>        | (PDG Collab.)     | REFID=49653 |
| YUAN          | 04   | PL B579 74        | C.Z. Yuan <i>et al.</i>          |                   | REFID=49677 |
| CHOI          | 03   | PRL 91 262001     | S.-K. Choi <i>et al.</i>         | (BELLE Collab.)   | REFID=49628 |
| BAI           | 98E  | PR D57 3854       | J.Z. Bai <i>et al.</i>           | (BES Collab.)     | REFID=46339 |
| ANTONIAZZI    | 94   | PR D50 4258       | L. Antoniazzi <i>et al.</i>      | (E705 Collab.)    | REFID=44074 |

**$Z_c(3900)$** 

$$J^G(J^{PC}) = 1^+(1^{+-})$$

was  $X(3900)$ 

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

Charged  $Z_c(3900)$  seen as a peak in the invariant mass distribution of the  $J/\psi\pi^\pm$  system by BES III (ABLIKIM 13T) in  $e^+e^- \rightarrow \pi^+\pi^- J/\psi$  at c.m. energy of 4.26 GeV and by radiative return from  $e^+e^-$  collisions at  $\sqrt{s}$  from 9.46 to 10.86 GeV at Belle (LIU 13B). Partial wave analysis of ABLIKIM 17J determines  $J^P = 1^+$  with more than  $7\sigma$  significance. Neutral  $Z_c(3900)$  seen in the  $J/\psi\pi^0$  invariant mass distribution in  $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$  at c.m. energies of 4.23, 4.26, and 4.36 GeV by BES III (ABLIKIM 15U) and at 4.17 GeV by XIAO 13A. Peaks in  $(D\bar{D}^*)^{0,\pm}$  reported by BES III (ABLIKIM 14A, ABLIKIM 15AB) are assumed to be related.

 **$Z_c(3900)$  MASS**

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID                                                                                                               | TECN | CHG  | COMMENT                                                  |
|-------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------|------|------|----------------------------------------------------------|
| <b><math>3887.1 \pm 2.6</math> OUR AVERAGE</b>                                |      | Error includes scale factor of 1.7. See the ideogram below.<br>[3888.4 $\pm$ 2.5 MeV OUR 2020 AVERAGE Scale factor = 1.7] |      |      |                                                          |
| $3893.1 \pm 2.2 \pm 3.0$                                                      |      | <sup>1</sup> ABLIKIM                                                                                                      | 20N  | BES3 | 0 $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$                 |
| $3902.6^{+5.2+3.3}_{-5.0-1.4}$                                                |      | <sup>2,3</sup> ABAZOV                                                                                                     | 19   | D0   | $\pm$ 1.96 TeV $p\bar{p} \rightarrow J/\psi\pi^+\pi^- X$ |
| $3881.2 \pm 4.2 \pm 52.7$                                                     | 6k   | <sup>4</sup> ABLIKIM                                                                                                      | 17J  | BES3 | $\pm$ $e^+e^- \rightarrow \pi^+\pi^- J/\psi$             |
| $3885.7^{+4.3}_{-5.7} \pm 8.4$                                                |      | <sup>2,4</sup> ABLIKIM                                                                                                    | 15AB | BES3 | 0 $e^+e^- \rightarrow \pi^0(D\bar{D}^*)^0$               |
| $3881.7 \pm 1.6 \pm 1.6$                                                      | 1.2k | <sup>2,4</sup> ABLIKIM                                                                                                    | 15AC | BES3 | $\pm$ $e^+e^- \rightarrow \pi^\pm(D\bar{D}^*)^\mp$       |
| $3883.9 \pm 1.5 \pm 4.2$                                                      | 1.2k | <sup>2,4</sup> ABLIKIM                                                                                                    | 14A  | BES3 | $\pm$ $e^+e^- \rightarrow \pi^\pm(D\bar{D}^*)^\mp$       |
| $3894.5 \pm 6.6 \pm 4.5$                                                      | 159  | <sup>2</sup> LIU                                                                                                          | 13B  | BELL | $\pm$ $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$       |
| $3886 \pm 4 \pm 2$                                                            | 81   | <sup>2,5</sup> XIAO                                                                                                       | 13A  |      | $\pm$ 4.17 $e^+e^- \rightarrow \pi^+\pi^- J/\psi$        |
| $3904 \pm 9 \pm 5$                                                            | 25   | <sup>2,5</sup> XIAO                                                                                                       | 13A  | 0    | 4.17 $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$              |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                                                                                           |      |      |                                                          |
| $3895.0 \pm 5.2^{+4.0}_{-2.7}$                                                | 502  | <sup>2,6</sup> ABAZOV                                                                                                     | 18B  | D0   | $\pm$ 1.96 TeV $p\bar{p} \rightarrow J/\psi\pi^+\pi^- X$ |
| $3894.8 \pm 2.3 \pm 3.2$                                                      | 356  | <sup>2,7</sup> ABLIKIM                                                                                                    | 15U  | BES3 | 0 $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$                 |
| $3899.0 \pm 3.6 \pm 4.9$                                                      | 307  | <sup>2,8</sup> ABLIKIM                                                                                                    | 13T  | BES3 | $\pm$ $e^+e^- \rightarrow \pi^+\pi^- J/\psi$             |

<sup>1</sup> Pole mass obtained from a fit to a relativistic Breit-Wigner.

<sup>2</sup> Neglecting interference between the  $Z_c(3900)$  and other processes.

<sup>3</sup> Measured in weak decays of  $b$ -flavored hadrons (nonprompt).

<sup>4</sup> Pole mass obtained from a fit to a Flatte-like formula.

<sup>5</sup> For  $M^2(\pi^+\pi^-) < 0.65 \text{ GeV}^2$ . Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

<sup>6</sup> The signal of the  $Z_c(3900)$  is correlated with a parent  $J/\psi\pi^+\pi^-$  system in the invariant mass range 4.2–4.7 GeV. Superseded by ABAZOV 19.

<sup>7</sup> Superseded by ABLIKIM 20N.

<sup>8</sup> Superseded by ABLIKIM 17J.

NODE=M210

NODE=M210

NODE=M210M

NODE=M210M

NEW

OCCUR=2

NODE=M210M;LINKAGE=L

NODE=M210M;LINKAGE=A

NODE=M210M;LINKAGE=G

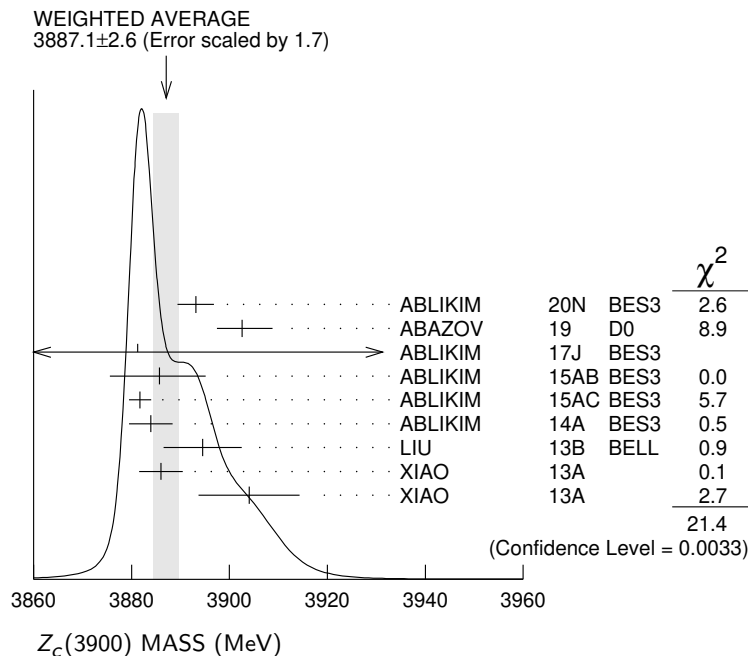
NODE=M210M;LINKAGE=E

NODE=M210M;LINKAGE=B

NODE=M210M;LINKAGE=F

NODE=M210M;LINKAGE=J

NODE=M210M;LINKAGE=K



### $Z_c(3900)$ WIDTH

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID            | TECN | CHG  | COMMENT |                                                                  |
|-------------------------------------------------------------------------------|------|------------------------|------|------|---------|------------------------------------------------------------------|
| <b>28.4± 2.6 OUR AVERAGE</b><br>[28.3 ± 2.5 MeV OUR 2020 AVERAGE]             |      |                        |      |      |         |                                                                  |
| 44.4± 5.2±14.0                                                                |      | <sup>1</sup> ABLIKIM   | 20N  | BES3 | 0       | $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$                           |
| 32 +28 +26<br>-21 -7                                                          |      | <sup>2,3</sup> ABAZOV  | 19   | D0   | ±       | 1.96 TeV $p\bar{p} \rightarrow \pi^+\pi^- J/\psi X$ (non-prompt) |
| 51.8± 4.6±36.0                                                                | 6 k  | <sup>4</sup> ABLIKIM   | 17J  | BES3 | ±       | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$                           |
| 35 +11 ±15<br>-12                                                             |      | <sup>2,4</sup> ABLIKIM | 15AB | BES3 | 0       | $e^+e^- \rightarrow \pi^0(D\bar{D}^*)^0$                         |
| 26.6± 2.0± 2.1                                                                | 1248 | <sup>2,4</sup> ABLIKIM | 15AC | BES3 | ±       | $e^+e^- \rightarrow \pi^\pm(D\bar{D}^*)^\mp$                     |
| 24.8± 3.3±11.0                                                                | 1212 | <sup>2,4</sup> ABLIKIM | 14A  | BES3 | ±       | $e^+e^- \rightarrow \pi^\pm(D\bar{D}^*)^\mp$                     |
| 63 ±24 ±26                                                                    | 159  | <sup>2</sup> LIU       | 13B  | BELL | ±       | $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$                     |
| 37 ± 4 ± 8                                                                    | 81   | <sup>2,5</sup> XIAO    | 13A  |      | ±       | 4.17 $e^+e^- \rightarrow \pi^+\pi^- J/\psi$                      |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                        |      |      |         |                                                                  |
| 29.6± 8.2± 8.2                                                                | 356  | <sup>2,6</sup> ABLIKIM | 15U  | BES3 | 0       | $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$                           |
| 46 ±10 ±20                                                                    | 307  | <sup>2,7</sup> ABLIKIM | 13T  | BES3 | ±       | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$                           |

<sup>1</sup> Pole width obtained from a fit to a relativistic Breit-Wigner.

<sup>2</sup> Neglecting interference between the  $Z_c(3900)$  and other processes.

<sup>3</sup> Measured in weak decays of  $b$ -flavored hadrons (nonprompt).

<sup>4</sup> Pole width obtained from a fit to a Flatte-like formula.

<sup>5</sup> For  $M^2(\pi^+\pi^-) < 0.65 \text{ GeV}^2$ . Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.

<sup>6</sup> Superseded by ABLIKIM 20N.

<sup>7</sup> Superseded by ABLIKIM 17J.

NODE=M210W

NODE=M210W

NEW

NODE=M210W;LINKAGE=G

NODE=M210W;LINKAGE=A

NODE=M210W;LINKAGE=F

NODE=M210W;LINKAGE=E

NODE=M210W;LINKAGE=B

NODE=M210W;LINKAGE=H

NODE=M210W;LINKAGE=I

### $Z_c(3900)$ DECAY MODES

| Mode                                           | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------------------------|--------------------------------|
| $\Gamma_1$ $J/\psi \pi$                        | seen                           |
| $\Gamma_2$ $h_c \pi^\pm$                       | not seen                       |
| $\Gamma_3$ $\eta_c \pi^+ \pi^-$                | not seen                       |
| $\Gamma_4$ $\eta_c(1S) \rho(770)^\pm$          |                                |
| $\Gamma_5$ $(D\bar{D}^*)^\pm$                  | seen                           |
| $\Gamma_6$ $D^0 D^{*-} + \text{c.c.}$          | seen                           |
| $\Gamma_7$ $D^- D^{*0} + \text{c.c.}$          | seen                           |
| $\Gamma_8$ $\omega \pi^\pm$                    | not seen                       |
| $\Gamma_9$ $J/\psi \eta$                       | not seen                       |
| $\Gamma_{10}$ $D^+ D^{*-} + \text{c.c.}$       | seen                           |
| $\Gamma_{11}$ $D^0 \bar{D}^{*0} + \text{c.c.}$ | seen                           |

NODE=M210215;NODE=M210

DESIG=1

DESIG=2

DESIG=10

DESIG=11

DESIG=3;OUR EVAL;→ UNCHECKED ←

DESIG=8

DESIG=9

DESIG=4

DESIG=5

DESIG=6

DESIG=7

**$Z_c(3900)$  BRANCHING RATIOS**

NODE=M210225

| $\Gamma(J/\psi\pi)/\Gamma_{\text{total}}$ |      | $\Gamma_1/\Gamma$   |      |      |         |                                                                 |
|-------------------------------------------|------|---------------------|------|------|---------|-----------------------------------------------------------------|
| VALUE                                     | EVTs | DOCUMENT ID         | TECN | CHG  | COMMENT |                                                                 |
| seen                                      |      | ABLIKIM             | 20N  | BES3 | 0       | $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$                          |
| seen                                      |      | <sup>1</sup> ABAZOV | 19   | D0   | $\pm$   | 1.96 TeV $p\bar{p} \rightarrow \pi^+\pi^-\pi^0 J/\psi$ (prompt) |
| seen                                      |      | ABLIKIM             | 17J  | BES3 | $\pm$   | $e^+e^- \rightarrow \pi^+\pi^-\pi^0 J/\psi$                     |
| seen                                      | 356  | ABLIKIM             | 15U  | BES3 | 0       | $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$                          |
| not seen                                  |      | <sup>2</sup> ADOLPH | 15D  | COMP | $\pm$   | $\gamma N \rightarrow J/\psi\pi^\pm N$                          |
| seen                                      | 307  | ABLIKIM             | 13T  | BES3 | $\pm$   | $e^+e^- \rightarrow \pi^+\pi^-\pi^0 J/\psi$                     |
| seen                                      | 25   | <sup>3</sup> XIAO   | 13A  |      | 0       | 4.17 $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$                     |

<sup>1</sup> But not seen in the "prompt" sample (no b-hadron enhancement).<sup>2</sup> ADOLPH 15D measure  $B(Z_c(3900)^\pm \rightarrow J/\psi\pi^\pm) \sigma(\gamma N \rightarrow Z_c(3900)^\pm N)/\sigma(\gamma N \rightarrow J/\psi N) < 3.7 \times 10^{-3}$  at 90% CL.<sup>3</sup> Obtained by analyzing CLEO-c data but not authored by the CLEO Collaboration.NODE=M210R01  
NODE=M210R01NODE=M210R01;LINKAGE=C  
NODE=M210R01;LINKAGE=A

NODE=M210R01;LINKAGE=XI

| $\Gamma(h_c\pi^\pm)/\Gamma_{\text{total}}$ |  | $\Gamma_2/\Gamma$ |      |      |         |                                    |
|--------------------------------------------|--|-------------------|------|------|---------|------------------------------------|
| VALUE                                      |  | DOCUMENT ID       | TECN | CHG  | COMMENT |                                    |
| not seen                                   |  | ABLIKIM           | 13X  | BES3 | $\pm$   | $e^+e^- \rightarrow h_c\pi^+\pi^-$ |

NODE=M210R02  
NODE=M210R02

| $\Gamma(\eta_c\pi^+\pi^-)/\Gamma_{\text{total}}$ |  | $\Gamma_3/\Gamma$          |      |     |                                       |  |
|--------------------------------------------------|--|----------------------------|------|-----|---------------------------------------|--|
| VALUE                                            |  | DOCUMENT ID                | TECN | CHG | COMMENT                               |  |
| not seen                                         |  | <sup>1</sup> VINOKUROVA 15 | BELL | 0   | $B^+ \rightarrow K^+\eta_c\pi^+\pi^-$ |  |

NODE=M210R11  
NODE=M210R11<sup>1</sup> VINOKUROVA 15 reports  $B(B^+ \rightarrow K^+Z_c(3900)^0) \times B(X \rightarrow \eta_c\pi^+\pi^-) < 4.7 \times 10^{-5}$  at 90% CL.

NODE=M210R11;LINKAGE=VI

| $\Gamma((D\bar{D}^*)^\pm)/\Gamma(J/\psi\pi)$ |  | $\Gamma_5/\Gamma_1$  |      |      |         |                                              |
|----------------------------------------------|--|----------------------|------|------|---------|----------------------------------------------|
| VALUE                                        |  | DOCUMENT ID          | TECN | CHG  | COMMENT |                                              |
| $6.2 \pm 1.1 \pm 2.7$                        |  | <sup>1</sup> ABLIKIM | 14A  | BES3 | $\pm$   | $e^+e^- \rightarrow \pi^\pm(D\bar{D}^*)^\mp$ |

<sup>1</sup> Assuming the same origin of the  $(D\bar{D}^*)^\pm$  and  $\pi^\pm J/\psi$  decay modes.NODE=M210R03  
NODE=M210R03

NODE=M210R03;LINKAGE=A

| $\Gamma(D^0 D^{*-} + \text{c.c.})/\Gamma_{\text{total}}$ |  | $\Gamma_6/\Gamma$ |      |      |         |                                                     |
|----------------------------------------------------------|--|-------------------|------|------|---------|-----------------------------------------------------|
| VALUE                                                    |  | DOCUMENT ID       | TECN | CHG  | COMMENT |                                                     |
| seen                                                     |  | ABLIKIM           | 15AC | BES3 | $\pm$   | $e^+e^- \rightarrow \pi^+ D^0 D^{*-} + \text{c.c.}$ |
| seen                                                     |  | ABLIKIM           | 14A  | BES3 | $\pm$   | $e^+e^- \rightarrow \pi^+ D^0 D^{*-} + \text{c.c.}$ |

NODE=M210R09  
NODE=M210R09

| $\Gamma(D^- D^{*0} + \text{c.c.})/\Gamma_{\text{total}}$ |  | $\Gamma_7/\Gamma$ |      |      |         |                                                     |
|----------------------------------------------------------|--|-------------------|------|------|---------|-----------------------------------------------------|
| VALUE                                                    |  | DOCUMENT ID       | TECN | CHG  | COMMENT |                                                     |
| seen                                                     |  | ABLIKIM           | 15AC | BES3 | $\pm$   | $e^+e^- \rightarrow \pi^+ D^- D^{*0} + \text{c.c.}$ |
| seen                                                     |  | ABLIKIM           | 14A  | BES3 | $\pm$   | $e^+e^- \rightarrow \pi^+ D^- D^{*0} + \text{c.c.}$ |

NODE=M210R10  
NODE=M210R10

| $\Gamma(\omega\pi^\pm)/\Gamma_{\text{total}}$ |  | $\Gamma_8/\Gamma$ |      |      |         |                                       |
|-----------------------------------------------|--|-------------------|------|------|---------|---------------------------------------|
| VALUE                                         |  | DOCUMENT ID       | TECN | CHG  | COMMENT |                                       |
| not seen                                      |  | ABLIKIM           | 15R  | BES3 | $\pm$   | $e^+e^- \rightarrow \omega\pi^+\pi^-$ |

NODE=M210R00  
NODE=M210R00

| $\Gamma(J/\psi\eta)/\Gamma_{\text{total}}$ |  | $\Gamma_9/\Gamma$ |      |      |         |                                              |
|--------------------------------------------|--|-------------------|------|------|---------|----------------------------------------------|
| VALUE                                      |  | DOCUMENT ID       | TECN | CHG  | COMMENT |                                              |
| not seen                                   |  | ABLIKIM           | 15Q  | BES3 | 0       | 4.0–4.6 $e^+e^- \rightarrow J/\psi\eta\pi^0$ |

NODE=M210R04  
NODE=M210R04

| $\Gamma(J/\psi\eta)/\Gamma(J/\psi\pi)$                                        |     | $\Gamma_9/\Gamma_1$ |      |      |         |                                            |
|-------------------------------------------------------------------------------|-----|---------------------|------|------|---------|--------------------------------------------|
| VALUE                                                                         | CL% | DOCUMENT ID         | TECN | CHG  | COMMENT |                                            |
| <0.15                                                                         | 90  | ABLIKIM             | 15Q  | BES3 | 0       | 4.226 $e^+e^- \rightarrow J/\psi\eta\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                     |      |      |         |                                            |
| <0.65                                                                         | 90  | ABLIKIM             | 15Q  | BES3 | 0       | 4.257 $e^+e^- \rightarrow J/\psi\eta\pi^0$ |

NODE=M210R05  
NODE=M210R05

OCCUR=2

| $\Gamma(\eta_c(1S)\rho(770)^\pm)/\Gamma(J/\psi\pi)$ |      | $\Gamma_4/\Gamma_1$  |      |      |                                                |  |
|-----------------------------------------------------|------|----------------------|------|------|------------------------------------------------|--|
| VALUE                                               | EVTs | DOCUMENT ID          | TECN | CHG  | COMMENT                                        |  |
| $2.3 \pm 0.8$                                       | 332  | <sup>1</sup> ABLIKIM | 19BC | BES3 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta_c(1S)$ |  |

<sup>1</sup> Using  $e^+e^- \rightarrow \pi^\mp(Z_c(3900)^\pm \rightarrow J/\psi\pi^\pm)$  cross section at 4.23 and 4.26 GeV from ABLIKIM 17J.NODE=M210R12  
NODE=M210R12

NODE=M210R12;LINKAGE=A

| $\Gamma(D^+ D^{*-} + \text{c.c.})/\Gamma_{\text{total}}$ |  | $\Gamma_{10}/\Gamma$ |      |      |         |                                          |
|----------------------------------------------------------|--|----------------------|------|------|---------|------------------------------------------|
| VALUE                                                    |  | DOCUMENT ID          | TECN | CHG  | COMMENT |                                          |
| seen                                                     |  | ABLIKIM              | 15AB | BES3 | 0       | $e^+e^- \rightarrow \pi^0(D\bar{D}^*)^0$ |

NODE=M210R06  
NODE=M210R06

$\Gamma(D^0 \bar{D}^{*0} + c.c.) / \Gamma_{\text{total}}$  $\Gamma_{11} / \Gamma$ 

| VALUE | DOCUMENT ID | TECN      | CHG | COMMENT                                     |
|-------|-------------|-----------|-----|---------------------------------------------|
| seen  | ABLIKIM     | 15AB BES3 | 0   | $e^+ e^- \rightarrow \pi^0 (D \bar{D}^*)^0$ |

NODE=M210R07  
 NODE=M210R07

 $\Gamma(D^+ D^{*-} + c.c.) / \Gamma(D^0 \bar{D}^{*0} + c.c.)$  $\Gamma_{10} / \Gamma_{11}$ 

| VALUE                     | DOCUMENT ID | TECN      | CHG | COMMENT                                     |
|---------------------------|-------------|-----------|-----|---------------------------------------------|
| <b>0.96 ± 0.18 ± 0.12</b> | ABLIKIM     | 15AB BES3 | 0   | $e^+ e^- \rightarrow \pi^0 (D \bar{D}^*)^0$ |

NODE=M210R08  
 NODE=M210R08

**Z<sub>c</sub>(3900) REFERENCES**

NODE=M210

|            |      |                        |                             |                     |
|------------|------|------------------------|-----------------------------|---------------------|
| ABLIKIM    | 20N  | PR D102 012009         | M. Ablikim <i>et al.</i>    | (BESIII Collab.) JP |
| ABAZOV     | 19   | PR D100 012005         | V.M. Abazov <i>et al.</i>   | (D0 Collab.)        |
| ABLIKIM    | 19BC | PR D100 111102         | M. Ablikim <i>et al.</i>    | (BESIII Collab.)    |
| ABAZOV     | 18B  | PR D98 052010          | V.M. Abazov <i>et al.</i>   | (D0 Collab.)        |
| ABLIKIM    | 17J  | PRL 119 072001         | M. Ablikim <i>et al.</i>    | (BESIII Collab.) JP |
| ABLIKIM    | 15AB | PRL 115 222002         | M. Ablikim <i>et al.</i>    | (BESIII Collab.)    |
| ABLIKIM    | 15AC | PR D92 092006          | M. Ablikim <i>et al.</i>    | (BESIII Collab.) JP |
| ABLIKIM    | 15Q  | PR D92 012008          | M. Ablikim <i>et al.</i>    | (BESIII Collab.)    |
| ABLIKIM    | 15R  | PR D92 032009          | M. Ablikim <i>et al.</i>    | (BESIII Collab.)    |
| ABLIKIM    | 15U  | PRL 115 112003         | M. Ablikim <i>et al.</i>    | (BESIII Collab.)    |
| ADOLPH     | 15D  | PL B742 330            | C. Adolph <i>et al.</i>     | (COMPASS Collab.)   |
| VINOKUROVA | 15   | JHEP 1506 132          | A. Vinokurova <i>et al.</i> | (BELLE Collab.)     |
| Also       |      | JHEP 1702 088 (errat.) | A. Vinokurava <i>et al.</i> | (BELLE Collab.)     |
| ABLIKIM    | 14A  | PRL 112 022001         | M. Ablikim <i>et al.</i>    | (BESIII Collab.) JP |
| ABLIKIM    | 13T  | PRL 110 252001         | M. Ablikim <i>et al.</i>    | (BESIII Collab.)    |
| ABLIKIM    | 13X  | PRL 111 242001         | M. Ablikim <i>et al.</i>    | (BESIII Collab.)    |
| LIU        | 13B  | PRL 110 252002         | Z.Q. Liu <i>et al.</i>      | (BELLE Collab.)     |
| XIAO       | 13A  | PL B727 366            | T. Xiao <i>et al.</i>       | (NWES)              |

REFID=60338  
 REFID=59903  
 REFID=60036  
 REFID=59442  
 REFID=57950  
 REFID=56954  
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 REFID=56791  
 REFID=56706  
 REFID=57795  
 REFID=55648  
 REFID=55409  
 REFID=55635  
 REFID=55410  
 REFID=55593

**X(3915)**

$$J^{PC} = 0^+(0 \text{ or } 2^{++})$$

was  $\chi_{c0}(3915)$ 

The experimental analysis prefers  $J^{PC} = 0^{++}$ . However, a re-analysis presented in ZHOU 15C shows that if helicity-2 dominance assumption is abandoned and a sizable helicity-0 component is allowed, a  $J^{PC} = 2^{++}$  assignment is possible.

NODE=M159

NODE=M159

**X(3915) MASS**

NODE=M159M

| VALUE (MeV)                         | EVTS | DOCUMENT ID                                                 | TECN | COMMENT |
|-------------------------------------|------|-------------------------------------------------------------|------|---------|
| <b>3921.7 ± 1.8 OUR AVERAGE</b>     |      | Error includes scale factor of 1.5. See the ideogram below. |      |         |
| [3918.4 ± 1.9 MeV OUR 2020 AVERAGE] |      |                                                             |      |         |

NODE=M159M  
 NEW

|                                             |         |                   |           |                                                  |
|---------------------------------------------|---------|-------------------|-----------|--------------------------------------------------|
| 3923.8 ± 1.5 ± 0.4                          | 1.2k    | <sup>1</sup> AAIJ | 20AI LHCb | $B^+ \rightarrow D^+ D^- K^+$                    |
| 3919.4 ± 2.2 ± 1.6                          | 59 ± 10 | LEES              | 12AD BABR | $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$      |
| 3919.1 <sup>+</sup> <sub>-</sub> 3.8<br>3.4 | 2.0     | DEL-AMO-SA..10B   | BABR      | $B \rightarrow \omega J/\psi K$                  |
| 3915 ± 3 ± 2                                | 49 ± 15 | UEHARA            | 10 BELL   | 10.6 $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$ |
| 3943 ± 11 ± 13                              | 58 ± 11 | <sup>2</sup> CHOI | 05 BELL   | $B \rightarrow \omega J/\psi K$                  |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                             |     |                      |          |                                            |
|---------------------------------------------|-----|----------------------|----------|--------------------------------------------|
| 3926.4 ± 2.2 ± 1.2                          |     | <sup>3</sup> ABLIKIM | 19V BES  | $e^+ e^- \rightarrow \gamma \omega J/\psi$ |
| 3914.6 <sup>+</sup> <sub>-</sub> 3.8<br>3.4 | 2.0 | <sup>2</sup> AUBERT  | 08W BABR | Superseded by DEL-AMO-SANCHEZ 10B          |

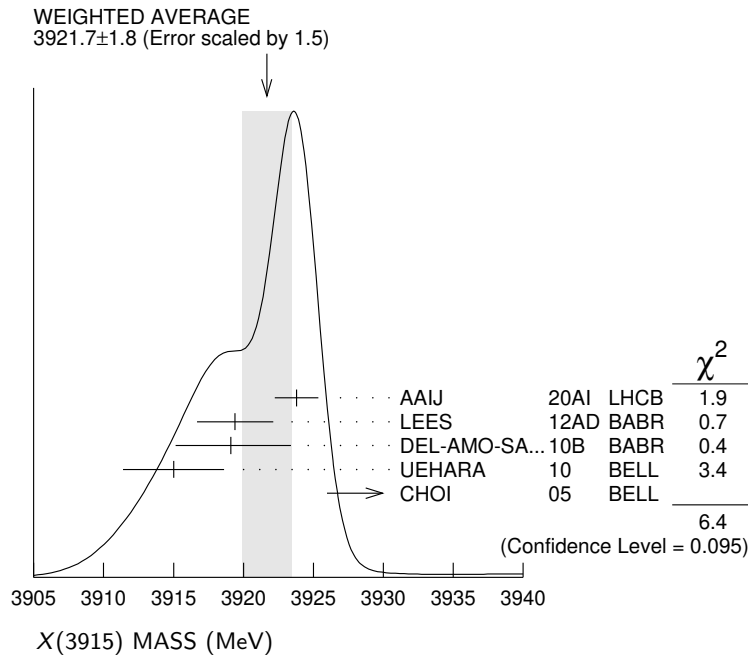
<sup>1</sup> Obtained from the full amplitude analysis. Parameterized with the relativistic Breit-Wigner line shape.

<sup>2</sup>  $\omega J/\psi$  threshold enhancement fitted as an S-wave Breit-Wigner resonance.

<sup>3</sup> Could also be X(3940). Significance 3.1 $\sigma$ . Fit with additional resonance at 3963.7 ± 5.7 MeV, significance 3.4 $\sigma$ .

NODE=M159M;LINKAGE=B

NODE=M159M;LINKAGE=CH  
 NODE=M159M;LINKAGE=A



### X(3915) WIDTH

| VALUE (MeV)                                                                      | EVTs | DOCUMENT ID          | TECN      | COMMENT                                          |
|----------------------------------------------------------------------------------|------|----------------------|-----------|--------------------------------------------------|
| <b>18.8± 3.5 OUR AVERAGE</b><br>[20 ± 5 MeV OUR 2020 AVERAGE Scale factor = 1.1] |      |                      |           |                                                  |
| 17.4 ± 5.1 ± 0.8                                                                 | 1.2k | <sup>1</sup> AAIJ    | 20AI LHCB | $B^+ \rightarrow D^+ D^- K^+$                    |
| 13 ± 6 ± 3                                                                       | 59   | LEES                 | 12AD BABR | $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$      |
| 31 $^{+10}_{-8}$ ± 5                                                             |      | DEL-AMO-SA..10B      | BABR      | $B \rightarrow \omega J/\psi K$                  |
| 17 ± 10 ± 3                                                                      | 49   | UEHARA               | 10 BELL   | 10.6 $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$ |
| 87 ± 22 ± 26                                                                     | 58   | <sup>2</sup> CHOI    | 05 BELL   | $B \rightarrow \omega J/\psi K$                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • •    |      |                      |           |                                                  |
| 3.8 ± 7.5 ± 2.6                                                                  |      | <sup>3</sup> ABLIKIM | 19V BES   | $e^+ e^- \rightarrow \gamma \omega J/\psi$       |
| 34 $^{+12}_{-8}$ ± 5                                                             |      | <sup>2</sup> AUBERT  | 08W BABR  | Superseded by DEL-AMO-SANCHEZ 10B                |

<sup>1</sup> Obtained from the full amplitude analysis. Parameterized with the relativistic Breit-Wigner line shape.

<sup>2</sup>  $\omega J/\psi$  threshold enhancement fitted as an S-wave Breit-Wigner resonance.

<sup>3</sup> Could also be X(3940). Significance 3.1 $\sigma$ . Fit with additional resonance at 3963.7 ± 5.7 MeV, significance 3.4 $\sigma$ .

NODE=M159W

NODE=M159W  
NEW

NODE=M159W;LINKAGE=B

NODE=M159W;LINKAGE=CH  
NODE=M159W;LINKAGE=A

### X(3915) DECAY MODES

| Mode                                | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------|--------------------------------|
| $\Gamma_1$ $\omega J/\psi$          | seen                           |
| $\Gamma_2$ $\overline{D}^{*0} D^0$  |                                |
| $\Gamma_3$ $\pi^+ \pi^- \eta_c(1S)$ | not seen                       |
| $\Gamma_4$ $\eta_c \eta$            | not seen                       |
| $\Gamma_5$ $\eta_c \pi^0$           | not seen                       |
| $\Gamma_6$ $K \overline{K}$         | not seen                       |
| $\Gamma_7$ $\gamma \gamma$          | seen                           |
| $\Gamma_8$ $\pi^0 \chi_{c1}$        |                                |

NODE=M159215;NODE=M159

DESIG=1;OUR EST;→ UNCHECKED ←  
DESIG=3  
DESIG=4;OUR EVAL;→ UNCHECKED ←  
DESIG=6  
DESIG=7  
DESIG=5;OUR EVAL;→ UNCHECKED ←  
DESIG=2  
DESIG=8

### X(3915) $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

| VALUE (eV)                                                                    | EVTs    | DOCUMENT ID         | TECN      | COMMENT                                          | $\Gamma_1 \Gamma_7 / \Gamma$ |
|-------------------------------------------------------------------------------|---------|---------------------|-----------|--------------------------------------------------|------------------------------|
| <b>54± 9 OUR AVERAGE</b>                                                      |         |                     |           |                                                  |                              |
| 52±10±3                                                                       | 59 ± 10 | <sup>1</sup> LEES   | 12AD BABR | $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$      |                              |
| 61±17±8                                                                       | 49 ± 15 | <sup>1</sup> UEHARA | 10 BELL   | 10.6 $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$ |                              |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |         |                     |           |                                                  |                              |
| 18± 5±2                                                                       | 49 ± 15 | <sup>2</sup> UEHARA | 10 BELL   | 10.6 $e^+ e^- \rightarrow e^+ e^- \omega J/\psi$ |                              |
| <sup>1</sup> For $J^P = 0^+$ .                                                |         |                     |           |                                                  |                              |
| <sup>2</sup> For $J^P = 2^+$ , helicity-2.                                    |         |                     |           |                                                  |                              |

NODE=M159220

NODE=M159G01  
NODE=M159G01

OCCUR=2

NODE=M159G01;LINKAGE=UH  
NODE=M159G01;LINKAGE=UR



| $\Gamma(\pi^+\pi^-\eta_c(1S)) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |     |             |           |                                             | $\Gamma_3\Gamma/\Gamma$ |
|----------------------------------------------------------------------------------|-----|-------------|-----------|---------------------------------------------|-------------------------|
| VALUE (eV)                                                                       | CL% | DOCUMENT ID | TECN      | COMMENT                                     |                         |
| <b>&lt;16</b>                                                                    | 90  | LEES        | 12AE BABR | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-\eta_c$ |                         |

NODE=M159G02  
NODE=M159G02

| $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |     |             |         |                                        | $\Gamma_6\Gamma/\Gamma$ |
|----------------------------------------------------------------------|-----|-------------|---------|----------------------------------------|-------------------------|
| VALUE (eV)                                                           | CL% | DOCUMENT ID | TECN    | COMMENT                                |                         |
| <b>&lt;1.96</b>                                                      | 90  | UEHARA      | 13 BELL | $\gamma\gamma \rightarrow K_S^0 K_S^0$ |                         |

NODE=M159G03  
NODE=M159G03

### X(3915) BRANCHING RATIOS

NODE=M159225

| $\Gamma(\omega J/\psi)/\Gamma_{\text{total}}$ |  |                               |         |                                 | $\Gamma_1/\Gamma$ |
|-----------------------------------------------|--|-------------------------------|---------|---------------------------------|-------------------|
| VALUE                                         |  | DOCUMENT ID                   | TECN    | COMMENT                         |                   |
| seen                                          |  | <sup>1</sup> DEL-AMO-SA...10B | BABR    | $B \rightarrow \omega J/\psi K$ |                   |
| seen                                          |  | <sup>2</sup> CHOI             | 05 BELL | $B \rightarrow \omega J/\psi K$ |                   |

NODE=M159R03  
NODE=M159R03

<sup>1</sup> DEL-AMO-SANCHEZ 10B reports  $B(B^\pm \rightarrow X(3915)K^\pm) \times B(X(3915) \rightarrow J/\psi\omega) = (3.0_{-0.6-0.3}^{+0.7+0.5}) \times 10^{-5}$  and  $B(B^0 \rightarrow X(3915)K^0) \times B(X(3915) \rightarrow J/\psi\omega) = (2.1 \pm 0.9 \pm 0.3) \times 10^{-5}$ .  
<sup>2</sup> CHOI 05 reports  $B(B \rightarrow X(3915)K) \times B(X(3915) \rightarrow J/\psi\omega) = (7.1 \pm 1.3 \pm 3.1) \times 10^{-5}$ .

NODE=M159R03;LINKAGE=DE

NODE=M159R03;LINKAGE=CH

| $\Gamma(\omega J/\psi)/\Gamma(\bar{D}^{*0}D^0)$ |     |                     |         |                                   | $\Gamma_1/\Gamma_2$ |
|-------------------------------------------------|-----|---------------------|---------|-----------------------------------|---------------------|
| VALUE                                           | CL% | DOCUMENT ID         | TECN    | COMMENT                           |                     |
| <b>&gt;0.71</b>                                 | 90  | <sup>1</sup> AUSHEV | 10 BELL | $B \rightarrow \bar{D}^{*0}D^0 K$ |                     |

NODE=M159R02  
NODE=M159R02

<sup>1</sup> By combining the upper limit  $B(B \rightarrow X(3915)K) \times B(X(3915) \rightarrow D^{*0}\bar{D}^0) < 0.67 \times 10^{-4}$  from AUSHEV 10 with the average of CHOI 05 and AUBERT 08W measurements  $B(B \rightarrow X(3915)K) \times B(X(3915) \rightarrow \omega J/\psi) = (0.51 \pm 0.11) \times 10^{-4}$ .

NODE=M159R02;LINKAGE=AU

| $\Gamma(\eta_c\eta)/\Gamma_{\text{total}}$ |     |                            |      |                                   | $\Gamma_4/\Gamma$ |
|--------------------------------------------|-----|----------------------------|------|-----------------------------------|-------------------|
| VALUE                                      | CL% | DOCUMENT ID                | TECN | COMMENT                           |                   |
| <b>not seen</b>                            | 90  | <sup>1</sup> VINOKUROVA 15 | BELL | $B^+ \rightarrow K^+ \eta_c \eta$ |                   |

NODE=M159R00  
NODE=M159R00

OCCUR=2

<sup>1</sup> VINOKUROVA 15 reports  $B(B^+ \rightarrow K^+ X(3915)^0) \times B(X \rightarrow \eta_c \eta) < 4.7 \times 10^{-5}$  at 90% CL.

NODE=M159R00;LINKAGE=A

| $\Gamma(\eta_c\pi^0)/\Gamma_{\text{total}}$ |     |                            |      |                                    | $\Gamma_5/\Gamma$ |
|---------------------------------------------|-----|----------------------------|------|------------------------------------|-------------------|
| VALUE                                       | CL% | DOCUMENT ID                | TECN | COMMENT                            |                   |
| <b>not seen</b>                             | 90  | <sup>1</sup> VINOKUROVA 15 | BELL | $B^+ \rightarrow K^+ \eta_c \pi^0$ |                   |

NODE=M159R04  
NODE=M159R04

OCCUR=2

<sup>1</sup> VINOKUROVA 15 reports  $B(B^+ \rightarrow K^+ X(3915)^0) \times B(X \rightarrow \eta_c \pi^0) < 1.7 \times 10^{-5}$  at 90% CL.

NODE=M159R04;LINKAGE=A

| $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ |         |             |           |                                               | $\Gamma_7/\Gamma$ |
|----------------------------------------------|---------|-------------|-----------|-----------------------------------------------|-------------------|
| VALUE                                        | EVTS    | DOCUMENT ID | TECN      | COMMENT                                       |                   |
| seen                                         | 59 ± 10 | LEES        | 12AD BABR | $e^+e^- \rightarrow e^+e^-\omega J/\psi$      |                   |
| seen                                         |         | UEHARA      | 10 BELL   | $10.6 e^+e^- \rightarrow e^+e^-\omega J/\psi$ |                   |

NODE=M159R01  
NODE=M159R01

| $\Gamma(\pi^0\chi_{c1})/\Gamma_{\text{total}}$ |      |             |      |         | $\Gamma_8/\Gamma$ |
|------------------------------------------------|------|-------------|------|---------|-------------------|
| VALUE                                          | EVTS | DOCUMENT ID | TECN | COMMENT |                   |

NODE=M159R05  
NODE=M159R05

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                                                                                                                                                               |         |                       |         |                                          |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------------------|---------|------------------------------------------|--|
| not seen                                                                                                                                                                                      | 42 ± 14 | <sup>1</sup> BHARDWAJ | 19 BELL | $B^\pm \rightarrow \chi_{c1}\pi^0 K^\pm$ |  |
| <sup>1</sup> BHARDWAJ 19 reports $B(B^+ \rightarrow K^+ X(3915)) \times B(X(3915) \rightarrow \chi_{c1}\pi^0) < 3.8 \times 10^{-5}$ at 90% CL. A signal significance 2.3 standard deviations. |         |                       |         |                                          |  |

NODE=M159R05;LINKAGE=A

### X(3915) REFERENCES

NODE=M159

|               |      |                        |                                  |                  |             |
|---------------|------|------------------------|----------------------------------|------------------|-------------|
| AAIJ          | 20AI | PR D102 112003         | R. Aaij <i>et al.</i>            | (LHCb Collab.)   | REFID=60739 |
| ABLIKIM       | 19V  | PRL 122 232002         | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=59796 |
| BHARDWAJ      | 19   | PR D99 111101          | V. Bhardwaj <i>et al.</i>        | (BELLE Collab.)  | REFID=59884 |
| VINOKUROVA    | 15   | JHEP 1506 132          | A. Vinokurova <i>et al.</i>      | (BELLE Collab.)  | REFID=56706 |
| Also          |      | JHEP 1702 088 (errat.) | A. Vinokurava <i>et al.</i>      | (BELLE Collab.)  | REFID=57795 |
| ZHOU          | 15C  | PRL 115 022001         | Z.-Y. Zhou, Z. Xiao, H.-Q. Zhou  | (BEIJT, NANJ)    | REFID=56842 |
| UEHARA        | 13   | PTEP 2013 123C01       | S. Uehara <i>et al.</i>          | (BELLE Collab.)  | REFID=55592 |
| LEES          | 12AD | PR D86 072002          | J.P. Lees <i>et al.</i>          | (BABAR Collab.)  | REFID=54751 |
| LEES          | 12AE | PR D86 092005          | J.P. Lees <i>et al.</i>          | (BABAR Collab.)  | REFID=54752 |
| AUSHEV        | 10   | PR D81 031103          | T. Aushev <i>et al.</i>          | (BELLE Collab.)  | REFID=53225 |
| DEL-AMO-SA... | 10B  | PR D82 011101          | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)  | REFID=53362 |
| UEHARA        | 10   | PRL 104 092001         | S. Uehara <i>et al.</i>          | (BELLE Collab.)  | REFID=53232 |
| AUBERT        | 08W  | PRL 101 082001         | B. Aubert <i>et al.</i>          | (BABAR Collab.)  | REFID=52263 |
| CHOI          | 05   | PRL 94 182002          | S.-K. Choi <i>et al.</i>         | (BELLE Collab.)  | REFID=50737 |

$\chi_{c2}(3930)$ 

$$J^{PC} = 0^+(2^{++})$$

NODE=M050

 $\chi_{c2}(3930)$  MASS

NODE=M050M

| VALUE (MeV)                   | EVTS    | DOCUMENT ID                                                                                                           | TECN      | COMMENT                                     |
|-------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------|-----------|---------------------------------------------|
| <b>3922.5±1.0 OUR AVERAGE</b> |         | Error includes scale factor of 1.7. See the ideogram below.<br>[3922.2 ± 1.0 MeV OUR 2020 AVERAGE Scale factor = 1.6] |           |                                             |
|                               |         |                                                                                                                       |           |                                             |
| 3926.8±2.4±0.8                | 1.2k    | <sup>1</sup> AAIJ                                                                                                     | 20AI LHCb | $B^+ \rightarrow D^+ D^- K^+$               |
| 3921.9±0.6±0.2                |         | <sup>2</sup> AAIJ                                                                                                     | 19M LHCb  | $pp \rightarrow D\bar{D} + \text{anything}$ |
| 3926.7±2.7±1.1                | 76 ± 17 | AUBERT                                                                                                                | 10G BABR  | 10.6 $e^+e^- \rightarrow e^+e^- D\bar{D}$   |
| 3929 ±5 ±2                    | 64      | UEHARA                                                                                                                | 06 BELL   | 10.6 $e^+e^- \rightarrow e^+e^- D\bar{D}$   |

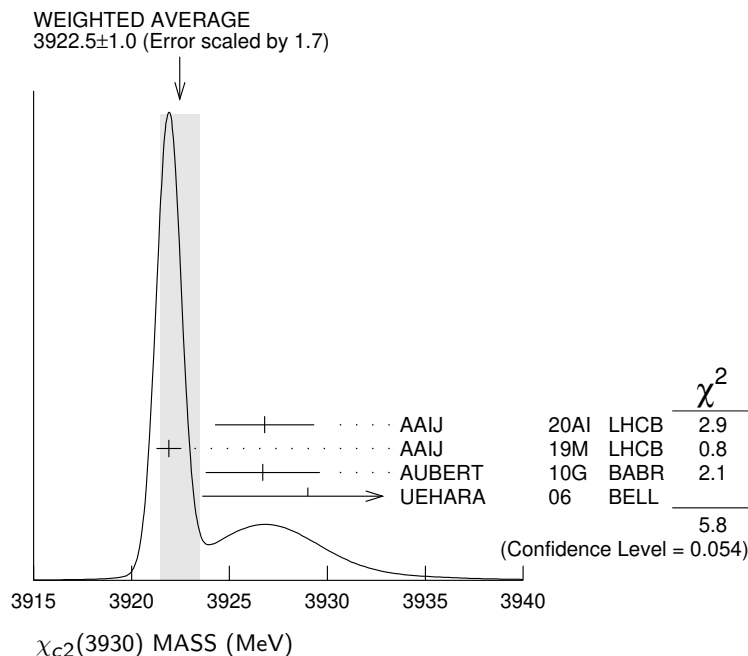
NODE=M050M  
NEW

<sup>1</sup> Obtained from the full amplitude analysis. Parameterized with the relativistic Breit-Wigner line shape. Previous measurements assumed a single state in this region. This analysis revealed the presence of  $\chi_{c0}(3930)$  with the same mass.

NODE=M050M;LINKAGE=B

<sup>2</sup> Measured in prompt hadroproduction.

NODE=M050M;LINKAGE=A

 $\chi_{c2}(3930)$  WIDTH

NODE=M050W

| VALUE (MeV)                   | EVTS    | DOCUMENT ID                                                                              | TECN      | COMMENT                                      |
|-------------------------------|---------|------------------------------------------------------------------------------------------|-----------|----------------------------------------------|
| <b>35.2 ± 2.2 OUR AVERAGE</b> |         | Error includes scale factor of 1.2. [35.3 ± 2.8 MeV OUR 2020 AVERAGE Scale factor = 1.4] |           |                                              |
| 34.2 ± 6.6 ± 1.1              | 1.2k    | <sup>1</sup> AAIJ                                                                        | 20AI LHCb | $B^+ \rightarrow D^+ D^- K^+$                |
| 36.6 ± 1.9 ± 0.9              |         | <sup>2</sup> AAIJ                                                                        | 19M LHCb  | $pp \rightarrow D \bar{D} + \text{anything}$ |
| 21.3 ± 6.8 ± 3.6              | 76 ± 17 | AUBERT                                                                                   | 10G BABR  | 10.6 $e^+ e^- \rightarrow e^+ e^- D \bar{D}$ |
| 29 ± 10 ± 2                   | 64      | UEHARA                                                                                   | 06 BELL   | 10.6 $e^+ e^- \rightarrow e^+ e^- D \bar{D}$ |

NODE=M050W  
NEW

<sup>1</sup> Obtained from the full amplitude analysis. Parameterized with the relativistic Breit-Wigner line shape. Previous measurements assumed a single state in this region. This analysis revealed the presence of  $\chi_{c0}(3930)$  with the same mass.

NODE=M050W;LINKAGE=B

<sup>2</sup> Measured in prompt hadroproduction.

NODE=M050W;LINKAGE=A

 $\chi_{c2}(3930)$  DECAY MODES

NODE=M050215;NODE=M050

| Mode                                   | Fraction ( $\Gamma_i/\Gamma$ ) |
|----------------------------------------|--------------------------------|
| $\Gamma_1$ $\gamma\gamma$              | seen                           |
| $\Gamma_2$ $K\bar{K}\pi$               |                                |
| $\Gamma_3$ $K^+ K^- \pi^+ \pi^- \pi^0$ |                                |
| $\Gamma_4$ $D\bar{D}$                  | seen                           |
| $\Gamma_5$ $D^+ D^-$                   | seen                           |
| $\Gamma_6$ $D^0 \bar{D}^0$             | seen                           |
| $\Gamma_7$ $\pi^+ \pi^- \eta_c(1S)$    | not seen                       |
| $\Gamma_8$ $K\bar{K}$                  | not seen                       |

DESIG=1;OUR EVAL;→ UNCHECKED ←  
DESIG=5  
DESIG=6  
DESIG=2;OUR EVAL;→ UNCHECKED ←  
DESIG=3;OUR EVAL;→ UNCHECKED ←  
DESIG=4;OUR EVAL;→ UNCHECKED ←  
DESIG=7;OUR EVAL;→ UNCHECKED ←  
DESIG=8;OUR EVAL;→ UNCHECKED ←

$\chi_{c2}(3930)$  PARTIAL WIDTHS

NODE=M050220

 $\chi_{c2}(3930) \Gamma(i) \Gamma(\gamma\gamma) / \Gamma(\text{total})$ 

NODE=M050222

| $\Gamma(K\bar{K}\pi) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |     | $\Gamma_2 \Gamma_1 / \Gamma$ |      |                                                |
|---------------------------------------------------------------------------|-----|------------------------------|------|------------------------------------------------|
| VALUE (eV)                                                                | CL% | DOCUMENT ID                  | TECN | COMMENT                                        |
| <b>&lt;2.1</b>                                                            | 90  | DEL-AMO-SA...11M             | BABR | $\gamma\gamma \rightarrow K_S^0 K^\pm \pi^\mp$ |

NODE=M050G01  
NODE=M050G01

| $\Gamma(K^+ K^- \pi^+ \pi^- \pi^0) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |     | $\Gamma_3 \Gamma_1 / \Gamma$ |      |                                                      |
|-----------------------------------------------------------------------------------------|-----|------------------------------|------|------------------------------------------------------|
| VALUE (eV)                                                                              | CL% | DOCUMENT ID                  | TECN | COMMENT                                              |
| <b>&lt;3.4</b>                                                                          | 90  | DEL-AMO-SA...11M             | BABR | $\gamma\gamma \rightarrow K^+ K^- \pi^+ \pi^- \pi^0$ |

NODE=M050G02  
NODE=M050G02

| $\Gamma(D\bar{D}) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |      | $\Gamma_4 \Gamma_1 / \Gamma$ |      |         |
|------------------------------------------------------------------------|------|------------------------------|------|---------|
| VALUE (keV)                                                            | EVTS | DOCUMENT ID                  | TECN | COMMENT |
| <b>0.21±0.04 OUR AVERAGE</b>                                           |      |                              |      |         |

NODE=M050G1  
NODE=M050G1

|                                                              |         |                     |     |      |                                             |
|--------------------------------------------------------------|---------|---------------------|-----|------|---------------------------------------------|
| 0.24±0.05±0.04                                               | 76 ± 17 | AUBERT              | 10G | BABR | 10.6 $e^+ e^- \rightarrow e^+ e^- D\bar{D}$ |
| 0.18±0.05±0.03                                               | 64      | <sup>1</sup> UEHARA | 06  | BELL | 10.6 $e^+ e^- \rightarrow e^+ e^- D\bar{D}$ |
| <sup>1</sup> Assuming $B(D^+ D^-) = 0.89 B(D^0 \bar{D}^0)$ . |         |                     |     |      |                                             |

NODE=M050G1;LINKAGE=UE

| $\Gamma(\pi^+ \pi^- \eta_c(1S)) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |     | $\Gamma_7 \Gamma_1 / \Gamma$ |      |                                                       |
|--------------------------------------------------------------------------------------|-----|------------------------------|------|-------------------------------------------------------|
| VALUE (eV)                                                                           | CL% | DOCUMENT ID                  | TECN | COMMENT                                               |
| <b>&lt;18</b>                                                                        | 90  | LEES                         | 12AE | BABR $e^+ e^- \rightarrow e^+ e^- \pi^+ \pi^- \eta_c$ |

NODE=M050G03  
NODE=M050G03

| $\Gamma(K\bar{K}) \times \Gamma(\gamma\gamma) / \Gamma_{\text{total}}$ |     | $\Gamma_8 \Gamma_1 / \Gamma$ |      |                                             |
|------------------------------------------------------------------------|-----|------------------------------|------|---------------------------------------------|
| VALUE (eV)                                                             | CL% | DOCUMENT ID                  | TECN | COMMENT                                     |
| <b>&lt;0.256</b>                                                       | 90  | UEHARA                       | 13   | BELL $\gamma\gamma \rightarrow K_S^0 K_S^0$ |

NODE=M050G04  
NODE=M050G04 $\chi_{c2}(3930)$  BRANCHING RATIOS

NODE=M050225

| $\Gamma(D^+ D^-) / \Gamma(D^0 \bar{D}^0)$ |      | $\Gamma_5 / \Gamma_6$ |      |                                                  |
|-------------------------------------------|------|-----------------------|------|--------------------------------------------------|
| VALUE                                     | EVTS | DOCUMENT ID           | TECN | COMMENT                                          |
| <b>0.74±0.43±0.16</b>                     | 64   | UEHARA                | 06   | BELL 10.6 $e^+ e^- \rightarrow e^+ e^- D\bar{D}$ |

NODE=M050R01  
NODE=M050R01 $\chi_{c2}(3930)$  REFERENCES

NODE=M050

|                  |               |                  |                                  |                 |
|------------------|---------------|------------------|----------------------------------|-----------------|
| AAIJ             | 20AI          | PR D102 112003   | R. Aaij <i>et al.</i>            | (LHCb Collab.)  |
| AAIJ             | 19M           | JHEP 1907 035    | R. Aaij <i>et al.</i>            | (LHCb Collab.)  |
| UEHARA           | 13            | PTEP 2013 123C01 | S. Uehara <i>et al.</i>          | (BELLE Collab.) |
| LEES             | 12AE          | PR D86 092005    | J.P. Lees <i>et al.</i>          | (BABAR Collab.) |
| DEL-AMO-SA...11M | PR D84 012004 |                  | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.) |
| AUBERT           | 10G           | PR D81 092003    | B. Aubert <i>et al.</i>          | (BABAR Collab.) |
| UEHARA           | 06            | PRL 96 082003    | S. Uehara <i>et al.</i>          | (BELLE Collab.) |

REFID=60739  
REFID=59697  
REFID=55592  
REFID=54752  
REFID=16751  
REFID=53357  
REFID=51039

**X(3940)**

$$I^G(J^{PC}) = ?^?(?^{??})$$

OMITTED FROM SUMMARY TABLE

Reported by ABE 07, observed in  $e^+e^- \rightarrow J/\psi X$ .**X(3940) MASS**

| VALUE (MeV)                                                                                  | EVTS | DOCUMENT ID      | TECN | COMMENT                                    |
|----------------------------------------------------------------------------------------------|------|------------------|------|--------------------------------------------|
| <b><math>3942^{+7}_{-6} \pm 6</math></b>                                                     | 52   | PAKHLOV          | 08   | BELL $e^+e^- \rightarrow J/\psi X$         |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                |      |                  |      |                                            |
| $3943 \pm 6 \pm 6$                                                                           | 25   | <sup>1</sup> ABE | 07   | BELL $e^+e^- \rightarrow J/\psi X$         |
| $3936 \pm 14$                                                                                | 266  | <sup>2</sup> ABE | 07   | BELL $e^+e^- \rightarrow J/\psi(c\bar{c})$ |
| <sup>1</sup> From a fit to $D^{*+}D^-$ and $D^{*0}\bar{D}^0$ events.                         |      |                  |      |                                            |
| <sup>2</sup> From the inclusive fit. Not independent of the exclusive measurement by ABE 07. |      |                  |      |                                            |

**X(3940) WIDTH**

| VALUE (MeV)                                                                   | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                            |
|-------------------------------------------------------------------------------|-----|------|-------------|------|------------------------------------|
| <b><math>37^{+26}_{-15} \pm 8</math></b>                                      |     | 52   | PAKHLOV     | 08   | BELL $e^+e^- \rightarrow J/\psi X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |             |      |                                    |
| <52                                                                           | 90  | 25   | ABE         | 07   | BELL $e^+e^- \rightarrow J/\psi X$ |

**X(3940) DECAY MODES**

| Mode                                  | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------------|--------------------------------|
| $\Gamma_1$ $D\bar{D}^* + \text{c.c.}$ | seen                           |
| $\Gamma_2$ $D\bar{D}$                 | not seen                       |
| $\Gamma_3$ $J/\psi\omega$             | not seen                       |

**X(3940) BRANCHING RATIOS** **$\Gamma(D\bar{D}^* + \text{c.c.})/\Gamma_{\text{total}}$**   **$\Gamma_1/\Gamma$** 

| VALUE                                                                                                             | CL% | EVTS | DOCUMENT ID        | TECN | COMMENT                            |
|-------------------------------------------------------------------------------------------------------------------|-----|------|--------------------|------|------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                     |     |      |                    |      |                                    |
| >0.45                                                                                                             | 90  | 25   | <sup>1,2</sup> ABE | 07   | BELL $e^+e^- \rightarrow J/\psi X$ |
| <sup>1</sup> For X(3940) decaying to final states with more than two tracks.                                      |     |      |                    |      |                                    |
| <sup>2</sup> PAKHLOV 08 finds that the inclusive peak near 3940 MeV/c <sup>2</sup> may consist of several states. |     |      |                    |      |                                    |

 **$\Gamma(D\bar{D})/\Gamma_{\text{total}}$**   **$\Gamma_2/\Gamma$** 

| VALUE                                                                                                             | CL% | DOCUMENT ID        | TECN | COMMENT                            |
|-------------------------------------------------------------------------------------------------------------------|-----|--------------------|------|------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                     |     |                    |      |                                    |
| <0.41                                                                                                             | 90  | <sup>1,2</sup> ABE | 07   | BELL $e^+e^- \rightarrow J/\psi X$ |
| <sup>1</sup> For X(3940) decaying to final states with more than two tracks.                                      |     |                    |      |                                    |
| <sup>2</sup> PAKHLOV 08 finds that the inclusive peak near 3940 MeV/c <sup>2</sup> may consist of several states. |     |                    |      |                                    |

 **$\Gamma(J/\psi\omega)/\Gamma_{\text{total}}$**   **$\Gamma_3/\Gamma$** 

| VALUE                                                                                                             | CL% | DOCUMENT ID        | TECN | COMMENT                            |
|-------------------------------------------------------------------------------------------------------------------|-----|--------------------|------|------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                     |     |                    |      |                                    |
| <0.26                                                                                                             | 90  | <sup>1,2</sup> ABE | 07   | BELL $e^+e^- \rightarrow J/\psi X$ |
| <sup>1</sup> For X(3940) decaying to final states with more than two tracks.                                      |     |                    |      |                                    |
| <sup>2</sup> PAKHLOV 08 finds that the inclusive peak near 3940 MeV/c <sup>2</sup> may consist of several states. |     |                    |      |                                    |

**X(3940) REFERENCES**

|         |    |                |                          |                 |
|---------|----|----------------|--------------------------|-----------------|
| PAKHLOV | 08 | PRL 100 202001 | P. Pakhlov <i>et al.</i> | (BELLE Collab.) |
| ABE     | 07 | PRL 98 082001  | K. Abe <i>et al.</i>     | (BELLE Collab.) |

NODE=M029

NODE=M029

NODE=M029M

NODE=M029M

OCCUR=2

NODE=M029M;LINKAGE=EB

NODE=M029M;LINKAGE=EM

NODE=M029W

NODE=M029W

NODE=M029215;NODE=M029

DESIG=1;OUR EVAL;→ UNCHECKED ←

DESIG=2;OUR EVAL;→ UNCHECKED ←

DESIG=3;OUR EVAL;→ UNCHECKED ←

NODE=M029225

NODE=M029R01

NODE=M029R01

NODE=M029R01;LINKAGE=AB

NODE=M029R01;LINKAGE=AE

NODE=M029R02

NODE=M029R02

NODE=M029R02;LINKAGE=AB

NODE=M029R02;LINKAGE=AE

NODE=M029R03

NODE=M029R03

NODE=M029R03;LINKAGE=AB

NODE=M029R03;LINKAGE=AE

NODE=M029

REFID=52302

REFID=51627

NODE=M213

**$X(4020)^\pm$**

$I^G(J^{PC}) = 1^+(?^-)$

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

NODE=M213

Charged  $X(4020)$  seen by ABLIKIM 13X from  $e^+e^- \rightarrow \pi^+\pi^-h_c(1P)$  at c.m. energy from 3.90 to 4.42 GeV as a peak in the invariant mass distribution of the  $\pi^\pm h_c(1P)$  system, and by ABLIKIM 14B from  $e^+e^- \rightarrow (D^*\bar{D}^*)^\pm\pi^\mp$  events in  $(D^*\bar{D}^*)^\pm$  mass. A neutral  $X(4020)$  seen by ABLIKIM 14P at three c.m. energies in the same range in  $e^+e^- \rightarrow \pi^0\pi^0h_c(1P)$  as a peak in the larger of the two masses recoiling against a  $\pi^0$ . ABLIKIM 15AA observes a  $5.9\sigma$  signal in  $(D^*\bar{D}^*)^0$  in  $e^+e^- \rightarrow (D^*\bar{D}^*)^0\pi^0$  events using collisions at two c.m. energies. Production rates and mass values support grouping neutral and charged  $X(4020)$  together as manifestations of a single  $I = 1$  particle.

**$X(4020)^\pm$  MASS**

NODE=M213M

| VALUE (MeV)                                 | EVTS | DOCUMENT ID                | TECN | CHG | COMMENT                                        |
|---------------------------------------------|------|----------------------------|------|-----|------------------------------------------------|
| <b>4024.1±1.9 OUR AVERAGE</b>               |      |                            |      |     |                                                |
| 4025.5 <sup>+2.0</sup> <sub>-4.7</sub> ±3.1 | 116  | <sup>1</sup> ABLIKIM 15AA  | BES3 | 0   | $e^+e^- \rightarrow (D^*\bar{D}^*)^0\pi^0$     |
| 4026.3±2.6±3.7                              | 401  | <sup>1</sup> ABLIKIM 14B   | BES3 | ±   | $e^+e^- \rightarrow (D^*\bar{D}^*)^\pm\pi^\mp$ |
| 4023.9±2.2±3.8                              | 61   | <sup>1,2</sup> ABLIKIM 14P | BES3 | 0   | $e^+e^- \rightarrow \pi^0\pi^0h_c$             |
| 4022.9±0.8±2.7                              | 253  | <sup>1</sup> ABLIKIM 13X   | BES3 | ±   | $e^+e^- \rightarrow \pi^+\pi^-h_c$             |

NODE=M213M

<sup>1</sup> Neglecting interference between the  $X(4020)$  and non-resonant continuum.  
<sup>2</sup> Assuming  $J^P = 1^+$  and width of  $7.9 \pm 2.6$  MeV.

NODE=M213M;LINKAGE=AB  
NODE=M213M;LINKAGE=B

**$X(4020)^\pm$  WIDTH**

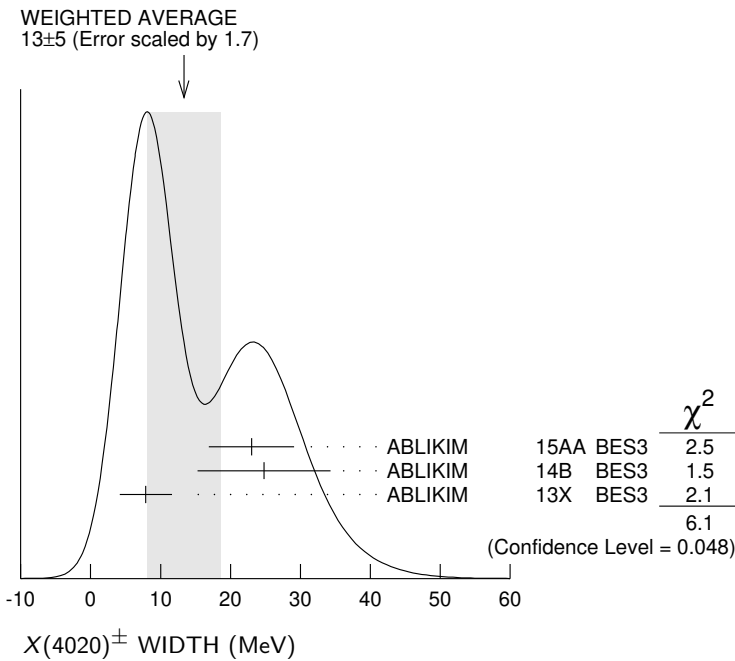
NODE=M213W

| VALUE (MeV)                                                                          | EVTS | DOCUMENT ID               | TECN | CHG | COMMENT                                        |
|--------------------------------------------------------------------------------------|------|---------------------------|------|-----|------------------------------------------------|
| <b>13 ±5 OUR AVERAGE</b> Error includes scale factor of 1.7. See the ideogram below. |      |                           |      |     |                                                |
| 23.0±6.0±1.0                                                                         | 116  | <sup>1</sup> ABLIKIM 15AA | BES3 | 0   | $e^+e^- \rightarrow (D^*\bar{D}^*)^0\pi^0$     |
| 24.8±5.6±7.7                                                                         | 401  | <sup>1</sup> ABLIKIM 14B  | BES3 | ±   | $e^+e^- \rightarrow (D^*\bar{D}^*)^\pm\pi^\mp$ |
| 7.9±2.7±2.6                                                                          | 253  | <sup>1</sup> ABLIKIM 13X  | BES3 | ±   | $e^+e^- \rightarrow \pi^+\pi^-h_c$             |

NODE=M213W

<sup>1</sup> Neglecting interference between the  $X(4020)$  and non-resonant continuum.

NODE=M213W;LINKAGE=AB



**$X(4020)^\pm$  DECAY MODES**

NODE=M213215;NODE=M213

| Mode                                  | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------------|--------------------------------|
| $\Gamma_1$ $h_c(1P)\pi$               | seen                           |
| $\Gamma_2$ $D^*\bar{D}^*$             | seen                           |
| $\Gamma_3$ $D\bar{D}^* + \text{c.c.}$ | not seen                       |
| $\Gamma_4$ $\eta_c\pi^+\pi^-$         | not seen                       |
| $\Gamma_5$ $\eta_c(1S)\rho(770)^\pm$  |                                |
| $\Gamma_6$ $J/\psi(1S)\pi^\pm$        | not seen                       |

DESIG=1

DESIG=2

DESIG=4

DESIG=3

DESIG=6

DESIG=5

 **$X(4020)^\pm$  BRANCHING RATIOS**

NODE=M213225

| $\Gamma(h_c(1P)\pi)/\Gamma_{\text{total}}$ |      |             |      |      |         | $\Gamma_1/\Gamma$                   |
|--------------------------------------------|------|-------------|------|------|---------|-------------------------------------|
| VALUE                                      | EVTS | DOCUMENT ID | TECN | CHG  | COMMENT |                                     |
| seen                                       | 61   | ABLIKIM     | 14P  | BES3 | 0       | $e^+e^- \rightarrow \pi^0\pi^0 h_c$ |
| seen                                       | 253  | ABLIKIM     | 13X  | BES3 | $\pm$   | $e^+e^- \rightarrow \pi^+\pi^- h_c$ |

NODE=M213R01  
NODE=M213R01

| $\Gamma(D^*\bar{D}^*)/\Gamma_{\text{total}}$ |      |                      |      |      |         | $\Gamma_2/\Gamma$                              |
|----------------------------------------------|------|----------------------|------|------|---------|------------------------------------------------|
| VALUE                                        | EVTS | DOCUMENT ID          | TECN | CHG  | COMMENT |                                                |
| seen                                         | 116  | <sup>1</sup> ABLIKIM | 15AA | BES3 | 0       | $e^+e^- \rightarrow (D^*\bar{D}^*)^0\pi^0$     |
| seen                                         | 401  | <sup>1</sup> ABLIKIM | 14B  | BES3 | $\pm$   | $e^+e^- \rightarrow (D^*\bar{D}^*)^\pm\pi^\mp$ |

NODE=M213R02  
NODE=M213R02<sup>1</sup> Neglecting interference between the  $X(4020)$  and non-resonant continuum.

NODE=M213R02;LINKAGE=A

| $\Gamma(D\bar{D}^* + \text{c.c.})/\Gamma_{\text{total}}$ |             |      |      |         |                                              | $\Gamma_3/\Gamma$ |
|----------------------------------------------------------|-------------|------|------|---------|----------------------------------------------|-------------------|
| VALUE                                                    | DOCUMENT ID | TECN | CHG  | COMMENT |                                              |                   |
| not seen                                                 | ABLIKIM     | 15AC | BES3 | $\pm$   | $e^+e^- \rightarrow \pi^\pm(D\bar{D}^*)^\mp$ |                   |

NODE=M213R03  
NODE=M213R03

| $\Gamma(\eta_c\pi^+\pi^-)/\Gamma_{\text{total}}$ |                            |      |                                       |  |  | $\Gamma_4/\Gamma$ |
|--------------------------------------------------|----------------------------|------|---------------------------------------|--|--|-------------------|
| VALUE                                            | DOCUMENT ID                | TECN | COMMENT                               |  |  |                   |
| not seen                                         | <sup>1</sup> VINOKUROVA 15 | BELL | $B^+ \rightarrow K^+\eta_c\pi^+\pi^-$ |  |  |                   |

NODE=M213R00  
NODE=M213R00<sup>1</sup> VINOKUROVA 15 reports  $B(B^+ \rightarrow K^+X(4020)^0) \times B(X \rightarrow \eta_c\pi^+\pi^-) < 1.6 \times 10^{-5}$  at 90% CL.

NODE=M213R00;LINKAGE=VI

| $\Gamma(\eta_c(1S)\rho(770)^\pm)/\Gamma(h_c(1P)\pi)$ |     |                      |      |         |                                                | $\Gamma_5/\Gamma_1$ |
|------------------------------------------------------|-----|----------------------|------|---------|------------------------------------------------|---------------------|
| VALUE                                                | CL% | DOCUMENT ID          | TECN | COMMENT |                                                |                     |
| <1.2                                                 | 90  | <sup>1</sup> ABLIKIM | 19BC | BES3    | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta_c(1S)$ |                     |

NODE=M213R05  
NODE=M213R05<sup>1</sup> Using  $e^+e^- \rightarrow \pi^\mp(Z_c(4020)^\pm \rightarrow h_c(1P)\pi^\pm)$  cross section at 4.23, 4.26 and 4.36 GeV from ABLIKIM 13X.

NODE=M213R05;LINKAGE=A

| $\Gamma(J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$ |                      |      |         |                                       |  | $\Gamma_6/\Gamma$ |
|---------------------------------------------------|----------------------|------|---------|---------------------------------------|--|-------------------|
| VALUE                                             | DOCUMENT ID          | TECN | COMMENT |                                       |  |                   |
| not seen                                          | <sup>1</sup> ABLIKIM | 17J  | BES3    | $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ |  |                   |

NODE=M213R04  
NODE=M213R04<sup>1</sup> From Partial Wave Analysis assuming  $J^P = 1^+$ .

NODE=M213R04;LINKAGE=A

 **$X(4020)^\pm$  REFERENCES**

NODE=M213

|            |      |                        |                             |                  |             |
|------------|------|------------------------|-----------------------------|------------------|-------------|
| ABLIKIM    | 19BC | PR D100 111102         | M. Ablikim <i>et al.</i>    | (BESIII Collab.) | REFID=60036 |
| ABLIKIM    | 17J  | PRL 119 072001         | M. Ablikim <i>et al.</i>    | (BESIII Collab.) | REFID=57950 |
| ABLIKIM    | 15AA | PRL 115 182002         | M. Ablikim <i>et al.</i>    | (BESIII Collab.) | REFID=56951 |
| ABLIKIM    | 15AC | PR D92 092006          | M. Ablikim <i>et al.</i>    | (BESIII Collab.) | REFID=56967 |
| VINOKUROVA | 15   | JHEP 1506 132          | A. Vinokurova <i>et al.</i> | (BELLE Collab.)  | REFID=56706 |
| Also       |      | JHEP 1702 088 (errat.) | A. Vinokurava <i>et al.</i> | (BELLE Collab.)  | REFID=57795 |
| ABLIKIM    | 14B  | PRL 112 132001         | M. Ablikim <i>et al.</i>    | (BESIII Collab.) | REFID=55654 |
| ABLIKIM    | 14P  | PRL 113 212002         | M. Ablikim <i>et al.</i>    | (BESIII Collab.) | REFID=56118 |
| ABLIKIM    | 13X  | PRL 111 242001         | M. Ablikim <i>et al.</i>    | (BESIII Collab.) | REFID=55635 |

$\psi(4040)$ 

$$J^G(J^{PC}) = 0^-(1^{--})$$

NODE=M072

 **$\psi(4040)$  MASS**

| VALUE (MeV)                                                                                                                                                                                                                                                                      | DOCUMENT ID          | TECN     | COMMENT                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|-------------------------------------|
| <b>4039 ± 1 OUR ESTIMATE</b>                                                                                                                                                                                                                                                     |                      |          |                                     |
| <b>4039.6 ± 4.3</b>                                                                                                                                                                                                                                                              | <sup>1</sup> ABLIKIM | 08D BES2 | $e^+e^- \rightarrow \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                    |                      |          |                                     |
| 4034 ± 6                                                                                                                                                                                                                                                                         | <sup>2</sup> MO      | 10 RVUE  | $e^+e^- \rightarrow \text{hadrons}$ |
| 4037 ± 2                                                                                                                                                                                                                                                                         | <sup>3</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$ |
| 4040 ± 1                                                                                                                                                                                                                                                                         | <sup>4</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$ |
| 4040 ± 10                                                                                                                                                                                                                                                                        | BRANDELIK            | 78C DASP | $e^+e^-$                            |
| <sup>1</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the $\psi(3770)$ , $\psi(4040)$ , $\psi(4160)$ , and $\psi(4415)$ resonances. Phase angle fixed in the fit to $\delta = (130 \pm 46)^\circ$ . |                      |          |                                     |
| <sup>2</sup> Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the $\psi(4040)$ , $\psi(4160)$ and $\psi(4415)$ resonances and including interference effects.                                           |                      |          |                                     |
| <sup>3</sup> From a fit to Crystal Ball (OSTERHELD 86) data.                                                                                                                                                                                                                     |                      |          |                                     |
| <sup>4</sup> From a fit to BES (BAI 02C) data.                                                                                                                                                                                                                                   |                      |          |                                     |

NODE=M072M

NODE=M072M  
→ UNCHECKED ←

OCCUR=2

NODE=M072M;LINKAGE=AB

NODE=M072M;LINKAGE=MO

NODE=M072M;LINKAGE=ST  
NODE=M072M;LINKAGE=SE **$\psi(4040)$  WIDTH**

| VALUE (MeV)                                                                                                                                                                                                                                                                      | DOCUMENT ID          | TECN     | COMMENT                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|-------------------------------------|
| <b>80 ± 10 OUR ESTIMATE</b>                                                                                                                                                                                                                                                      |                      |          |                                     |
| <b>84.5 ± 12.3</b>                                                                                                                                                                                                                                                               | <sup>5</sup> ABLIKIM | 08D BES2 | $e^+e^- \rightarrow \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                    |                      |          |                                     |
| 87 ± 11                                                                                                                                                                                                                                                                          | <sup>6</sup> MO      | 10 RVUE  | $e^+e^- \rightarrow \text{hadrons}$ |
| 85 ± 10                                                                                                                                                                                                                                                                          | <sup>7</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$ |
| 89 ± 6                                                                                                                                                                                                                                                                           | <sup>8</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$ |
| 52 ± 10                                                                                                                                                                                                                                                                          | BRANDELIK            | 78C DASP | $e^+e^-$                            |
| <sup>5</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the $\psi(3770)$ , $\psi(4040)$ , $\psi(4160)$ , and $\psi(4415)$ resonances. Phase angle fixed in the fit to $\delta = (130 \pm 46)^\circ$ . |                      |          |                                     |
| <sup>6</sup> Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the $\psi(4040)$ , $\psi(4160)$ and $\psi(4415)$ resonances and including interference effects.                                           |                      |          |                                     |
| <sup>7</sup> From a fit to Crystal Ball (OSTERHELD 86) data.                                                                                                                                                                                                                     |                      |          |                                     |
| <sup>8</sup> From a fit to BES (BAI 02C) data.                                                                                                                                                                                                                                   |                      |          |                                     |

NODE=M072W

NODE=M072W  
→ UNCHECKED ←

OCCUR=2

NODE=M072W;LINKAGE=AB

NODE=M072W;LINKAGE=MO

NODE=M072W;LINKAGE=ST  
NODE=M072W;LINKAGE=SE **$\psi(4040)$  DECAY MODES**

Due to the complexity of the  $c\bar{c}$  threshold region, in this listing, “seen” (“not seen”) means that a cross section for the mode in question has been measured at effective  $\sqrt{s}$  near this particle’s central mass value, more (less) than  $2\sigma$  above zero, without regard to any peaking behavior in  $\sqrt{s}$  or absence thereof. See mode listing(s) for details and references.

NODE=M072215;NODE=M072

NODE=M072

| Mode                                                                                                                     | Fraction ( $\Gamma_i/\Gamma$ )   | Confidence level               |
|--------------------------------------------------------------------------------------------------------------------------|----------------------------------|--------------------------------|
| $\Gamma_1$ $e^+e^-$                                                                                                      | $(1.07 \pm 0.16) \times 10^{-5}$ | DESIG=5                        |
| $\Gamma_2$ $D\bar{D}$                                                                                                    | seen                             | DESIG=17;OUR EST;→ UNCHECKED ← |
| $\Gamma_3$ $D^0\bar{D}^0$                                                                                                | seen                             | DESIG=1                        |
| $\Gamma_4$ $D^+D^-$                                                                                                      | seen                             | DESIG=18                       |
| $\Gamma_5$ $D^*\bar{D} + \text{c.c.}$                                                                                    | seen                             | DESIG=19;OUR EST;→ UNCHECKED ← |
| $\Gamma_6$ $D^*(2007)^0\bar{D}^0 + \text{c.c.}$                                                                          | seen                             | DESIG=2                        |
| $\Gamma_7$ $D^*(2010)^+D^- + \text{c.c.}$                                                                                | seen                             | DESIG=20                       |
| $\Gamma_8$ $D^*\bar{D}^*$                                                                                                | seen                             | DESIG=21;OUR EST;→ UNCHECKED ← |
| $\Gamma_9$ $D^*(2007)^0\bar{D}^*(2007)^0$                                                                                | seen                             | DESIG=3                        |
| $\Gamma_{10}$ $D^*(2010)^+D^*(2010)^-$                                                                                   | seen                             | DESIG=22                       |
| $\Gamma_{11}$ $D\bar{D}\pi$ (excl. $D^*\bar{D}$ )                                                                        |                                  | DESIG=23                       |
| $\Gamma_{12}$ $D^0D^-\pi^+ + \text{c.c.}$ (excl. $D^*(2007)^0\bar{D}^0 + \text{c.c.}$ , $D^*(2010)^+D^- + \text{c.c.}$ ) | not seen                         | DESIG=24                       |
| $\Gamma_{13}$ $D\bar{D}^*\pi$ (excl. $D^*\bar{D}^*$ )                                                                    | not seen                         | DESIG=25                       |

|               |                                                                                   |                                |                  |     |          |
|---------------|-----------------------------------------------------------------------------------|--------------------------------|------------------|-----|----------|
| $\Gamma_{14}$ | $D^0 \bar{D}^{*-} \pi^+ + \text{c.c. (excl. } D^{*+}(2010) D^{*-}(2010) \text{)}$ | seen                           |                  |     | DESIG=26 |
| $\Gamma_{15}$ | $D_s^+ D_s^-$                                                                     | seen                           |                  |     | DESIG=27 |
| $\Gamma_{16}$ | $J/\psi(1S) \text{ hadrons}$                                                      |                                |                  |     | DESIG=4  |
| $\Gamma_{17}$ | $J/\psi \pi^+ \pi^-$                                                              | $< 4$                          | $\times 10^{-3}$ | 90% | DESIG=7  |
| $\Gamma_{18}$ | $J/\psi \pi^0 \pi^0$                                                              | $< 2$                          | $\times 10^{-3}$ | 90% | DESIG=8  |
| $\Gamma_{19}$ | $J/\psi \eta$                                                                     | $(5.2 \pm 0.7) \times 10^{-3}$ |                  |     | DESIG=9  |
| $\Gamma_{20}$ | $J/\psi \pi^0$                                                                    | $< 2.8$                        | $\times 10^{-4}$ | 90% | DESIG=10 |
| $\Gamma_{21}$ | $J/\psi \pi^+ \pi^- \pi^0$                                                        | $< 2$                          | $\times 10^{-3}$ | 90% | DESIG=11 |
| $\Gamma_{22}$ | $\chi_{c1} \gamma$                                                                | $< 3.4$                        | $\times 10^{-3}$ | 90% | DESIG=12 |
| $\Gamma_{23}$ | $\chi_{c2} \gamma$                                                                | $< 5$                          | $\times 10^{-3}$ | 90% | DESIG=13 |
| $\Gamma_{24}$ | $\chi_{c1} \pi^+ \pi^- \pi^0$                                                     | $< 1.1$                        | %                | 90% | DESIG=14 |
| $\Gamma_{25}$ | $\chi_{c2} \pi^+ \pi^- \pi^0$                                                     | $< 3.2$                        | %                | 90% | DESIG=15 |
| $\Gamma_{26}$ | $h_c(1P) \pi^+ \pi^-$                                                             | $< 3$                          | $\times 10^{-3}$ | 90% | DESIG=28 |
| $\Gamma_{27}$ | $\phi \pi^+ \pi^-$                                                                | $< 3$                          | $\times 10^{-3}$ | 90% | DESIG=16 |
| $\Gamma_{28}$ | $\Lambda \bar{\Lambda} \pi^+ \pi^-$                                               | $< 2.9$                        | $\times 10^{-4}$ | 90% | DESIG=29 |
| $\Gamma_{29}$ | $\Lambda \bar{\Lambda} \pi^0$                                                     | $< 9$                          | $\times 10^{-5}$ | 90% | DESIG=30 |
| $\Gamma_{30}$ | $\Lambda \bar{\Lambda} \eta$                                                      | $< 3.0$                        | $\times 10^{-4}$ | 90% | DESIG=31 |
| $\Gamma_{31}$ | $\Sigma^+ \bar{\Sigma}^-$                                                         | $< 1.3$                        | $\times 10^{-4}$ | 90% | DESIG=32 |
| $\Gamma_{32}$ | $\Sigma^0 \bar{\Sigma}^0$                                                         | $< 7$                          | $\times 10^{-5}$ | 90% | DESIG=33 |
| $\Gamma_{33}$ | $\Xi^+ \bar{\Xi}^-$                                                               | $< 1.6$                        | $\times 10^{-4}$ | 90% | DESIG=34 |
| $\Gamma_{34}$ | $\Xi^0 \bar{\Xi}^0$                                                               | $< 1.8$                        | $\times 10^{-4}$ | 90% | DESIG=35 |
| $\Gamma_{35}$ | $\mu^+ \mu^-$                                                                     | $(9 \pm 6) \times 10^{-6}$     |                  |     | DESIG=6  |

 **$\psi(4040)$  PARTIAL WIDTHS**

NODE=M072220

 **$\Gamma(e^+ e^-)$**  **$\Gamma_1$** 

VALUE (keV)

DOCUMENT ID

TECN

COMMENT

 **$0.86 \pm 0.07$  OUR ESTIMATE** **$0.83 \pm 0.20$** <sup>9</sup> ABLIKIM 08D BES2  $e^+ e^- \rightarrow \text{hadrons}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.6 to 1.4

<sup>10</sup> MO 10 RVUE  $e^+ e^- \rightarrow \text{hadrons}$  $0.88 \pm 0.11$ <sup>11</sup> SETH 05A RVUE  $e^+ e^- \rightarrow \text{hadrons}$  $0.91 \pm 0.13$ <sup>12</sup> SETH 05A RVUE  $e^+ e^- \rightarrow \text{hadrons}$  $0.75 \pm 0.15$ BRANDELIK 78C DASP  $e^+ e^-$ 

OCCUR=2

<sup>9</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the  $\psi(3770)$ ,  $\psi(4040)$ ,  $\psi(4160)$ , and  $\psi(4415)$  resonances. Phase angle fixed in the fit to  $\delta = (130 \pm 46)^\circ$ .

NODE=M072W5;LINKAGE=AB

<sup>10</sup> Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the  $\psi(4040)$ ,  $\psi(4160)$  and  $\psi(4415)$  resonances and including interference effects. Four sets of solutions are obtained with the same fit quality, mass and total width, but with different  $e^+ e^-$  partial widths. We quote only the range of values.

NODE=M072W5;LINKAGE=MO

<sup>11</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

NODE=M072W5;LINKAGE=ST

<sup>12</sup> From a fit to BES (BAI 02C) data.

NODE=M072W5;LINKAGE=SE

 **$\Gamma(\mu^+ \mu^-)$**  **$\Gamma_{35}$** 

VALUE (keV)

DOCUMENT ID

TECN

COMMENT

 **$0.73 \pm 0.48 \pm 0.12$** <sup>13,14</sup> ABLIKIM 20AG BES3  $e^+ e^- \rightarrow \mu^+ \mu^-$ 

<sup>13</sup> From a fit to the  $e^+ e^- \rightarrow \mu^+ \mu^-$  cross section between 3.8 and 4.6 GeV to the coherent sum of four resonant amplitudes assuming  $\Gamma(\mu^+ \mu^-) = \Gamma(e^+ e^-)$ .

NODE=M072W2;LINKAGE=A

<sup>14</sup> From solution 1 of 8 with equal fit quality. Other solutions range from  $0.58 \pm 0.52 \pm 0.10$  to  $0.80 \pm 0.48 \pm 0.13$  keV.

NODE=M072W2;LINKAGE=B

 **$\psi(4040) \Gamma(i) \times \Gamma(e^+ e^-) / \Gamma(\text{total})$** 

NODE=M072235

 **$\Gamma(\chi_{c1} \gamma) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$**  **$\Gamma_{22} \Gamma_1 / \Gamma$** 

VALUE (eV)

CL%

DOCUMENT ID

TECN

COMMENT

 **$< 2.9$** 

90

<sup>15</sup> HAN

15

BELL

 $10.58 e^+ e^- \rightarrow \chi_{c1} \gamma$ 

<sup>15</sup> Using  $B(\eta \rightarrow \gamma \gamma) = (39.41 \pm 0.21)\%$ .

NODE=M072G01  
NODE=M072G01

NODE=M072G01;LINKAGE=A



$$\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{23}\Gamma_1/\Gamma$$

| VALUE (eV)     | CL% | DOCUMENT ID       | TECN | COMMENT |
|----------------|-----|-------------------|------|---------|
| <b>&lt;4.6</b> | 90  | <sup>16</sup> HAN | 15   | BELL    |

<sup>16</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M072G02  
NODE=M072G02

NODE=M072G02;LINKAGE=A

$$\Gamma(J/\psi\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{19}\Gamma_1/\Gamma$$

| VALUE (eV) | DOCUMENT ID | TECN | COMMENT |
|------------|-------------|------|---------|
|------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |                       |     |      |                                  |
|---------|-----------------------|-----|------|----------------------------------|
| 1.5±0.3 | <sup>17</sup> ABLIKIM | 200 | BES3 | $e^+e^- \rightarrow \eta J/\psi$ |
| 1.4±0.3 | <sup>18</sup> ABLIKIM | 200 | BES3 | $e^+e^- \rightarrow \eta J/\psi$ |
| 7.0±0.6 | <sup>19</sup> ABLIKIM | 200 | BES3 | $e^+e^- \rightarrow \eta J/\psi$ |

<sup>17</sup> Solution 1 of three equivalent fit solutions using three resonant structures.

<sup>18</sup> Solution 2 of three equivalent fit solutions using three resonant structures.

<sup>19</sup> Solution 3 of three equivalent fit solutions using three resonant structures.

NODE=M072R00  
NODE=M072R00

OCCUR=2

OCCUR=3

NODE=M072R00;LINKAGE=A  
NODE=M072R00;LINKAGE=B  
NODE=M072R00;LINKAGE=C

$$\psi(4040) \Gamma(i) \times \Gamma(e^+e^-)/\Gamma^2(\text{total})$$

NODE=M072230

$$\Gamma(J/\psi\eta)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{19}/\Gamma \times \Gamma_1/\Gamma$$

| VALUE (units 10 <sup>-8</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|              |                    |     |      |                                       |
|--------------|--------------------|-----|------|---------------------------------------|
| 5.1±1.4±1.5  | <sup>20</sup> WANG | 13B | BELL | $e^+e^- \rightarrow J/\psi\eta\gamma$ |
| 12.8±2.1±1.9 | <sup>21</sup> WANG | 13B | BELL | $e^+e^- \rightarrow J/\psi\eta\gamma$ |

<sup>20</sup> Solution I of two equivalent solutions in a fit using two interfering resonances. Mass and width fixed at 4039 MeV and 80 MeV, respectively.

<sup>21</sup> Solution II of two equivalent solutions in a fit using two interfering resonances. Mass and width fixed at 4039 MeV and 80 MeV, respectively.

NODE=M072R25  
NODE=M072R25

OCCUR=2

NODE=M072R25;LINKAGE=A

NODE=M072R25;LINKAGE=B

### $\psi(4040)$ BRANCHING RATIOS

NODE=M072225

$$\Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_1/\Gamma$$

| VALUE (units 10 <sup>-5</sup> ) | DOCUMENT ID | TECN | COMMENT |
|---------------------------------|-------------|------|---------|
|---------------------------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |         |    |      |          |
|-------|---------|----|------|----------|
| ~ 1.0 | FELDMAN | 77 | MRK1 | $e^+e^-$ |
|-------|---------|----|------|----------|

NODE=M072R4  
NODE=M072R4

$$\Gamma(D^0\bar{D}^0)/\Gamma_{\text{total}} \quad \Gamma_3/\Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |                |      |      |                                         |
|------|----------------|------|------|-----------------------------------------|
| seen | AUBERT         | 09M  | BABR | $e^+e^- \rightarrow D^0\bar{D}^0\gamma$ |
| seen | CRONIN-HEN..09 | CLEO |      | $e^+e^- \rightarrow D^0\bar{D}^0$       |
| seen | PAKHLOVA       | 08   | BELL | $e^+e^- \rightarrow D^0\bar{D}^0\gamma$ |

NODE=M072R14  
NODE=M072R14

$$\Gamma(D^+D^-)/\Gamma_{\text{total}} \quad \Gamma_4/\Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |                |      |      |                                   |
|------|----------------|------|------|-----------------------------------|
| seen | AUBERT         | 09M  | BABR | $e^+e^- \rightarrow D^+D^-\gamma$ |
| seen | CRONIN-HEN..09 | CLEO |      | $e^+e^- \rightarrow D^+D^-$       |
| seen | PAKHLOVA       | 08   | BELL | $e^+e^- \rightarrow D^+D^-\gamma$ |

NODE=M072R15  
NODE=M072R15

$$\Gamma(D\bar{D})/\Gamma(D^*\bar{D} + \text{c.c.}) \quad \Gamma_2/\Gamma_5$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|                       |        |     |      |                                            |
|-----------------------|--------|-----|------|--------------------------------------------|
| <b>0.24±0.05±0.12</b> | AUBERT | 09M | BABR | $e^+e^- \rightarrow \gamma D^{(*)}\bar{D}$ |
|-----------------------|--------|-----|------|--------------------------------------------|

NODE=M072R12  
NODE=M072R12

$$\Gamma(D^0\bar{D}^0)/\Gamma(D^*(2007)^0\bar{D}^0 + \text{c.c.}) \quad \Gamma_3/\Gamma_6$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|                  |                         |    |      |          |
|------------------|-------------------------|----|------|----------|
| <b>0.05±0.03</b> | <sup>22</sup> GOLDBABER | 77 | MRK1 | $e^+e^-$ |
|------------------|-------------------------|----|------|----------|

<sup>22</sup> Phase-space factor ( $p^3$ ) explicitly removed.

NODE=M072R1  
NODE=M072R1

NODE=M072R;LINKAGE=P

$$\Gamma(D^*(2007)^0\bar{D}^0 + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_6/\Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |                |      |      |                                            |
|------|----------------|------|------|--------------------------------------------|
| seen | AUBERT         | 09M  | BABR | $e^+e^- \rightarrow D^{*0}\bar{D}^0\gamma$ |
| seen | CRONIN-HEN..09 | CLEO |      | $e^+e^- \rightarrow D^{*0}\bar{D}^0$       |

NODE=M072R16  
NODE=M072R16

$\Gamma(D^*(2010)^+ D^- + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_7/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID              | TECN | COMMENT                                 |
|-------------------------------------------------------------------------------|--------------------------|------|-----------------------------------------|
| <b>seen</b>                                                                   | <sup>23</sup> ZHUKOVA 18 | BELL | $e^+ e^- \rightarrow D^{*+} D^- \gamma$ |
| <b>seen</b>                                                                   | AUBERT 09M               | BABR | $e^+ e^- \rightarrow D^{*+} D^- \gamma$ |
| <b>seen</b>                                                                   | CRONIN-HEN..09           | CLEO | $e^+ e^- \rightarrow D^{*+} D^-$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |                                         |
| <b>seen</b>                                                                   | PAKHLOVA 07              | BELL | $e^+ e^- \rightarrow D^{*+} D^- \gamma$ |
| <sup>23</sup> Supersedes PAKHLOVA 07.                                         |                          |      |                                         |

NODE=M072R17  
NODE=M072R17  
OCCUR=3

 $\Gamma(D^*(2010)^+ D^- + \text{c.c.})/\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.})$ 
 $\Gamma_7/\Gamma_6$ 

| VALUE                     | DOCUMENT ID | TECN | COMMENT                                       |
|---------------------------|-------------|------|-----------------------------------------------|
| <b>0.95 ± 0.09 ± 0.10</b> | AUBERT 09M  | BABR | $e^+ e^- \rightarrow \gamma D^{*+} \bar{D}^0$ |

NODE=M072R11  
NODE=M072R11

 $\Gamma(D^* \bar{D}^*)/\Gamma(D^* \bar{D} + \text{c.c.})$ 
 $\Gamma_8/\Gamma_5$ 

| VALUE                     | DOCUMENT ID | TECN | COMMENT                                            |
|---------------------------|-------------|------|----------------------------------------------------|
| <b>0.18 ± 0.14 ± 0.03</b> | AUBERT 09M  | BABR | $e^+ e^- \rightarrow \gamma D^{(*)} \bar{D}^{(*)}$ |

NODE=M072R13  
NODE=M072R13

 $\Gamma(D^*(2007)^0 \bar{D}^*(2007)^0)/\Gamma_{\text{total}}$ 
 $\Gamma_9/\Gamma$ 

| VALUE       | DOCUMENT ID    | TECN | COMMENT                                          |
|-------------|----------------|------|--------------------------------------------------|
| <b>seen</b> | AUBERT 09M     | BABR | $e^+ e^- \rightarrow D^{*0} \bar{D}^{*0} \gamma$ |
| <b>seen</b> | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^{*0} \bar{D}^{*0}$        |

NODE=M072R18  
NODE=M072R18

 $\Gamma(D^*(2007)^0 \bar{D}^*(2007)^0)/\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.})$ 
 $\Gamma_9/\Gamma_6$ 

| VALUE              | DOCUMENT ID                | TECN | COMMENT   |
|--------------------|----------------------------|------|-----------|
| <b>32.0 ± 12.0</b> | <sup>24</sup> GOLDHABER 77 | MRK1 | $e^+ e^-$ |

NODE=M072R2  
NODE=M072R2

<sup>24</sup> Phase-space factor ( $p^3$ ) explicitly removed.

NODE=M072R2;LINKAGE=P

 $\Gamma(D^*(2010)^+ D^*(2010)^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{10}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID              | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|--------------------------|------|--------------------------------------------|
| <b>seen</b>                                                                   | <sup>25</sup> ZHUKOVA 18 | BELL | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| <b>seen</b>                                                                   | AUBERT 09M               | BABR | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| <b>seen</b>                                                                   | CRONIN-HEN..09           | CLEO | $e^+ e^- \rightarrow D^{*+} D^{*-}$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                          |      |                                            |
| <b>seen</b>                                                                   | PAKHLOVA 07              | BELL | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| <sup>25</sup> Supersedes PAKHLOVA 07.                                         |                          |      |                                            |

NODE=M072R19  
NODE=M072R19  
OCCUR=2

NODE=M072R19;LINKAGE=B

 $\Gamma(D^0 D^- \pi^+ + \text{c.c. (excl. } D^*(2007)^0 \bar{D}^0 + \text{c.c., } D^*(2010)^+ D^- + \text{c.c.}))/\Gamma_{\text{total}}$ 
 $\Gamma_{12}/\Gamma$ 

| VALUE           | DOCUMENT ID  | TECN | COMMENT                                    |
|-----------------|--------------|------|--------------------------------------------|
| <b>not seen</b> | PAKHLOVA 08A | BELL | $e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma$ |

NODE=M072R20  
NODE=M072R20

 $\Gamma(D \bar{D}^* \pi (\text{excl. } D^* \bar{D}^*))/\Gamma_{\text{total}}$ 
 $\Gamma_{13}/\Gamma$ 

| VALUE           | DOCUMENT ID    | TECN | COMMENT                               |
|-----------------|----------------|------|---------------------------------------|
| <b>not seen</b> | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D \bar{D}^* \pi$ |

NODE=M072R21  
NODE=M072R21

 $\Gamma(D^0 \bar{D}^{*-} \pi^+ + \text{c.c. (excl. } D^*(2010)^+ D^*(2010)^-))/\Gamma_{\text{total}}$ 
 $\Gamma_{14}/\Gamma$ 

| VALUE       | DOCUMENT ID | TECN | COMMENT                                       |
|-------------|-------------|------|-----------------------------------------------|
| <b>seen</b> | PAKHLOVA 09 | BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+ \gamma$ |

NODE=M072R22  
NODE=M072R22

 $\Gamma(D_s^+ D_s^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{15}/\Gamma$ 

| VALUE       | DOCUMENT ID     | TECN | COMMENT                                  |
|-------------|-----------------|------|------------------------------------------|
| <b>seen</b> | PAKHLOVA 11     | BELL | $e^+ e^- \rightarrow D_s^+ D_s^- \gamma$ |
| <b>seen</b> | DEL-AMO-SA..10N | BABR | $e^+ e^- \rightarrow D_s^+ D_s^- \gamma$ |
| <b>seen</b> | CRONIN-HEN..09  | CLEO | $e^+ e^- \rightarrow D_s^+ D_s^-$        |

NODE=M072R23  
NODE=M072R23

 $\Gamma(J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{17}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                        |
|--------------------------|-----|-------------|------|------------------------------------------------|
| <b>&lt;4</b>             | 90  | COAN 06     | CLEO | $3.97-4.06 e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M072R01  
NODE=M072R01

 $\Gamma(J/\psi \pi^0 \pi^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{18}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                        |
|--------------------------|-----|-------------|------|------------------------------------------------|
| <b>&lt;2</b>             | 90  | COAN 06     | CLEO | $3.97-4.06 e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M072R02  
NODE=M072R02

$\Gamma(J/\psi\eta)/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ 

| VALUE (units $10^{-3}$ )                | CL% | DOCUMENT ID           | TECN     | COMMENT                                  |
|-----------------------------------------|-----|-----------------------|----------|------------------------------------------|
| <b><math>5.2 \pm 0.5 \pm 0.5</math></b> | 90  | <sup>26</sup> ABLIKIM | 12K BES3 | $e^+e^- \rightarrow \ell^+\ell^-2\gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<7 90 COAN 06 CLEO 3.97–4.06  $e^+e^- \rightarrow$  hadrons

<sup>26</sup> ABLIKIM 12K measure  $\sigma(e^+e^- \rightarrow J/\psi\eta) = 32.1 \pm 2.8 \pm 1.3$  pb. They assume the  $\eta J/\psi$  fully originates from  $\psi(4040)$  decays.

NODE=M072R03  
NODE=M072R03

NODE=M072R03;LINKAGE=AB

 $\Gamma(J/\psi\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{20}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID           | TECN     | COMMENT                                  |
|--------------------------|-----|-----------------------|----------|------------------------------------------|
| <b>&lt;0.28</b>          | 90  | <sup>27</sup> ABLIKIM | 12K BES3 | $e^+e^- \rightarrow \ell^+\ell^-2\gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<2 90 COAN 06 CLEO 3.97–4.06  $e^+e^- \rightarrow$  hadrons

<sup>27</sup> ABLIKIM 12K measure  $\sigma(e^+e^- \rightarrow J/\psi\pi^0) < 1.6$  pb. They assume the  $\eta J/\psi$  fully originates from  $\psi(4040)$  decays.

NODE=M072R04  
NODE=M072R04

NODE=M072R04;LINKAGE=AB

 $\Gamma(J/\psi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                                |
|--------------------------|-----|-------------|---------|----------------------------------------|
| <b>&lt;2</b>             | 90  | COAN        | 06 CLEO | 3.97–4.06 $e^+e^- \rightarrow$ hadrons |

NODE=M072R05  
NODE=M072R05

 $\Gamma(\chi_{c1}\gamma)/\Gamma_{\text{total}}$  $\Gamma_{22}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                                |
|--------------------------|-----|-------------|---------|----------------------------------------|
| <11                      | 90  | COAN        | 06 CLEO | 3.97–4.06 $e^+e^- \rightarrow$ hadrons |

• • • We do not use the following data for averages, fits, limits, etc. • • •

NODE=M072R06  
NODE=M072R06

 $\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$  $\Gamma_{23}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                                |
|--------------------------|-----|-------------|---------|----------------------------------------|
| <17                      | 90  | COAN        | 06 CLEO | 3.97–4.06 $e^+e^- \rightarrow$ hadrons |

• • • We do not use the following data for averages, fits, limits, etc. • • •

NODE=M072R07  
NODE=M072R07

 $\Gamma(\chi_{c1}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                                |
|--------------------------|-----|-------------|---------|----------------------------------------|
| <b>&lt;11</b>            | 90  | COAN        | 06 CLEO | 3.97–4.06 $e^+e^- \rightarrow$ hadrons |

NODE=M072R08  
NODE=M072R08

 $\Gamma(\chi_{c2}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                                |
|--------------------------|-----|-------------|---------|----------------------------------------|
| <b>&lt;32</b>            | 90  | COAN        | 06 CLEO | 3.97–4.06 $e^+e^- \rightarrow$ hadrons |

NODE=M072R09  
NODE=M072R09

 $\Gamma(h_c(1P)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID          | TECN    | COMMENT                                |
|--------------------------|-----|----------------------|---------|----------------------------------------|
| <b>&lt;3</b>             | 90  | <sup>28</sup> PEDLAR | 11 CLEO | $e^+e^- \rightarrow h_c(1P)\pi^+\pi^-$ |

<sup>28</sup> From several values of  $\sqrt{s}$  near the peak of the  $\psi(4040)$ , PEDLAR 11 measures  $\sigma(e^+e^- \rightarrow h_c(1P)\pi^+\pi^-) = 1.0 \pm 8.0 \pm 5.4 \pm 0.2$  pb, where the errors are statistical, systematic, and due to uncertainty in  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$ , respectively.

NODE=M072R24  
NODE=M072R24

NODE=M072R24;LINKAGE=PE

 $\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN    | COMMENT                                |
|--------------------------|-----|-------------|---------|----------------------------------------|
| <b>&lt;3</b>             | 90  | COAN        | 06 CLEO | 3.97–4.06 $e^+e^- \rightarrow$ hadrons |

NODE=M072R10  
NODE=M072R10

 $\Gamma(\Lambda\bar{\Lambda}\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{28}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID           | TECN     | COMMENT                         |
|--------------------------|-----|-----------------------|----------|---------------------------------|
| <b>&lt;2.9</b>           | 90  | <sup>29</sup> ABLIKIM | 13Q BES3 | $e^+e^- \rightarrow \psi(4040)$ |

<sup>29</sup> Assuming that interference effects between resonance and continuum can be neglected.

NODE=M072R26  
NODE=M072R26

NODE=M072R26;LINKAGE=A

 $\Gamma(\Lambda\bar{\Lambda}\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID           | TECN     | COMMENT                         |
|--------------------------|-----|-----------------------|----------|---------------------------------|
| <b>&lt;0.9</b>           | 90  | <sup>30</sup> ABLIKIM | 13Q BES3 | $e^+e^- \rightarrow \psi(4040)$ |

<sup>30</sup> Assuming that interference effects between resonance and continuum can be neglected.

NODE=M072R27  
NODE=M072R27

NODE=M072R27;LINKAGE=A

$\Gamma(\Lambda\bar{\Lambda}\eta)/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                         |
|--------------------------|-----|-------------|----------|---------------------------------|
| <3.0                     | 90  | 31 ABLIKIM  | 13Q BES3 | $e^+e^- \rightarrow \psi(4040)$ |

31 Assuming that interference effects between resonance and continuum can be neglected.

NODE=M072R28  
NODE=M072R28

NODE=M072R28;LINKAGE=A

 $\Gamma(\Sigma^+\bar{\Sigma}^-)/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                         |
|--------------------------|-----|-------------|----------|---------------------------------|
| <1.3                     | 90  | 32 ABLIKIM  | 13Q BES3 | $e^+e^- \rightarrow \psi(4040)$ |

32 Assuming that interference effects between resonance and continuum can be neglected.

NODE=M072R29  
NODE=M072R29

NODE=M072R29;LINKAGE=A

 $\Gamma(\Sigma^0\bar{\Sigma}^0)/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                         |
|--------------------------|-----|-------------|----------|---------------------------------|
| <0.7                     | 90  | 33 ABLIKIM  | 13Q BES3 | $e^+e^- \rightarrow \psi(4040)$ |

33 Assuming that interference effects between resonance and continuum can be neglected.

NODE=M072R30  
NODE=M072R30

NODE=M072R30;LINKAGE=A

 $\Gamma(\Xi^+\bar{\Xi}^-)/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                         |
|--------------------------|-----|-------------|----------|---------------------------------|
| <1.6                     | 90  | 34 ABLIKIM  | 13Q BES3 | $e^+e^- \rightarrow \psi(4040)$ |

34 Assuming that interference effects between resonance and continuum can be neglected.

NODE=M072R31  
NODE=M072R31

NODE=M072R31;LINKAGE=A

 $\Gamma(\Xi^0\bar{\Xi}^0)/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                         |
|--------------------------|-----|-------------|----------|---------------------------------|
| <1.8                     | 90  | 35 ABLIKIM  | 13Q BES3 | $e^+e^- \rightarrow \psi(4040)$ |

35 Assuming that interference effects between resonance and continuum can be neglected.

NODE=M072R32  
NODE=M072R32

NODE=M072R32;LINKAGE=A

## $\psi(4040)$ REFERENCES

|               |      |                |                                  |                             |             |
|---------------|------|----------------|----------------------------------|-----------------------------|-------------|
| ABLIKIM       | 20AG | PR D102 112009 | M. Ablikim <i>et al.</i>         | (BESIII Collab.)            | REFID=60744 |
| ABLIKIM       | 20O  | PR D102 031101 | M. Ablikim <i>et al.</i>         | (BESIII Collab.)            | REFID=60344 |
| ZHUKOVA       | 18   | PR D97 012002  | V. Zhukova <i>et al.</i>         | (BELLE Collab.)             | REFID=58710 |
| HAN           | 15   | PR D92 012011  | Y.L. Han <i>et al.</i>           | (BELLE Collab.)             | REFID=56816 |
| ABLIKIM       | 13Q  | PR D87 112011  | Ablikim M. <i>et al.</i>         | (BESIII Collab.)            | REFID=55393 |
| WANG          | 13B  | PR D87 051101  | X.L. Wang <i>et al.</i>          | (BELLE Collab.)             | REFID=55377 |
| ABLIKIM       | 12K  | PR D86 071101  | M. Ablikim <i>et al.</i>         | (BESIII Collab.)            | REFID=54738 |
| PAKHLOVA      | 11   | PR D83 011101  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)             | REFID=53638 |
| PEDLAR        | 11   | PRL 107 041803 | T. Pedlar <i>et al.</i>          | (CLEO Collab.)              | REFID=16787 |
| DEL-AMO-SA... | 10N  | PR D82 052004  | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)             | REFID=53532 |
| MO            | 10   | PR D82 077501  | X.H. Mo, C.Z. Yuan, P. Wang      | (BHEP)                      | REFID=53540 |
| AUBERT        | 09M  | PR D79 092001  | B. Aubert <i>et al.</i>          | (BABAR Collab.)             | REFID=52724 |
| CRONIN-HEN... | 09   | PR D80 072001  | D. Cronin-Hennessy <i>et al.</i> | (CLEO Collab.)              | REFID=53114 |
| PAKHLOVA      | 09   | PR D80 091101  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)             | REFID=53143 |
| ABLIKIM       | 08D  | PL B660 315    | M. Ablikim <i>et al.</i>         | (BES Collab.)               | REFID=52142 |
| PAKHLOVA      | 08   | PR D77 011103  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)             | REFID=52132 |
| PAKHLOVA      | 08A  | PRL 100 062001 | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)             | REFID=52134 |
| PAKHLOVA      | 07   | PRL 98 092001  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)             | REFID=51628 |
| COAN          | 06   | PRL 96 162003  | T.E. Coan <i>et al.</i>          | (CLEO Collab.)              | REFID=51075 |
| SETH          | 05A  | PR D72 017501  | K.K. Seth                        |                             | REFID=50813 |
| BAI           | 02C  | PRL 88 101802  | J.Z. Bai <i>et al.</i>           | (BES Collab.)               | REFID=50506 |
| BAI           | 00   | PRL 84 594     | J.Z. Bai <i>et al.</i>           | (BES Collab.)               | REFID=50503 |
| OSTERHELD     | 86   | SLAC-PUB-4160  | A. Osterheld <i>et al.</i>       | (SLAC Crystal Ball Collab.) | REFID=51064 |
| BRANDELIK     | 78C  | PL 76B 361     | R. Brandelik <i>et al.</i>       | (DASP Collab.)              | REFID=22232 |
| Also          |      | ZPHY C1 233    | R. Brandelik <i>et al.</i>       | (DASP Collab.)              | REFID=22114 |
| FELDMAN       | 77   | PRPL 33C 285   | G.J. Feldman, M.L. Perl          | (LBL, SLAC)                 | REFID=22062 |
| GOLDHABER     | 77   | PL 69B 503     | G. Goldhaber <i>et al.</i>       | (Mark I Collab.)            | REFID=11434 |

NODE=M072

X(4050)<sup>±</sup>

$I^G(J^{PC}) = 1^-(?^{?+})$   
 $I, G, C$  need confirmation.

OMITTED FROM SUMMARY TABLE

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

Observed by MIZUK 08 in the  $\pi^+\chi_{c1}(1P)$  invariant mass distribution in  $\bar{B}^0 \rightarrow K^-\pi^+\chi_{c1}(1P)$  decays. Not seen by LEES 12B in this same mode after accounting for  $K\pi$  resonant mass and angular structure.

NODE=M191

NODE=M191

X(4050)<sup>±</sup> MASS

NODE=M191M

| VALUE (MeV)                                                                | DOCUMENT ID        | TECN | COMMENT                                            |
|----------------------------------------------------------------------------|--------------------|------|----------------------------------------------------|
| 4051±14 <sup>+20</sup> <sub>-41</sub>                                      | <sup>1</sup> MIZUK | 08   | BELL $\bar{B}^0 \rightarrow K^-\pi^+\chi_{c1}(1P)$ |
| <sup>1</sup> From a Dalitz plot analysis with two Breit-Wigner amplitudes. |                    |      |                                                    |

NODE=M191M

NODE=M191M;LINKAGE=MI

X(4050)<sup>±</sup> WIDTH

NODE=M191W

| VALUE (MeV)                                                                | DOCUMENT ID        | TECN | COMMENT                                            |
|----------------------------------------------------------------------------|--------------------|------|----------------------------------------------------|
| 82 <sup>+21+47</sup> <sub>-17-22</sub>                                     | <sup>1</sup> MIZUK | 08   | BELL $\bar{B}^0 \rightarrow K^-\pi^+\chi_{c1}(1P)$ |
| <sup>1</sup> From a Dalitz plot analysis with two Breit-Wigner amplitudes. |                    |      |                                                    |

NODE=M191W

NODE=M191W;LINKAGE=MI

X(4050)<sup>±</sup> DECAY MODES

NODE=M191215;NODE=M191

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1$ $\pi^+\chi_{c1}(1P)$ | seen                           |
| $\Gamma_2$ $\pi^\pm\psi(3770)$  | not seen                       |

DESIG=1

DESIG=2

X(4050)<sup>±</sup> BRANCHING RATIOS

NODE=M191225

| $\Gamma(\pi^+\chi_{c1}(1P))/\Gamma_{\text{total}}$                                                                                                                                                          | $\Gamma_1/\Gamma$  |      |                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|----------------------------------------------------|
| VALUE                                                                                                                                                                                                       | DOCUMENT ID        | TECN | COMMENT                                            |
| seen                                                                                                                                                                                                        | <sup>1</sup> MIZUK | 08   | BELL $\bar{B}^0 \rightarrow K^-\pi^+\chi_{c1}(1P)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                               |                    |      |                                                    |
| not seen                                                                                                                                                                                                    | <sup>2</sup> LEES  | 12B  | BABR $B \rightarrow K\pi\chi_{c1}(1P)$             |
| <sup>1</sup> With a product branching fraction measurement of $B(\bar{B}^0 \rightarrow K^-\chi_{c1}(1P)) \times B(X(4050)^+ \rightarrow \pi^+\chi_{c1}(1P)) = (3.0^{+1.5+3.7}_{-0.8-1.6}) \times 10^{-5}$ . |                    |      |                                                    |
| <sup>2</sup> With a product branching fraction limit of $B(\bar{B}^0 \rightarrow X(4050)^+K^-) \times B(X(4050)^+ \rightarrow \chi_{c1}\pi^+) < 1.8 \times 10^{-5}$ at 90% CL.                              |                    |      |                                                    |

NODE=M191R01  
NODE=M191R01

NODE=M191R01;LINKAGE=MI

NODE=M191R01;LINKAGE=LE

| $\Gamma(\pi^\pm\psi(3770))/\Gamma_{\text{total}}$                                                                         | $\Gamma_2/\Gamma$    |           |                                         |
|---------------------------------------------------------------------------------------------------------------------------|----------------------|-----------|-----------------------------------------|
| VALUE                                                                                                                     | DOCUMENT ID          | TECN      | COMMENT                                 |
| not seen                                                                                                                  | <sup>1</sup> ABLIKIM | 19AR BES3 | $e^+e^- \rightarrow \pi^+\pi^-D\bar{D}$ |
| <sup>1</sup> From a measurement of $\sigma(e^+e^- \rightarrow \pi^+\pi^-D\bar{D})$ between $\sqrt{s} = 4.08$ and 4.6 GeV. |                      |           |                                         |

NODE=M191R00  
NODE=M191R00

NODE=M191R00;LINKAGE=A

X(4050)<sup>±</sup> REFERENCES

NODE=M191

|         |      |                |                          |                  |
|---------|------|----------------|--------------------------|------------------|
| ABLIKIM | 19AR | PR D100 032005 | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| LEES    | 12B  | PR D85 052003  | J.P. Lees <i>et al.</i>  | (BABAR Collab.)  |
| MIZUK   | 08   | PR D78 072004  | R. Mizuk <i>et al.</i>   | (BELLE Collab.)  |

REFID=59910  
REFID=54042  
REFID=52535

**$X(4055)^\pm$** 
 $I^G(J^{PC}) = 1^+(?^-)$   
 $I, G, C$  need confirmation.

## OMITTED FROM SUMMARY TABLE

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

Needs confirmation. Seen by WANG 15A in the  $\psi(2S)\pi^+\pi^-$  invariant mass distribution in  $\psi(4360) \rightarrow \psi(2S)\pi^+\pi^-$  decay.

NODE=M223

NODE=M223

 **$X(4055)^\pm$  MASS**

| VALUE (MeV)                                                                   | DOCUMENT ID          | TECN     | COMMENT                                             |
|-------------------------------------------------------------------------------|----------------------|----------|-----------------------------------------------------|
| <b>4054 <math>\pm 3 \pm 1</math></b>                                          | <sup>1</sup> WANG    | 15A BELL | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |          |                                                     |
| 4039.3 $\pm 6.0$                                                              | <sup>2</sup> ABLIKIM | 18K BES3 | $e^+e^- \rightarrow \pi^0\pi^0\psi(2S)$             |
| 4032.1 $\pm 2.4$                                                              | <sup>3</sup> ABLIKIM | 17V BES3 | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$             |

<sup>1</sup> Statistical significance of 3.5  $\sigma$ .

<sup>2</sup> Statistical error only, with significance of 5.9  $\sigma$  (from a fit with a 19% CL). Identified as the same structure observed in ABLIKIM 17V in  $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$  decays.

<sup>3</sup> Statistical error only, with significance of 9.2  $\sigma$ . From an unbinned maximum likelihood fit of the  $\pi^+\pi^-\psi(2S)$  Dalitz plot from data collected at  $\sqrt{s} = 4.416$  GeV for a  $J^C = 1^+$  state. The fit does not match the detailed structure of the data, having a C.L. of only 8%.

NODE=M223M

NODE=M223M

OCCUR=2

NODE=M223M;LINKAGE=A

NODE=M223M;LINKAGE=C

NODE=M223M;LINKAGE=B

 **$X(4055)^\pm$  WIDTH**

| VALUE (MeV)                                                                   | DOCUMENT ID          | TECN     | COMMENT                                             |
|-------------------------------------------------------------------------------|----------------------|----------|-----------------------------------------------------|
| <b>45 <math>\pm 11 \pm 6</math></b>                                           | <sup>1</sup> WANG    | 15A BELL | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |          |                                                     |
| 31.9 $\pm 14.8$                                                               | <sup>2</sup> ABLIKIM | 18K BES3 | $e^+e^- \rightarrow \pi^0\pi^0\psi(2S)$             |
| 26.1 $\pm 5.3$                                                                | <sup>3</sup> ABLIKIM | 17V BES3 | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$             |

<sup>1</sup> Statistical significance of 3.5  $\sigma$ .

<sup>2</sup> Statistical error only, with significance of 5.9  $\sigma$  (from a fit with a 19% CL). Identified as the same structure observed in ABLIKIM 17V in  $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$  decays.

<sup>3</sup> Statistical error only, with significance of 9.2  $\sigma$ . From an unbinned maximum likelihood fit of the  $\pi^+\pi^-\psi(2S)$  Dalitz plot from data collected at  $\sqrt{s} = 4.416$  GeV for a  $J^C = 1^+$  state. The fit does not match the detailed structure of the data, having a C.L. of only 8%.

NODE=M223W

NODE=M223W

NODE=M223W;LINKAGE=A

NODE=M223W;LINKAGE=C

NODE=M223W;LINKAGE=B

 **$X(4055)^\pm$  DECAY MODES**

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------|--------------------------------|
| $\Gamma_1$ $\pi^+\psi(2S)$     | seen                           |
| $\Gamma_2$ $\pi^\pm\psi(3770)$ | not seen                       |

NODE=M223215;NODE=M223

DESIG=1

DESIG=2

 **$X(4055)^\pm$  BRANCHING RATIOS**

| $\Gamma(\pi^+\psi(2S))/\Gamma_{\text{total}}$ |                    |             |                | $\Gamma_1/\Gamma$                                   |
|-----------------------------------------------|--------------------|-------------|----------------|-----------------------------------------------------|
| <u>VALUE</u>                                  | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                                                     |
| <b>seen</b>                                   | <sup>1</sup> WANG  | 15A         | BELL           | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |

<sup>1</sup> Statistical significance of 3.5  $\sigma$ .

NODE=M223225

NODE=M223R01

NODE=M223R01

NODE=M223R01;LINKAGE=A

| $\Gamma(\pi^\pm\psi(3770))/\Gamma_{\text{total}}$ | $\Gamma_2/\Gamma$    |           |                                         |
|---------------------------------------------------|----------------------|-----------|-----------------------------------------|
| VALUE                                             | DOCUMENT ID          | TECN      | COMMENT                                 |
| <b>not seen</b>                                   | <sup>1</sup> ABLIKIM | 19AR BES3 | $e^+e^- \rightarrow \pi^+\pi^-D\bar{D}$ |

<sup>1</sup> From a measurement of  $\sigma(e^+e^- \rightarrow \pi^+\pi^-D\bar{D})$  between  $\sqrt{s} = 4.08$  and 4.6 GeV.

NODE=M223R00

NODE=M223R00

NODE=M223R00;LINKAGE=A

 **$X(4055)^\pm$  REFERENCES**

|         |      |                         |                          |                  |
|---------|------|-------------------------|--------------------------|------------------|
| ABLIKIM | 19AR | PR D100 032005          | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| ABLIKIM | 18K  | PR D97 052001           | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| ABLIKIM | 17V  | PR D96 032004           | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| Also    |      | PR D99 019903 (errata.) | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| WANG    | 15A  | PR D91 112007           | X.L. Wang <i>et al.</i>  | (BELLE Collab.)  |

NODE=M223

REFID=59910

REFID=58896

REFID=58029

REFID=59611

REFID=56839

**$X(4100)^\pm$** 

$$I^G(J^{PC}) = 1^-(?^{??})$$

NODE=M240

## OMITTED FROM SUMMARY TABLE

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

NODE=M240

Reported by AAIJ 18AN in the  $\eta_c(1S)\pi^-$  invariant mass distribution in  $B^0 \rightarrow \eta_c(1S)K^+\pi^-$  decays with a significance of  $3.4\sigma$ .  $J^P = 0^+$  or  $1^-$  assignment consistent with data.

 **$X(4100)^\pm$  MASS**

NODE=M240M

| VALUE (MeV)               | DOCUMENT ID | TECN      | COMMENT                              |
|---------------------------|-------------|-----------|--------------------------------------|
| $4096 \pm 20^{+18}_{-22}$ | AAIJ        | 18AN LHCb | $B^0 \rightarrow \eta_c(1S)K^+\pi^-$ |

NODE=M240M

 **$X(4100)^\pm$  WIDTH**

NODE=M240W

| VALUE (MeV)              | DOCUMENT ID | TECN      | COMMENT                              |
|--------------------------|-------------|-----------|--------------------------------------|
| $152 \pm 58^{+60}_{-35}$ | AAIJ        | 18AN LHCb | $B^0 \rightarrow \eta_c(1S)K^+\pi^-$ |

NODE=M240W

 **$X(4100)^\pm$  DECAY MODES**

NODE=M240215;NODE=M240

| Mode                               | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------------|--------------------------------|
| $\Gamma_1 \quad \eta_c(1S)\pi^-$   | seen                           |
| $\Gamma_2 \quad \pi^\pm\psi(3770)$ | not seen                       |

DESIG=1

DESIG=2

 **$X(4100)^\pm$  BRANCHING RATIOS**

NODE=M240225

| $\Gamma(\eta_c(1S)\pi^-)/\Gamma_{\text{total}}$                                                                                                                               | $\Gamma_1/\Gamma$ |           |                                      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------|--------------------------------------|
| VALUE                                                                                                                                                                         | DOCUMENT ID       | TECN      | COMMENT                              |
| <b>seen</b>                                                                                                                                                                   | <sup>1</sup> AAIJ | 18AN LHCb | $B^0 \rightarrow \eta_c(1S)K^+\pi^-$ |
| <sup>1</sup> AAIJ 18AN quotes a fit fraction for $B^0 \rightarrow X(4100)^-K^+ \rightarrow \eta_c(1S)\pi^-K^+$ of $(3.3 \pm 1.1^{+1.2}_{-1.1})\%$ from an amplitude analysis. |                   |           |                                      |

NODE=M240R01  
NODE=M240R01

NODE=M240R01;LINKAGE=A

| $\Gamma(\pi^\pm\psi(3770))/\Gamma_{\text{total}}$                                                                           | $\Gamma_2/\Gamma$    |             |                                         |
|-----------------------------------------------------------------------------------------------------------------------------|----------------------|-------------|-----------------------------------------|
| <u>VALUE</u>                                                                                                                | <u>DOCUMENT ID</u>   | <u>TECN</u> | <u>COMMENT</u>                          |
| <b>not seen</b>                                                                                                             | <sup>1</sup> ABLIKIM | 19AR BES3   | $e^+e^- \rightarrow \pi^+\pi^-D\bar{D}$ |
| <sup>1</sup> From a measurement of $\sigma(e^+e^- \rightarrow \pi^+\pi^-D\bar{D})$ between $\sqrt{s} = 4.08$ and $4.6$ GeV. |                      |             |                                         |

NODE=M240R00  
NODE=M240R00

NODE=M240R00;LINKAGE=A

 **$X(4100)^\pm$  REFERENCES**

NODE=M240

|         |                     |                          |                  |
|---------|---------------------|--------------------------|------------------|
| ABLIKIM | 19AR PR D100 032005 | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| AAIJ    | 18AN EPJ C78 1019   | R. Aaij <i>et al.</i>    | (LHCb Collab.)   |

REFID=59910  
REFID=59335

$\chi_{c1}(4140)$ 

$$J^G(J^{PC}) = 0^+(1^{++})$$

was  $X(4140)$ 

This state shows properties different from a conventional  $q\bar{q}$  state.  
A candidate for an exotic structure. See the review on non- $q\bar{q}$  states.

Seen by AALTONEN 09AH, ABAZOV 14A, CHATRCHYAN 14M, AAIJ 17C in  $B^+ \rightarrow \chi_{c1} K^+$ ,  $\chi_{c1} \rightarrow J/\psi \phi$ , and by ABAZOV 15M separately in both prompt ( $4.7 \sigma$ ) and non-prompt ( $5.6 \sigma$ ) production in  $p\bar{p} \rightarrow J/\psi \phi + \text{anything}$ . Not seen by SHEN 10 in  $\gamma\gamma \rightarrow J/\psi \phi$  and ABLIKIM 15 in  $e^+e^- \rightarrow \gamma J/\psi \phi$  at  $\sqrt{s} = 4.23, 4.26, 4.36$  GeV.

NODE=M193

NODE=M193

 **$\chi_{c1}(4140)$  MASS**

NODE=M193M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                         | TECN     | COMMENT                                              |
|-------------------------------------------------------------------------------|------|-------------------------------------|----------|------------------------------------------------------|
| <b>4146.8<math>\pm</math>2.4 OUR AVERAGE</b>                                  |      | Error includes scale factor of 1.1. |          |                                                      |
| 4146.5 $\pm$ 4.5 $^{+4.6}_{-2.8}$                                             | 4289 | <sup>1</sup> AAIJ                   | 17C LHCb | $B^+ \rightarrow J/\psi \phi K^+$                    |
| 4143.4 $^{+2.9}_{-3.0}$ $\pm$ 0.6                                             | 19   | <sup>2</sup> AALTONEN               | 17 CDF   | $B^+ \rightarrow J/\psi \phi K^+$                    |
| 4152.5 $\pm$ 1.7 $^{+6.2}_{-5.4}$                                             | 616  | <sup>3</sup> ABAZOV                 | 15M D0   | $p\bar{p} \rightarrow J/\psi \phi + \text{anything}$ |
| 4159.0 $\pm$ 4.3 $\pm$ 6.6                                                    | 52   | <sup>4</sup> ABAZOV                 | 14A D0   | $B^+ \rightarrow J/\psi \phi K^+$                    |
| 4148.0 $\pm$ 2.4 $\pm$ 6.3                                                    | 0.3k | <sup>5</sup> CHATRCHYAN 14M         | CMS      | $B^+ \rightarrow J/\psi \phi K^+$                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                     |          |                                                      |
| 4143.0 $\pm$ 2.9 $\pm$ 1.2                                                    | 14   | <sup>6,7</sup> AALTONEN             | 09AH CDF | $B^+ \rightarrow J/\psi \phi K^+$                    |

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of  $8.4 \sigma$ .

<sup>2</sup> Statistical significance of more than  $5 \sigma$ .

<sup>3</sup> Statistical significance of more than  $6 \sigma$ .

<sup>4</sup> Statistical significance of  $3.1 \sigma$ .

<sup>5</sup> From a fit assuming an  $S$ -wave relativistic Breit-Wigner shape above a three-body phase-space non-resonant component with statistical significance of more than  $5 \sigma$ .

<sup>6</sup> Statistical significance of  $3.8 \sigma$ .

<sup>7</sup> Superseded by AALTONEN 17.

NODE=M193M;LINKAGE=D  
NODE=M193M;LINKAGE=E  
NODE=M193M;LINKAGE=C  
NODE=M193M;LINKAGE=A  
NODE=M193M;LINKAGE=B

NODE=M193M;LINKAGE=AA  
NODE=M193M;LINKAGE=F

 **$\chi_{c1}(4140)$  WIDTH**

NODE=M193W

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                              |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|----------|------------------------------------------------------|
| <b>22 <math>^{+8}_{-7}</math> OUR AVERAGE</b>                                 |      | Error includes scale factor of 1.3. See the ideogram below. |          |                                                      |
| 83 $\pm$ 21 $^{+21}_{-14}$                                                    | 4289 | <sup>1</sup> AAIJ                                           | 17C LHCb | $B^+ \rightarrow J/\psi \phi K^+$                    |
| 15.3 $^{+10.4}_{-6.1}$ $\pm$ 2.5                                              | 19   | <sup>2</sup> AALTONEN                                       | 17 CDF   | $B^+ \rightarrow J/\psi \phi K^+$                    |
| 16.3 $\pm$ 5.6 $\pm$ 11.4                                                     | 616  | <sup>3</sup> ABAZOV                                         | 15M D0   | $p\bar{p} \rightarrow J/\psi \phi + \text{anything}$ |
| 20 $\pm$ 13 $^{+3}_{-8}$                                                      | 52   | <sup>4</sup> ABAZOV                                         | 14A D0   | $B^+ \rightarrow J/\psi \phi K^+$                    |
| 28 $^{+15}_{-11}$ $\pm$ 19                                                    | 0.3k | <sup>5</sup> CHATRCHYAN 14M                                 | CMS      | $B^+ \rightarrow J/\psi \phi K^+$                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                             |          |                                                      |
| 11.7 $^{+8.3}_{-5.0}$ $\pm$ 3.7                                               | 14   | <sup>6,7</sup> AALTONEN                                     | 09AH CDF | $B^+ \rightarrow J/\psi \phi K^+$                    |

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of  $8.4 \sigma$ .

<sup>2</sup> Statistical significance of more than  $5 \sigma$ .

<sup>3</sup> Statistical significance of more than  $6 \sigma$ .

<sup>4</sup> Statistical significance of  $3.1 \sigma$ .

<sup>5</sup> From a fit assuming an  $S$ -wave relativistic Breit-Wigner shape above a three-body phase-space non-resonant component with statistical significance of more than  $5 \sigma$ .

<sup>6</sup> Statistical significance of  $3.8 \sigma$ .

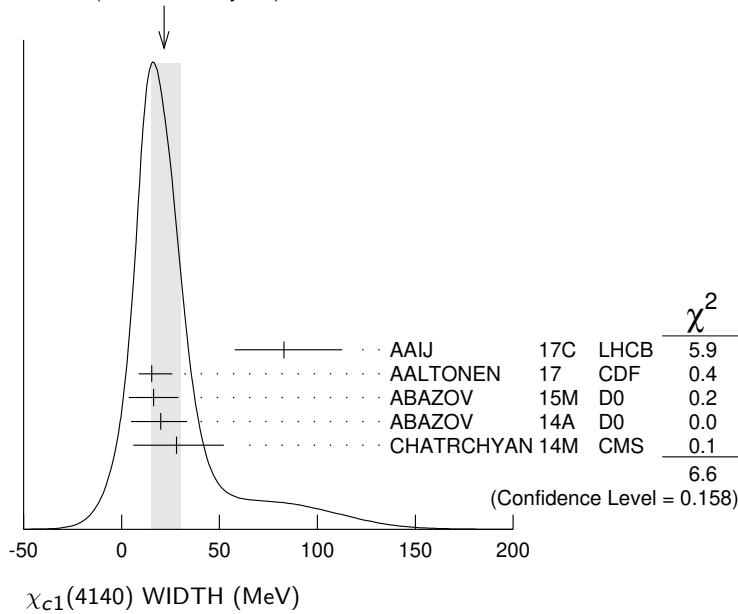
<sup>7</sup> Superseded by AALTONEN 17.

NODE=M193W;LINKAGE=D  
NODE=M193W;LINKAGE=E  
NODE=M193W;LINKAGE=C  
NODE=M193W;LINKAGE=A  
NODE=M193W;LINKAGE=B

NODE=M193W;LINKAGE=AA  
NODE=M193W;LINKAGE=F



WEIGHTED AVERAGE  
22+8-7 (Error scaled by 1.3)



### $\chi_{c1}(4140)$ DECAY MODES

NODE=M193215;NODE=M193

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $J/\psi\phi$   | seen                           |
| $\Gamma_2$ $\gamma\gamma$ | not seen                       |

DESIG=1

DESIG=2

### $\chi_{c1}(4140)$ $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

NODE=M193220

| $\Gamma(\gamma\gamma) \times \Gamma(J/\psi\phi)/\Gamma_{\text{total}}$        |     |                   |      |         | $\Gamma_2\Gamma_1/\Gamma$                   |
|-------------------------------------------------------------------------------|-----|-------------------|------|---------|---------------------------------------------|
| VALUE (eV)                                                                    | CL% | DOCUMENT ID       | TECN | COMMENT |                                             |
| <b>&lt;41</b>                                                                 | 90  | <sup>1</sup> SHEN | 10   | BELL    | 10.6 $e^+e^- \rightarrow e^+e^- J/\psi\phi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                   |      |         |                                             |
| <b>&lt; 6</b>                                                                 | 90  | <sup>2</sup> SHEN | 10   | BELL    | 10.6 $e^+e^- \rightarrow e^+e^- J/\psi\phi$ |
| <sup>1</sup> For $J^P = 0^+$ .                                                |     |                   |      |         |                                             |
| <sup>2</sup> For $J^P = 2^+$ .                                                |     |                   |      |         |                                             |

NODE=M193G01  
NODE=M193G01

OCCUR=2

NODE=M193G01;LINKAGE=S0  
NODE=M193G01;LINKAGE=S2

### $\chi_{c1}(4140)$ BRANCHING RATIOS

NODE=M193225

| $\Gamma(J/\psi\phi)/\Gamma_{\text{total}}$                                    |      |                         |      |         | $\Gamma_1/\Gamma$                                   |
|-------------------------------------------------------------------------------|------|-------------------------|------|---------|-----------------------------------------------------|
| VALUE                                                                         | EVTS | DOCUMENT ID             | TECN | COMMENT |                                                     |
| seen                                                                          | 4289 | <sup>1</sup> AAIJ       | 17C  | LHCB    | $B^+ \rightarrow J/\psi\phi K^+$                    |
| seen                                                                          | 616  | <sup>2</sup> ABAZOV     | 15M  | D0      | $p\bar{p} \rightarrow J/\psi\phi + \text{anything}$ |
| <b>seen</b>                                                                   | 52   | <sup>3</sup> ABAZOV     | 14A  | D0      | $B^+ \rightarrow J/\psi\phi K^+$                    |
| <b>seen</b>                                                                   | 0.3k | <sup>4</sup> CHATRCHYAN | 14M  | CMS     | $B^+ \rightarrow J/\psi\phi K^+$                    |
| <b>seen</b>                                                                   | 14   | <sup>5</sup> AALTONEN   | 09AH | CDF     | $B^+ \rightarrow J/\psi\phi K^+$                    |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |      |                         |      |         |                                                     |
| not seen                                                                      |      | <sup>6</sup> ABLIKIM    | 15   | BES3    | $e^+e^- \rightarrow \gamma\phi J/\psi$              |
| not seen                                                                      |      | <sup>7</sup> AAIJ       | 12AA | LHCB    | $p\bar{p} \rightarrow B^+ X$ at 7 TeV               |

NODE=M193R01  
NODE=M193R01

- From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi\phi K^+$  with a significance of 8.4  $\sigma$ .
- Statistical significance of more than 6  $\sigma$ .
- ABAZOV 14A reports  $B(B^+ \rightarrow \chi_{c1}(4140) K^+ \rightarrow J/\psi\phi K^+)/B(B^+ \rightarrow J/\psi\phi K^+) = (19 \pm 7 \pm 4)\%$  with 3.1  $\sigma$  significance.
- From a fit assuming an S-wave relativistic Breit-Wigner shape above a three-body phase-space non-resonant component with statistical significance of more than 5  $\sigma$ .
- Statistical significance of 3.8  $\sigma$ .
- Reported  $\sigma(e^+e^- \rightarrow \gamma\chi_{c1}(4140)) \cdot B(\chi_{c1}(4140) \rightarrow J/\psi\phi) < 0.35, 0.28, \text{ and } 0.33$  pb at 4.23, 4.26, and 4.36 GeV, respectively, at 90% CL.
- Reported  $B(B^+ \rightarrow \chi_{c1}(4140) K^+) \cdot B(\chi_{c1}(4140) \rightarrow J/\psi\phi)/B(B^+ \rightarrow J/\psi\phi K^+) < 0.07$  at 90% CL.

NODE=M193R01;LINKAGE=E  
NODE=M193R01;LINKAGE=D  
NODE=M193R01;LINKAGE=A

NODE=M193R01;LINKAGE=C

NODE=M193R01;LINKAGE=AA  
NODE=M193R01;LINKAGE=B

NODE=M193R01;LINKAGE=AI

$\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ 

VALUE

not seen

DOCUMENT ID

SHEN

TECN

10

COMMENT

10.6  $e^+e^- \rightarrow e^+e^- J/\psi\phi$  $\Gamma_2/\Gamma$ 

NODE=M193R02

NODE=M193R02

 $\chi_{c1}(4140)$  REFERENCES

|            |      |                 |                             |                   |
|------------|------|-----------------|-----------------------------|-------------------|
| AAIJ       | 17C  | PRL 118 022003  | R. Aaij <i>et al.</i>       | (LHCb Collab.) JP |
| Also       |      | PR D95 012002   | R. Aaij <i>et al.</i>       | (LHCb Collab.)    |
| AALTONEN   | 17   | MPL A32 1750139 | T. Altonen <i>et al.</i>    | (CDF Collab.)     |
| ABAZOV     | 15M  | PRL 115 232001  | V.M. Abazov <i>et al.</i>   | (D0 Collab.)      |
| ABLIKIM    | 15   | PR D91 032002   | M. Ablikim <i>et al.</i>    | (BESIII Collab.)  |
| ABAZOV     | 14A  | PR D89 012004   | V.M. Abazov <i>et al.</i>   | (D0 Collab.)      |
| CHATRCHYAN | 14M  | PL B734 261     | S. Chatrchyan <i>et al.</i> | (CMS Collab.)     |
| AAIJ       | 12AA | PR D85 091103   | R. Aaij <i>et al.</i>       | (LHCb Collab.)    |
| SHEN       | 10   | PRL 104 112004  | C.P. Shen <i>et al.</i>     | (BELLE Collab.)   |
| AALTONEN   | 09AH | PRL 102 242002  | T. Aaltonen <i>et al.</i>   | (CDF Collab.)     |

NODE=M193

REFID=57657  
 REFID=57636  
 REFID=58161  
 REFID=56957  
 REFID=56368  
 REFID=55650  
 REFID=55753  
 REFID=54263  
 REFID=53235  
 REFID=52968

 $\psi(4160)$ 

$$I^G(J^{PC}) = 0^-(1^{--})$$

NODE=M025

 $\psi(4160)$  MASS

VALUE (MeV)

**4191 ± 5 OUR AVERAGE**

DOCUMENT ID

TECN

COMMENT

4191  $\begin{smallmatrix} +9 \\ -8 \end{smallmatrix}$ 

AAIJ

13BC LHCb

 $B^+ \rightarrow K^+ \mu^+ \mu^-$ 

4191.7 ± 6.5

<sup>1</sup> ABLIKIM

08D BES2

 $e^+e^- \rightarrow \text{hadrons}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

4193 ± 7

<sup>2</sup> MO

10 RVUE

 $e^+e^- \rightarrow \text{hadrons}$ 

4151 ± 4

<sup>3</sup> SETH

05A RVUE

 $e^+e^- \rightarrow \text{hadrons}$ 

4155 ± 5

<sup>4</sup> SETH

05A RVUE

 $e^+e^- \rightarrow \text{hadrons}$ 

4159 ± 20

BRANDELIK

78C DASP

 $e^+e^-$ 

<sup>1</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the  $\psi(3770)$ ,  $\psi(4040)$ ,  $\psi(4160)$ , and  $\psi(4415)$  resonances. Phase angle fixed in the fit to  $\delta = (293 \pm 57)^\circ$ .

<sup>2</sup> Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the  $\psi(4040)$ ,  $\psi(4160)$  and  $\psi(4415)$  resonances and including interference effects.

<sup>3</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>4</sup> From a fit to BES (BAI 02C) data.

NODE=M025M

NODE=M025M

OCCUR=2

NODE=M025M;LINKAGE=AB

NODE=M025M;LINKAGE=MO

NODE=M025M;LINKAGE=ST

NODE=M025M;LINKAGE=SE

 $\psi(4160)$  WIDTH

VALUE (MeV)

**70 ± 10 OUR AVERAGE**

DOCUMENT ID

TECN

COMMENT

65  $\begin{smallmatrix} +22 \\ -16 \end{smallmatrix}$ 

AAIJ

13BC LHCb

 $B^+ \rightarrow K^+ \mu^+ \mu^-$ 

71.8 ± 12.3

<sup>1</sup> ABLIKIM

08D BES2

 $e^+e^- \rightarrow \text{hadrons}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

79 ± 14

<sup>2</sup> MO

10 RVUE

 $e^+e^- \rightarrow \text{hadrons}$ 

107 ± 10

<sup>3</sup> SETH

05A RVUE

 $e^+e^- \rightarrow \text{hadrons}$ 

107 ± 16

<sup>4</sup> SETH

05A RVUE

 $e^+e^- \rightarrow \text{hadrons}$ 

78 ± 20

BRANDELIK

78C DASP

 $e^+e^-$ 

<sup>1</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the  $\psi(3770)$ ,  $\psi(4040)$ ,  $\psi(4160)$ , and  $\psi(4415)$  resonances. Phase angle fixed in the fit to  $\delta = (293 \pm 57)^\circ$ .

<sup>2</sup> Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the  $\psi(4040)$ ,  $\psi(4160)$  and  $\psi(4415)$  resonances and including interference effects.

<sup>3</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>4</sup> From a fit to BES (BAI 02C) data.

NODE=M025W

NODE=M025W

OCCUR=2

NODE=M025W;LINKAGE=AB

NODE=M025W;LINKAGE=MO

NODE=M025W;LINKAGE=ST

NODE=M025W;LINKAGE=SE

**$\psi(4160)$  DECAY MODES**

Due to the complexity of the  $c\bar{c}$  threshold region, in this listing, “seen” (“not seen”) means that a cross section for the mode in question has been measured at effective  $\sqrt{s}$  near this particle’s central mass value, more (less) than  $2\sigma$  above zero, without regard to any peaking behavior in  $\sqrt{s}$  or absence thereof. See mode listing(s) for details and references.

NODE=M025215;NODE=M025

NODE=M025

| Mode                                                                                                                 | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |                                 |
|----------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------|---------------------------------|
| $\Gamma_1$ $e^+e^-$                                                                                                  | $(6.9 \pm 3.3) \times 10^{-6}$ |                  | DESIG=1                         |
| $\Gamma_2$ $\mu^+\mu^-$                                                                                              | seen                           |                  | DESIG=33                        |
| $\Gamma_3$ $D\bar{D}$                                                                                                | seen                           |                  | DESIG=15;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_4$ $D^0\bar{D}^0$                                                                                            | seen                           |                  | DESIG=16                        |
| $\Gamma_5$ $D^+D^-$                                                                                                  | seen                           |                  | DESIG=17                        |
| $\Gamma_6$ $D^*\bar{D} + \text{c.c.}$                                                                                | seen                           |                  | DESIG=18;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_7$ $D^*(2007)^0\bar{D}^0 + \text{c.c.}$                                                                      | seen                           |                  | DESIG=19                        |
| $\Gamma_8$ $D^*(2010)^+D^- + \text{c.c.}$                                                                            | seen                           |                  | DESIG=20                        |
| $\Gamma_9$ $D^*\bar{D}^*$                                                                                            | seen                           |                  | DESIG=21;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{10}$ $D^*(2007)^0\bar{D}^*(2007)^0$                                                                         | seen                           |                  | DESIG=22                        |
| $\Gamma_{11}$ $D^*(2010)^+D^*(2010)^-$                                                                               | seen                           |                  | DESIG=23                        |
| $\Gamma_{12}$ $D^0D^-\pi^+ + \text{c.c. (excl. } D^*(2007)^0\bar{D}^0 + \text{c.c., } D^*(2010)^+D^- + \text{c.c.})$ | not seen                       |                  | DESIG=24                        |
| $\Gamma_{13}$ $D\bar{D}^*\pi + \text{c.c. (excl. } D^*\bar{D}^*)$                                                    | seen                           |                  | DESIG=25                        |
| $\Gamma_{14}$ $D^0D^{*-}\pi^+ + \text{c.c. (excl. } D^*(2010)^+D^*(2010)^-)$                                         | not seen                       |                  | DESIG=26                        |
| $\Gamma_{15}$ $D_s^+D_s^-$                                                                                           | not seen                       |                  | DESIG=27                        |
| $\Gamma_{16}$ $D_s^{*+}D_s^- + \text{c.c.}$                                                                          | seen                           |                  | DESIG=28                        |
| $\Gamma_{17}$ $J/\psi\pi^+\pi^-$                                                                                     | $< 3 \times 10^{-3}$           | 90%              | DESIG=2                         |
| $\Gamma_{18}$ $J/\psi\pi^0\pi^0$                                                                                     | $< 3 \times 10^{-3}$           | 90%              | DESIG=3                         |
| $\Gamma_{19}$ $J/\psi K^+K^-$                                                                                        | $< 2 \times 10^{-3}$           | 90%              | DESIG=4                         |
| $\Gamma_{20}$ $J/\psi\eta$                                                                                           | $< 8 \times 10^{-3}$           | 90%              | DESIG=5                         |
| $\Gamma_{21}$ $J/\psi\pi^0$                                                                                          | $< 1 \times 10^{-3}$           | 90%              | DESIG=6                         |
| $\Gamma_{22}$ $J/\psi\eta'$                                                                                          | $< 5 \times 10^{-3}$           | 90%              | DESIG=7                         |
| $\Gamma_{23}$ $J/\psi\pi^+\pi^-\pi^0$                                                                                | $< 1 \times 10^{-3}$           | 90%              | DESIG=8                         |
| $\Gamma_{24}$ $\psi(2S)\pi^+\pi^-$                                                                                   | $< 4 \times 10^{-3}$           | 90%              | DESIG=9                         |
| $\Gamma_{25}$ $\chi_{c1}\gamma$                                                                                      | $< 5 \times 10^{-3}$           | 90%              | DESIG=10                        |
| $\Gamma_{26}$ $\chi_{c2}\gamma$                                                                                      | $< 1.3 \%$                     | 90%              | DESIG=11                        |
| $\Gamma_{27}$ $\chi_{c1}\pi^+\pi^-\pi^0$                                                                             | $< 2 \times 10^{-3}$           | 90%              | DESIG=12                        |
| $\Gamma_{28}$ $\chi_{c2}\pi^+\pi^-\pi^0$                                                                             | $< 8 \times 10^{-3}$           | 90%              | DESIG=13                        |
| $\Gamma_{29}$ $h_c(1P)\pi^+\pi^-$                                                                                    | $< 5 \times 10^{-3}$           | 90%              | DESIG=29                        |
| $\Gamma_{30}$ $h_c(1P)\pi^0\pi^0$                                                                                    | $< 2 \times 10^{-3}$           | 90%              | DESIG=30                        |
| $\Gamma_{31}$ $h_c(1P)\eta$                                                                                          | $< 2 \times 10^{-3}$           | 90%              | DESIG=31                        |
| $\Gamma_{32}$ $h_c(1P)\pi^0$                                                                                         | $< 4 \times 10^{-4}$           | 90%              | DESIG=32                        |
| $\Gamma_{33}$ $\phi\pi^+\pi^-$                                                                                       | $< 2 \times 10^{-3}$           | 90%              | DESIG=14                        |
| $\Gamma_{34}$ $\gamma\chi_{c1}(3872)$                                                                                | $< 2.0 \times 10^{-3}$         | 90%              | DESIG=44                        |
| $\Gamma_{35}$ $\gamma X(3915) \rightarrow \gamma J/\psi\pi^+\pi^-$                                                   | $< 1.36 \times 10^{-4}$        | 90%              | DESIG=35                        |
| $\Gamma_{36}$ $\gamma X(3930) \rightarrow \gamma J/\psi\pi^+\pi^-$                                                   | $< 1.18 \times 10^{-4}$        | 90%              | DESIG=36                        |
| $\Gamma_{37}$ $\gamma X(3940) \rightarrow \gamma J/\psi\pi^+\pi^-$                                                   | $< 1.47 \times 10^{-4}$        | 90%              | DESIG=37                        |
| $\Gamma_{38}$ $\gamma X(3915) \rightarrow \gamma\gamma J/\psi$                                                       | $< 1.26 \times 10^{-4}$        | 90%              | DESIG=39                        |
| $\Gamma_{39}$ $\gamma X(3930) \rightarrow \gamma\gamma J/\psi$                                                       | $< 8.8 \times 10^{-5}$         | 90%              | DESIG=40                        |
| $\Gamma_{40}$ $\gamma X(3940) \rightarrow \gamma\gamma J/\psi$                                                       | $< 1.79 \times 10^{-4}$        | 90%              | DESIG=41                        |
| $\Gamma_{41}$ $K^+K^-$                                                                                               |                                |                  | DESIG=42                        |
| $\Gamma_{42}$ $K_S^0 K^\pm \pi^\mp$                                                                                  |                                |                  | DESIG=43                        |
| $\Gamma_{43}$ $p\bar{p}p\bar{p}$                                                                                     | not seen                       |                  | DESIG=45                        |

$\psi(4160)$  PARTIAL WIDTHS $\Gamma(e^+e^-)$  $\Gamma_1$ 

| VALUE (keV)                                                                   | DOCUMENT ID          | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------|----------------------|----------|-------------------------------------|
| <b>0.48±0.22</b>                                                              | <sup>1</sup> ABLIKIM | 08D BES2 | $e^+e^- \rightarrow \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |          |                                     |
| 0.4 to 1.1                                                                    | <sup>2</sup> MO      | 10 RVUE  | $e^+e^- \rightarrow \text{hadrons}$ |
| 0.83±0.08                                                                     | <sup>3</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$ |
| 0.84±0.13                                                                     | <sup>4</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$ |
| 0.77±0.23                                                                     | BRANDELIK            | 78C DASP | $e^+e^-$                            |

<sup>1</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the  $\psi(3770)$ ,  $\psi(4040)$ ,  $\psi(4160)$ , and  $\psi(4415)$  resonances. Phase angle fixed in the fit to  $\delta = (293 \pm 57)^\circ$ .

<sup>2</sup> Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the  $\psi(4040)$ ,  $\psi(4160)$  and  $\psi(4415)$  resonances and including interference effects. Four sets of solutions are obtained with the same fit quality, mass and total width, but with different  $e^+e^-$  partial widths. We quote only the range of values.

<sup>3</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>4</sup> From a fit to BES (BAI 02C) data.

NODE=M025220

NODE=M025W1  
NODE=M025W1

OCCUR=2

NODE=M025W1;LINKAGE=AB

NODE=M025W1;LINKAGE=MO

NODE=M025W1;LINKAGE=ST

NODE=M025W1;LINKAGE=SE

 $\Gamma(\mu^+\mu^-)$  $\Gamma_2$ 

| VALUE (keV)           | DOCUMENT ID            | TECN      | COMMENT                         |
|-----------------------|------------------------|-----------|---------------------------------|
| <b>2.45±1.24±0.94</b> | <sup>1,2</sup> ABLIKIM | 20AG BES3 | $e^+e^- \rightarrow \mu^+\mu^-$ |

<sup>1</sup> From a fit to the  $e^+e^- \rightarrow \mu^+\mu^-$  cross section between 3.8 and 4.6 GeV to the coherent sum of four resonant amplitudes assuming  $\Gamma(\mu^+\mu^-) = \Gamma(e^+e^-)$ .

<sup>2</sup> From solution 1 of 8 with equal fit quality. Other solutions range from  $2.08 \pm 0.99 \pm 0.80$  to  $2.45 \pm 1.24 \pm 0.94$  keV.

NODE=M025W2  
NODE=M025W2

NODE=M025W2;LINKAGE=A

NODE=M025W2;LINKAGE=B

 $\psi(4160) \Gamma(i) \times \Gamma(e^+e^-)/\Gamma(\text{total})$ 

NODE=M025235

 $\Gamma(J/\psi\eta') \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{22}\Gamma_1/\Gamma$ 

| VALUE (eV) | EVTs | DOCUMENT ID            | TECN     | COMMENT                           |
|------------|------|------------------------|----------|-----------------------------------|
| 0.17±0.04  | 86   | <sup>1,2</sup> ABLIKIM | 20A BES3 | $e^+e^- \rightarrow \eta' J/\psi$ |
| 1.07±0.09  | 86   | <sup>1,3</sup> ABLIKIM | 20A BES3 | $e^+e^- \rightarrow \eta' J/\psi$ |

<sup>1</sup> Based on a fit to  $\sigma(e^+e^- \rightarrow \eta' J/\psi)$  from  $\sqrt{s} = 4.18$  to 4.60 GeV assuming interfering  $\psi(4160)$  and  $\psi(4260)$  contributions. At  $\sqrt{s} = 4.18$  GeV,  $\sigma(e^+e^- \rightarrow \eta' J/\psi) = 2.4 \pm 0.3 \pm 0.2$  pb.

<sup>2</sup> Solution I of the fit, corresponding to a phase of  $-0.03 \pm 0.44$  rad.

<sup>3</sup> Solution II of the fit, corresponding to a phase of  $2.54 \pm 0.04$  rad.

NODE=M025R42  
NODE=M025R42

OCCUR=2

NODE=M025R42;LINKAGE=A

NODE=M025R42;LINKAGE=B

NODE=M025R42;LINKAGE=C

 $\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{25}\Gamma_1/\Gamma$ 

| VALUE (eV)     | CL% | DOCUMENT ID      | TECN    | COMMENT                                    |
|----------------|-----|------------------|---------|--------------------------------------------|
| <b>&lt;2.2</b> | 90  | <sup>1</sup> HAN | 15 BELL | $10.58 e^+e^- \rightarrow \chi_{c1}\gamma$ |

<sup>1</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M025G01  
NODE=M025G01

NODE=M025G01;LINKAGE=A

 $\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{26}\Gamma_1/\Gamma$ 

| VALUE (eV) | CL% | DOCUMENT ID      | TECN    | COMMENT                                    |
|------------|-----|------------------|---------|--------------------------------------------|
| <6.1       | 90  | <sup>1</sup> HAN | 15 BELL | $10.58 e^+e^- \rightarrow \chi_{c2}\gamma$ |

<sup>1</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M025G02  
NODE=M025G02

NODE=M025G02;LINKAGE=A

 $\Gamma(K_S^0 K^\pm \pi^\mp) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$  $\Gamma_{42}\Gamma_1/\Gamma$ 

| VALUE (eV)           | DOCUMENT ID          | TECN      | COMMENT                                  |
|----------------------|----------------------|-----------|------------------------------------------|
| 2.71 ± 0.13 ± 0.12   | <sup>1</sup> ABLIKIM | 19AE BES3 | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$ |
| 0.0095±0.0088±0.0004 | <sup>2</sup> ABLIKIM | 19AE BES3 | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$ |

<sup>1</sup> Solution I of the fit including the  $\psi(4160)$  with mass  $4191 \pm 5$  MeV and width  $70 \pm 10$  MeV from PDG 16 and the  $\psi(4230)$  with mass  $4219.6 \pm 3.3 \pm 5.1$  MeV and width  $56.0 \pm 3.6 \pm 6.9$  MeV from GAO 17.

<sup>2</sup> Solution II of the fit including the  $\psi(4160)$  with mass  $4191 \pm 5$  MeV and width  $70 \pm 10$  MeV from PDG 16 and the  $\psi(4230)$  with mass  $4219.6 \pm 3.3 \pm 5.1$  MeV and width  $56.0 \pm 3.6 \pm 6.9$  MeV from GAO 17.

NODE=M025R00  
NODE=M025R00

OCCUR=5

NODE=M025R00;LINKAGE=A

NODE=M025R00;LINKAGE=D

$\psi(4160) \Gamma(i) \times \Gamma(e^+ e^-) / \Gamma^2(\text{total})$ 

NODE=M025230

 $\Gamma(J/\psi\eta) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_{20} / \Gamma \times \Gamma_1 / \Gamma$ NODE=M025R32  
NODE=M025R32VALUE (units  $10^{-8}$ )

DOCUMENT ID

TECN

COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

 $2.8 \pm 0.9 \pm 0.9$ <sup>1</sup> WANG

13B

BELL

 $e^+ e^- \rightarrow J/\psi \eta \gamma$  $12.8 \pm 1.7 \pm 2.0$ <sup>2</sup> WANG

13B

BELL

 $e^+ e^- \rightarrow J/\psi \eta \gamma$ 

OCCUR=2

<sup>1</sup> Solution I of two equivalent solutions in a fit using two interfering resonances. Mass and width fixed at 4153 MeV and 103 MeV, respectively.

NODE=M025R32;LINKAGE=A

<sup>2</sup> Solution II of two equivalent solutions in a fit using two interfering resonances. Mass and width fixed at 4153 MeV and 103 MeV, respectively.

NODE=M025R32;LINKAGE=B

 $\psi(4160) \text{ BRANCHING RATIOS}$ 

NODE=M025225

 $\Gamma(\mu^+ \mu^-) / \Gamma_{\text{total}}$  $\Gamma_2 / \Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

seen

<sup>1</sup> AAIJ

13BC

LHCB

 $B^+ \rightarrow K^+ \mu^+ \mu^-$ NODE=M025R31  
NODE=M025R31<sup>1</sup> AAIJ 13BC report  $B(B^+ \rightarrow K^+ \psi(4160)) B(\psi(4160) \rightarrow \mu^+ \mu^-) = (3.5^{+0.9}_{-0.8}) \times 10^{-9}$ .

NODE=M025R31;LINKAGE=A

 $\Gamma(D\bar{D}) / \Gamma(D^* \bar{D}^*)$  $\Gamma_3 / \Gamma_9$ 

VALUE

DOCUMENT ID

TECN

COMMENT

 $0.02 \pm 0.03 \pm 0.02$ 

AUBERT

09M

BABR

 $e^+ e^- \rightarrow \gamma D^{(*)} \bar{D}^{(*)}$ NODE=M025R14  
NODE=M025R14 $\Gamma(D^0 \bar{D}^0) / \Gamma_{\text{total}}$  $\Gamma_4 / \Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

seen

CRONIN-HEN..09

CLEO

 $e^+ e^- \rightarrow D^0 \bar{D}^0$ 

seen

PAKHLOVA

08

BELL

 $e^+ e^- \rightarrow D^0 \bar{D}^0 \gamma$ NODE=M025R16  
NODE=M025R16

• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen

AUBERT

09M

BABR

 $e^+ e^- \rightarrow D^0 \bar{D}^0 \gamma$  $\Gamma(D^+ D^-) / \Gamma_{\text{total}}$  $\Gamma_5 / \Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

seen

CRONIN-HEN..09

CLEO

 $e^+ e^- \rightarrow D^+ D^-$ 

seen

PAKHLOVA

08

BELL

 $e^+ e^- \rightarrow D^+ D^- \gamma$ NODE=M025R17  
NODE=M025R17

• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen

AUBERT

09M

BABR

 $e^+ e^- \rightarrow D^+ D^- \gamma$  $\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.}) / \Gamma_{\text{total}}$  $\Gamma_7 / \Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

seen

AUBERT

09M

BABR

 $e^+ e^- \rightarrow D^{*0} \bar{D}^0 \gamma$ 

seen

CRONIN-HEN..09

CLEO

 $e^+ e^- \rightarrow D^{*0} \bar{D}^0$ NODE=M025R18  
NODE=M025R18 $\Gamma(D^*(2010)^+ D^- + \text{c.c.}) / \Gamma_{\text{total}}$  $\Gamma_8 / \Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

seen

<sup>1</sup> ZHUKOVA

18

BELL

 $e^+ e^- \rightarrow D^{*+} D^- \gamma$ 

seen

AUBERT

09M

BABR

 $e^+ e^- \rightarrow D^{*+} D^- \gamma$ 

seen

CRONIN-HEN..09

CLEO

 $e^+ e^- \rightarrow D^{*+} D^-$ NODE=M025R19  
NODE=M025R19

• • • We do not use the following data for averages, fits, limits, etc. • • •

seen

PAKHLOVA

07

BELL

 $e^+ e^- \rightarrow D^{*+} D^- \gamma$ <sup>1</sup> Supersedes PAKHLOVA 07.

NODE=M025R19;LINKAGE=A

 $\Gamma(D^* \bar{D} + \text{c.c.}) / \Gamma(D^* \bar{D}^*)$  $\Gamma_6 / \Gamma_9$ 

VALUE

DOCUMENT ID

TECN

COMMENT

 $0.34 \pm 0.14 \pm 0.05$ 

AUBERT

09M

BABR

 $e^+ e^- \rightarrow \gamma D^{(*)} \bar{D}^{(*)}$ NODE=M025R15  
NODE=M025R15 $\Gamma(D^*(2007)^0 \bar{D}^*(2007)^0) / \Gamma_{\text{total}}$  $\Gamma_{10} / \Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

seen

AUBERT

09M

BABR

 $e^+ e^- \rightarrow D^{*0} \bar{D}^{*0} \gamma$ 

seen

CRONIN-HEN..09

CLEO

 $e^+ e^- \rightarrow D^{*0} \bar{D}^{*0}$ NODE=M025R20  
NODE=M025R20

$\Gamma(D^*(2010)^+ D^*(2010)^-)/\Gamma_{\text{total}}$ 

| VALUE                                                                         | DOCUMENT ID             | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|-------------------------|------|--------------------------------------------|
| seen                                                                          | <sup>1</sup> ZHUKOVA 18 | BELL | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| seen                                                                          | AUBERT 09M              | BABR | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| seen                                                                          | CRONIN-HEN..09          | CLEO | $e^+ e^- \rightarrow D^{*+} D^{*-}$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                         |      |                                            |
| seen                                                                          | PAKHLOVA 07             | BELL | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |

<sup>1</sup> Supersedes PAKHLOVA 07.NODE=M025R21  
NODE=M025R21

NODE=M025R21;LINKAGE=A

 $\Gamma(D^0 D^- \pi^+ + \text{c.c. (excl. } D^*(2007)^0 \bar{D}^0 + \text{c.c., } D^*(2010)^+ D^- + \text{c.c.}))/\Gamma_{\text{total}}$ 

| VALUE    | DOCUMENT ID  | TECN | COMMENT                                    |
|----------|--------------|------|--------------------------------------------|
| not seen | PAKHLOVA 08A | BELL | $e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma$ |

NODE=M025R22  
NODE=M025R22 $\Gamma(D \bar{D}^* \pi + \text{c.c. (excl. } D^* \bar{D}^*))/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID    | TECN | COMMENT                               |
|-------|----------------|------|---------------------------------------|
| seen  | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D \bar{D}^* \pi$ |

NODE=M025R23  
NODE=M025R23 $\Gamma(D^0 D^{*-} \pi^+ + \text{c.c. (excl. } D^*(2010)^+ D^*(2010)^-))/\Gamma_{\text{total}}$ 

| VALUE    | DOCUMENT ID | TECN | COMMENT                                       |
|----------|-------------|------|-----------------------------------------------|
| not seen | PAKHLOVA 09 | BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+ \gamma$ |

NODE=M025R24  
NODE=M025R24 $\Gamma(D_s^+ D_s^-)/\Gamma_{\text{total}}$ 

| VALUE    | DOCUMENT ID     | TECN | COMMENT                                  |
|----------|-----------------|------|------------------------------------------|
| not seen | PAKHLOVA 11     | BELL | $e^+ e^- \rightarrow D_s^+ D_s^- \gamma$ |
| not seen | DEL-AMO-SA..10N | BABR | $e^+ e^- \rightarrow D_s^+ D_s^- \gamma$ |
| not seen | CRONIN-HEN..09  | CLEO | $e^+ e^- \rightarrow D_s^+ D_s^-$        |

NODE=M025R25  
NODE=M025R25 $\Gamma(D_s^{*+} D_s^- + \text{c.c.}))/\Gamma_{\text{total}}$ 

| VALUE | DOCUMENT ID     | TECN | COMMENT                                     |
|-------|-----------------|------|---------------------------------------------|
| seen  | PAKHLOVA 11     | BELL | $e^+ e^- \rightarrow D_s^{*+} D_s^- \gamma$ |
| seen  | DEL-AMO-SA..10N | BABR | $e^+ e^- \rightarrow D_s^{*+} D_s^- \gamma$ |
| seen  | CRONIN-HEN..09  | CLEO | $e^+ e^- \rightarrow D_s^{*+} D_s^-$        |

NODE=M025R26  
NODE=M025R26 $\Gamma(J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                |
|--------------------------|-----|-------------|------|----------------------------------------|
| <3                       | 90  | COAN 06     | CLEO | 4.12–4.2 $e^+ e^- \rightarrow$ hadrons |

NODE=M025R01  
NODE=M025R01 $\Gamma(J/\psi \pi^0 \pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                |
|--------------------------|-----|-------------|------|----------------------------------------|
| <3                       | 90  | COAN 06     | CLEO | 4.12–4.2 $e^+ e^- \rightarrow$ hadrons |

NODE=M025R02  
NODE=M025R02 $\Gamma(J/\psi K^+ K^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                |
|--------------------------|-----|-------------|------|----------------------------------------|
| <2                       | 90  | COAN 06     | CLEO | 4.12–4.2 $e^+ e^- \rightarrow$ hadrons |

NODE=M025R03  
NODE=M025R03 $\Gamma(J/\psi \eta)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                |
|--------------------------|-----|-------------|------|----------------------------------------|
| <8                       | 90  | COAN 06     | CLEO | 4.12–4.2 $e^+ e^- \rightarrow$ hadrons |

NODE=M025R04  
NODE=M025R04

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |                          |      |                                          |
|---------------|--------------------------|------|------------------------------------------|
| possibly seen | <sup>1</sup> ABLIKIM 15L | BES3 | $e^+ e^- \rightarrow J/\psi \eta$        |
| seen          | WANG 13B                 | BELL | $e^+ e^- \rightarrow J/\psi \eta \gamma$ |

<sup>1</sup> An enhancement around 4.2 GeV is observed.

NODE=M025R04;LINKAGE=A

 $\Gamma(J/\psi \pi^0)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                |
|--------------------------|-----|-------------|------|----------------------------------------|
| <1                       | 90  | COAN 06     | CLEO | 4.12–4.2 $e^+ e^- \rightarrow$ hadrons |

NODE=M025R05  
NODE=M025R05 $\Gamma(J/\psi \eta')/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                |
|--------------------------|-----|-------------|------|----------------------------------------|
| <5                       | 90  | COAN 06     | CLEO | 4.12–4.2 $e^+ e^- \rightarrow$ hadrons |

NODE=M025R06  
NODE=M025R06

$\Gamma(J/\psi\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{23}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|--------------------------|-----|-------------|------|--------------------------------------------|
| <1                       | 90  | COAN        | 06   | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |

NODE=M025R07  
 NODE=M025R07

 $\Gamma(\psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|--------------------------|-----|-------------|------|--------------------------------------------|
| <4                       | 90  | COAN        | 06   | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |

NODE=M025R08  
 NODE=M025R08

 $\Gamma(\chi_{c1}\gamma)/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|    |    |      |    |                                            |
|----|----|------|----|--------------------------------------------|
| <7 | 90 | COAN | 06 | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |
|----|----|------|----|--------------------------------------------|

NODE=M025R09  
 NODE=M025R09

 $\Gamma(\chi_{c2}\gamma)/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|     |    |      |    |                                            |
|-----|----|------|----|--------------------------------------------|
| <13 | 90 | COAN | 06 | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |
|-----|----|------|----|--------------------------------------------|

NODE=M025R10  
 NODE=M025R10

 $\Gamma(\chi_{c1}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|    |    |      |    |                                            |
|----|----|------|----|--------------------------------------------|
| <2 | 90 | COAN | 06 | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |
|----|----|------|----|--------------------------------------------|

NODE=M025R11  
 NODE=M025R11

 $\Gamma(\chi_{c2}\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{28}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|    |    |      |    |                                            |
|----|----|------|----|--------------------------------------------|
| <8 | 90 | COAN | 06 | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |
|----|----|------|----|--------------------------------------------|

NODE=M025R12  
 NODE=M025R12

 $\Gamma(h_c(1P)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|    |    |                     |    |                                             |
|----|----|---------------------|----|---------------------------------------------|
| <5 | 90 | <sup>1</sup> PEDLAR | 11 | CLEO $e^+e^- \rightarrow h_c(1P)\pi^+\pi^-$ |
|----|----|---------------------|----|---------------------------------------------|

<sup>1</sup> At  $\sqrt{s} = 4170$  MeV, PEDLAR 11 measures  $\sigma(e^+e^- \rightarrow h_c(1P)\pi^+\pi^-) = 15.6 \pm 2.3 \pm 1.9 \pm 3.0$  pb, where the errors are statistical, systematic, and due to uncertainty in  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$ , respectively.

NODE=M025R27  
 NODE=M025R27

NODE=M025R27;LINKAGE=PE

 $\Gamma(h_c(1P)\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|    |    |                     |    |                                             |
|----|----|---------------------|----|---------------------------------------------|
| <2 | 90 | <sup>1</sup> PEDLAR | 11 | CLEO $e^+e^- \rightarrow h_c(1P)\pi^0\pi^0$ |
|----|----|---------------------|----|---------------------------------------------|

<sup>1</sup> At  $\sqrt{s} = 4170$  MeV, PEDLAR 11 measures  $\sigma(e^+e^- \rightarrow h_c(1P)\pi^0\pi^0) = 3.0 \pm 3.3 \pm 1.1 \pm 0.6$  pb, where the errors are statistical, systematic, and due to uncertainty in  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$ , respectively.

NODE=M025R28  
 NODE=M025R28

NODE=M025R28;LINKAGE=PE

 $\Gamma(h_c(1P)\eta)/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

|    |    |  |                     |    |                                       |
|----|----|--|---------------------|----|---------------------------------------|
| <2 | 90 |  | <sup>1</sup> PEDLAR | 11 | CLEO $e^+e^- \rightarrow h_c(1P)\eta$ |
|----|----|--|---------------------|----|---------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

possibly seen 41 <sup>2</sup> ABLIKIM 17R BES3  $e^+e^- \rightarrow h_c(1P)\eta$

<sup>1</sup> At  $\sqrt{s} = 4170$  MeV, PEDLAR 11 measures  $\sigma(e^+e^- \rightarrow h_c(1P)\eta) = 4.7 \pm 1.7 \pm 1.0 \pm 0.9$  pb, where the errors are statistical, systematic, and due to uncertainty in  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$ , respectively.

<sup>2</sup> An enhancement around 4.2 GeV is observed.

NODE=M025R29  
 NODE=M025R29

NODE=M025R29;LINKAGE=PE

NODE=M025R29;LINKAGE=A

 $\Gamma(h_c(1P)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|      |    |                     |    |                                        |
|------|----|---------------------|----|----------------------------------------|
| <0.4 | 90 | <sup>1</sup> PEDLAR | 11 | CLEO $e^+e^- \rightarrow h_c(1P)\pi^0$ |
|------|----|---------------------|----|----------------------------------------|

<sup>1</sup> At  $\sqrt{s} = 4170$  MeV, PEDLAR 11 measures  $\sigma(e^+e^- \rightarrow h_c(1P)\pi^0) = -0.7 \pm 1.8 \pm 0.7 \pm 0.1$  pb, where the errors are statistical, systematic, and due to uncertainty in  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$ , respectively.

NODE=M025R30  
 NODE=M025R30

NODE=M025R30;LINKAGE=PE

 $\Gamma(\phi\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|    |    |      |    |                                            |
|----|----|------|----|--------------------------------------------|
| <2 | 90 | COAN | 06 | CLEO 4.12–4.2 $e^+e^- \rightarrow$ hadrons |
|----|----|------|----|--------------------------------------------|

NODE=M025R13  
 NODE=M025R13

$\Gamma(\gamma\chi_{c1}(3872))/\Gamma_{\text{total}}$   $\Gamma_{34}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                                             | CL% | DOCUMENT ID            | COMMENT                                            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------------------------|----------------------------------------------------|
| $<2.0 \times 10^{-3}$                                                                                                                                                                                                                                                                                             | 90  | <sup>1,2</sup> XIAO 13 | $\psi(4160) \rightarrow \gamma J/\psi \pi^+ \pi^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                     |     |                        |                                                    |
| $<0.014$                                                                                                                                                                                                                                                                                                          | 90  | <sup>1,3</sup> XIAO 13 | $\psi(4160) \rightarrow \gamma J/\psi \pi^+ \pi^-$ |
| <sup>1</sup> Obtained by analyzing CLEO data but not authored by the CLEO Collaboration.                                                                                                                                                                                                                          |     |                        |                                                    |
| <sup>2</sup> XIAO 13 reports $[\Gamma(\psi(4160) \rightarrow \gamma\chi_{c1}(3872))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S))] < 0.68 \times 10^{-4}$ which we divide by our best value $B(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) = 3.4 \times 10^{-2}$ . |     |                        |                                                    |
| <sup>3</sup> XIAO 13 reports $[\Gamma(\psi(4160) \rightarrow \gamma\chi_{c1}(3872))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \gamma J/\psi)] < 1.05 \times 10^{-4}$ which we divide by our best value $B(\chi_{c1}(3872) \rightarrow \gamma J/\psi) = 7.7 \times 10^{-3}$ .                   |     |                        |                                                    |

NODE=M025R43  
NODE=M025R43

OCCUR=2

NODE=M025R43;LINKAGE=A  
NODE=M025R43;LINKAGE=B

NODE=M025R43;LINKAGE=C

 $\Gamma(\gamma X(3915) \rightarrow \gamma J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$   $\Gamma_{35}/\Gamma$ 

| VALUE                                                                                    | CL% | DOCUMENT ID          | COMMENT                                            |
|------------------------------------------------------------------------------------------|-----|----------------------|----------------------------------------------------|
| $<1.36 \times 10^{-4}$                                                                   | 90  | <sup>1</sup> XIAO 13 | $\psi(4160) \rightarrow \gamma J/\psi \pi^+ \pi^-$ |
| <sup>1</sup> Obtained by analyzing CLEO data but not authored by the CLEO Collaboration. |     |                      |                                                    |

NODE=M025R35  
NODE=M025R35

NODE=M025R35;LINKAGE=A

 $\Gamma(\gamma X(3930) \rightarrow \gamma J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$   $\Gamma_{36}/\Gamma$ 

| VALUE                                                                                    | CL% | DOCUMENT ID          | COMMENT                                            |
|------------------------------------------------------------------------------------------|-----|----------------------|----------------------------------------------------|
| $<1.18 \times 10^{-4}$                                                                   | 90  | <sup>1</sup> XIAO 13 | $\psi(4160) \rightarrow \gamma J/\psi \pi^+ \pi^-$ |
| <sup>1</sup> Obtained by analyzing CLEO data but not authored by the CLEO Collaboration. |     |                      |                                                    |

NODE=M025R36  
NODE=M025R36

NODE=M025R36;LINKAGE=A

 $\Gamma(\gamma X(3940) \rightarrow \gamma J/\psi \pi^+ \pi^-)/\Gamma_{\text{total}}$   $\Gamma_{37}/\Gamma$ 

| VALUE                                                                                    | CL% | DOCUMENT ID          | COMMENT                                            |
|------------------------------------------------------------------------------------------|-----|----------------------|----------------------------------------------------|
| $<1.47 \times 10^{-4}$                                                                   | 90  | <sup>1</sup> XIAO 13 | $\psi(4160) \rightarrow \gamma J/\psi \pi^+ \pi^-$ |
| <sup>1</sup> Obtained by analyzing CLEO data but not authored by the CLEO Collaboration. |     |                      |                                                    |

NODE=M025R37  
NODE=M025R37

NODE=M025R37;LINKAGE=A

 $\Gamma(\gamma X(3915) \rightarrow \gamma\gamma J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{38}/\Gamma$ 

| VALUE                                                                                    | CL% | DOCUMENT ID          | COMMENT                                      |
|------------------------------------------------------------------------------------------|-----|----------------------|----------------------------------------------|
| $<1.26 \times 10^{-4}$                                                                   | 90  | <sup>1</sup> XIAO 13 | $\psi(4160) \rightarrow \gamma\gamma J/\psi$ |
| <sup>1</sup> Obtained by analyzing CLEO data but not authored by the CLEO Collaboration. |     |                      |                                              |

NODE=M025R39  
NODE=M025R39

NODE=M025R39;LINKAGE=A

 $\Gamma(\gamma X(3930) \rightarrow \gamma\gamma J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{39}/\Gamma$ 

| VALUE                                                                                    | CL% | DOCUMENT ID          | COMMENT                                      |
|------------------------------------------------------------------------------------------|-----|----------------------|----------------------------------------------|
| $<0.88 \times 10^{-4}$                                                                   | 90  | <sup>1</sup> XIAO 13 | $\psi(4160) \rightarrow \gamma\gamma J/\psi$ |
| <sup>1</sup> Obtained by analyzing CLEO data but not authored by the CLEO Collaboration. |     |                      |                                              |

NODE=M025R40  
NODE=M025R40

NODE=M025R40;LINKAGE=A

 $\Gamma(\gamma X(3940) \rightarrow \gamma\gamma J/\psi)/\Gamma_{\text{total}}$   $\Gamma_{40}/\Gamma$ 

| VALUE                                                                                    | CL% | DOCUMENT ID          | COMMENT                                      |
|------------------------------------------------------------------------------------------|-----|----------------------|----------------------------------------------|
| $<1.79 \times 10^{-4}$                                                                   | 90  | <sup>1</sup> XIAO 13 | $\psi(4160) \rightarrow \gamma\gamma J/\psi$ |
| <sup>1</sup> Obtained by analyzing CLEO data but not authored by the CLEO Collaboration. |     |                      |                                              |

NODE=M025R41  
NODE=M025R41

NODE=M025R41;LINKAGE=A

 $\Gamma(K^+ K^-)/\Gamma_{\text{total}}$   $\Gamma_{41}/\Gamma$ 

| VALUE                                                                                                                                                                      | CL% | DOCUMENT ID               | TECN | COMMENT                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|---------------------------|------|----------------------------------|
| $<2 \times 10^{-5}$                                                                                                                                                        | 90  | <sup>1</sup> DRUZHININ 15 | RVUE | $e^+ e^- \rightarrow \psi(3770)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                              |     |                           |      |                                  |
| <sup>1</sup> DRUZHININ 15 uses BABAR and CLEO data taking into account interference of the processes $e^+ e^- \rightarrow K^+ K^-$ and $e^+ e^- \rightarrow K_S^0 K_L^0$ . |     |                           |      |                                  |

NODE=M025R33  
NODE=M025R33

NODE=M025R33;LINKAGE=A

 $\Gamma(p\bar{p}p\bar{p})/\Gamma_{\text{total}}$   $\Gamma_{43}/\Gamma$ 

| VALUE    | DOCUMENT ID      | TECN | COMMENT                                                |
|----------|------------------|------|--------------------------------------------------------|
| not seen | ABLIKIM 21D BES3 |      | $4.0\text{--}4.6 e^+ e^- \rightarrow p\bar{p}p\bar{p}$ |

NODE=M025R44  
NODE=M025R44

 $\psi(4160)$  REFERENCES

NODE=M025

|              |                |                                |                  |             |
|--------------|----------------|--------------------------------|------------------|-------------|
| ABLIKIM 21D  | PR D103 052003 | M. Ablikim <i>et al.</i>       | (BESIII Collab.) | REFID=61031 |
| ABLIKIM 20A  | PR D101 012008 | M. Ablikim <i>et al.</i>       | (BESIII Collab.) | REFID=60210 |
| ABLIKIM 20AG | PR D102 112009 | M. Ablikim <i>et al.</i>       | (BESIII Collab.) | REFID=60744 |
| ABLIKIM 19AE | PR D99 072005  | M. Ablikim <i>et al.</i>       | (BESIII Collab.) | REFID=59856 |
| ZHUKOVA 18   | PR D97 012002  | V. Zhukova <i>et al.</i>       | (BELLE Collab.)  | REFID=58710 |
| ABLIKIM 17R  | PR D96 012001  | M. Ablikim <i>et al.</i>       | (BESIII Collab.) | REFID=58009 |
| GAO 17       | PR D95 092007  | X.Y. Gao, C.P. Shen, C.Z. Yuan |                  | REFID=57991 |
| PDG 16       | CP C40 100001  | C. Patrignani <i>et al.</i>    | (PDG Collab.)    | REFID=57140 |
| ABLIKIM 15L  | PR D91 112005  | M. Ablikim <i>et al.</i>       | (BESIII Collab.) | REFID=56777 |
| DRUZHININ 15 | PR D92 054024  | V.P. Druzhinin                 | (NOVO)           | REFID=56962 |
| HAN 15       | PR D92 012011  | Y.L. Han <i>et al.</i>         | (BELLE Collab.)  | REFID=56816 |
| AAIJ 13BC    | PRL 111 112003 | R. Aaij <i>et al.</i>          | (LHCb Collab.)   | REFID=55229 |
| WANG 13B     | PR D87 051101  | X.L. Wang <i>et al.</i>        | (BELLE Collab.)  | REFID=55377 |
| XIAO 13      | PR D87 057501  | T. Xiao <i>et al.</i>          | (NWES, WAYN)     | REFID=55381 |



|               |     |                |                                  |                             |
|---------------|-----|----------------|----------------------------------|-----------------------------|
| PAKHLOVA      | 11  | PR D83 011101  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)             |
| PEDLAR        | 11  | PRL 107 041803 | T. Pedlar <i>et al.</i>          | (CLEO Collab.)              |
| DEL-AMO-SA... | 10N | PR D82 052004  | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)             |
| MO            | 10  | PR D82 077501  | X.H. Mo, C.Z. Yuan, P. Wang      | (BHEP)                      |
| AUBERT        | 09M | PR D79 092001  | B. Aubert <i>et al.</i>          | (BABAR Collab.)             |
| CRONIN-HEN... | 09  | PR D80 072001  | D. Cronin-Hennessy <i>et al.</i> | (CLEO Collab.)              |
| PAKHLOVA      | 09  | PR D80 091101  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)             |
| ABLIKIM       | 08D | PL B660 315    | M. Ablikim <i>et al.</i>         | (BES Collab.)               |
| PAKHLOVA      | 08  | PR D77 011103  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)             |
| PAKHLOVA      | 08A | PRL 100 062001 | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)             |
| PAKHLOVA      | 07  | PRL 98 092001  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)             |
| COAN          | 06  | PRL 96 162003  | T.E. Coan <i>et al.</i>          | (CLEO Collab.)              |
| SETH          | 05A | PR D72 017501  | K.K. Seth                        |                             |
| BAI           | 02C | PRL 88 101802  | J.Z. Bai <i>et al.</i>           | (BES Collab.)               |
| BAI           | 00  | PRL 84 594     | J.Z. Bai <i>et al.</i>           | (BES Collab.)               |
| OSTERHELD     | 86  | SLAC-PUB-4160  | A. Osterheld <i>et al.</i>       | (SLAC Crystal Ball Collab.) |
| BRANDELIK     | 78C | PL 76B 361     | R. Brandelik <i>et al.</i>       | (DASP Collab.)              |

REFID=53638  
REFID=16787  
REFID=53532  
REFID=53540  
REFID=52724  
REFID=53114  
REFID=53143  
REFID=52142  
REFID=52132  
REFID=52134  
REFID=51628  
REFID=51075  
REFID=50813  
REFID=50506  
REFID=50503  
REFID=51064  
REFID=22232

NODE=M190

X(4160)

$I^G(J^{PC}) = ?^?(?^?)$

OMITTED FROM SUMMARY TABLE  
Seen by PAKHLOV 08 in  $e^+e^- \rightarrow J/\psi X, X \rightarrow D^*\bar{D}^*$

NODE=M190

X(4160) MASS

NODE=M190M

| VALUE (MeV)               | EVTS | DOCUMENT ID | TECN | COMMENT                            |
|---------------------------|------|-------------|------|------------------------------------|
| $4156^{+25}_{-20} \pm 15$ | 24   | PAKHLOV     | 08   | BELL $e^+e^- \rightarrow J/\psi X$ |

NODE=M190M

X(4160) WIDTH

NODE=M190W

| VALUE (MeV)               | EVTS | DOCUMENT ID | TECN | COMMENT                            |
|---------------------------|------|-------------|------|------------------------------------|
| $139^{+111}_{-61} \pm 21$ | 24   | PAKHLOV     | 08   | BELL $e^+e^- \rightarrow J/\psi X$ |

NODE=M190W

X(4160) DECAY MODES

NODE=M190215;NODE=M190

| Mode                                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------------|--------------------------------|
| $\Gamma_1 \quad D\bar{D}$                 | not seen                       |
| $\Gamma_2 \quad D^*\bar{D} + \text{c.c.}$ | not seen                       |
| $\Gamma_3 \quad D^*\bar{D}^*$             | seen                           |

DESIG=1;OUR EVAL;→ UNCHECKED ←  
DESIG=2;OUR EVAL;→ UNCHECKED ←  
DESIG=3;OUR EVAL;→ UNCHECKED ←

X(4160) BRANCHING RATIOS

NODE=M190225

| $\Gamma(D\bar{D})/\Gamma(D^*\bar{D}^*)$                 |     |             |      |                                    | $\Gamma_1/\Gamma_3$ |
|---------------------------------------------------------|-----|-------------|------|------------------------------------|---------------------|
| VALUE                                                   | CL% | DOCUMENT ID | TECN | COMMENT                            |                     |
| $<0.09$                                                 | 90  | PAKHLOV     | 08   | BELL $e^+e^- \rightarrow J/\psi X$ |                     |
| $\Gamma(D^*\bar{D} + \text{c.c.})/\Gamma(D^*\bar{D}^*)$ |     |             |      |                                    | $\Gamma_2/\Gamma_3$ |
| VALUE                                                   | CL% | DOCUMENT ID | TECN | COMMENT                            |                     |
| $<0.22$                                                 | 90  | PAKHLOV     | 08   | BELL $e^+e^- \rightarrow J/\psi X$ |                     |

NODE=M190R01  
NODE=M190R01

NODE=M190R02  
NODE=M190R02

X(4160) REFERENCES

NODE=M190

|         |    |                |                          |                 |
|---------|----|----------------|--------------------------|-----------------|
| PAKHLOV | 08 | PRL 100 202001 | P. Pakhlov <i>et al.</i> | (BELLE Collab.) |
|---------|----|----------------|--------------------------|-----------------|

REFID=52302

**Z<sub>c</sub>(4200)**

$I^G(J^{PC}) = 1^+(1^{+-})$   
*I*, *G*, *C* need confirmation.

OMITTED FROM SUMMARY TABLE  
was  $X(4200)^\pm$

This state shows properties different from a conventional  $q\bar{q}$  state.  
A candidate for an exotic structure. See the review on non- $q\bar{q}$  states.

Reported by CHILIKIN 14 in  $J/\psi\pi^+$  at a significance of  $6.2\sigma$ . As-  
signments of  $0^-$ ,  $1^-$ ,  $2^-$ , and  $2^+$  excluded at  $6.1\sigma$ ,  $7.4\sigma$ ,  $4.4\sigma$ ,  
and  $7.0\sigma$  level, respectively. Needs confirmation.

NODE=M231

NODE=M231

**Z<sub>c</sub>(4200) MASS**

NODE=M231M

| VALUE (MeV)                                   | DOCUMENT ID | TECN | COMMENT                                       |
|-----------------------------------------------|-------------|------|-----------------------------------------------|
| <b>4196<sup>+31+17</sup><sub>-29-13</sub></b> | CHILIKIN    | 14   | BELL $\bar{B}^0 \rightarrow J/\psi K^- \pi^+$ |

NODE=M231M

**Z<sub>c</sub>(4200) WIDTH**

NODE=M231W

| VALUE (MeV)                                               | DOCUMENT ID | TECN | COMMENT                                       |
|-----------------------------------------------------------|-------------|------|-----------------------------------------------|
| <b>370<math>\pm</math>70<sup>+70</sup><sub>-132</sub></b> | CHILIKIN    | 14   | BELL $\bar{B}^0 \rightarrow J/\psi K^- \pi^+$ |

NODE=M231W

**Z<sub>c</sub>(4200) DECAY MODES**

NODE=M231215;NODE=M231

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1$ $J/\psi\pi^+$ | seen                           |

DESIG=1

**Z<sub>c</sub>(4200) BRANCHING RATIOS**

NODE=M231220

| $\Gamma(J/\psi\pi^+)/\Gamma_{\text{total}}$                                   | DOCUMENT ID       | TECN | COMMENT                                               | $\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------|-------------------|------|-------------------------------------------------------|-------------------|
| <b>seen</b>                                                                   | CHILIKIN          | 14   | BELL $\bar{B}^0 \rightarrow J/\psi K^- \pi^+$         |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                   |      |                                                       |                   |
| possibly seen                                                                 | <sup>1</sup> AAIJ | 19R  | LHCB $B^0 \rightarrow K^+ \pi^- J/\psi + \text{c.c.}$ |                   |
| <sup>1</sup> From a model-independent analysis.                               |                   |      |                                                       |                   |

NODE=M231R01  
NODE=M231R01

NODE=M231R01;LINKAGE=C

**Z<sub>c</sub>(4200) REFERENCES**

NODE=M231

|          |     |                |                           |                 |
|----------|-----|----------------|---------------------------|-----------------|
| AAIJ     | 19R | PRL 122 152002 | R. Aaij <i>et al.</i>     | (LHCb Collab.)  |
| CHILIKIN | 14  | PR D90 112009  | K. Chilikin <i>et al.</i> | (BELLE Collab.) |

REFID=59776  
REFID=56344

$\psi(4230)$ 

$$I^G(J^{PC}) = 0^-(1^{--})$$

also known as  $Y(4230)$ ; was  $X(4230)$

The recent measurement of  $e^+e^- \rightarrow J/\psi\pi\pi$  (ABLIKIM 17B) led to a downward shift in the mass of the  $\psi(4260)$ , also known as  $Y(4260)$ , such that a distinction between the  $\psi(4260)$  and  $\psi(4230)$  no longer appears justified. Therefore, starting from this edition, we include the data of ABLIKIM 17B in this node and have listed the  $\psi(4230)$  in the summary tables instead of the  $\psi(4260)$ .

NODE=M222

NODE=M222

 **$\psi(4230)$  MASS**

NODE=M222M

| VALUE (MeV)                                                                                                                | EVTS | DOCUMENT ID | TECN      | COMMENT                                                                |
|----------------------------------------------------------------------------------------------------------------------------|------|-------------|-----------|------------------------------------------------------------------------|
| <b>4220 ±15 OUR ESTIMATE</b>                                                                                               |      |             |           |                                                                        |
| <b>4219.1 ± 1.7 OUR AVERAGE</b> Error includes scale factor of 1.1. [4218.7 ± 2.8 MeV OUR 2020 AVERAGE Scale factor = 1.3] |      |             |           |                                                                        |
| 4216.7 ± 8.9 ± 4.1                                                                                                         | 1    | ABLIKIM     | 20AG BES3 | $e^+e^- \rightarrow \mu^+\mu^-$                                        |
| 4220.4 ± 2.4 ± 2.3                                                                                                         | 2    | ABLIKIM     | 20N BES3  | $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$                                 |
| 4218.6 ± 3.8 ± 2.5                                                                                                         | 2    | ABLIKIM     | 20O BES3  | $e^+e^- \rightarrow \eta J/\psi$                                       |
| 4218.5 ± 1.6 ± 4.0                                                                                                         | 3    | ABLIKIM     | 19AI BES3 | $e^+e^- \rightarrow \omega\chi_{c0}$                                   |
| 4228.6 ± 4.1 ± 6.3                                                                                                         |      | ABLIKIM     | 19R BES3  | $e^+e^- \rightarrow \pi^+D^0D^{*-} + \text{c.c.}$                      |
| 4200.6 <sup>+7.9</sup> <sub>-13.3</sub> ± 3.0                                                                              | 4    | ABLIKIM     | 19V BES3  | $e^+e^- \rightarrow \gamma\chi_{c1}(3872)$                             |
| 4222.0 ± 3.1 ± 1.4                                                                                                         | 5    | ABLIKIM     | 17B BES3  | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$                                 |
| 4218 <sup>+5.5</sup> <sub>-4.5</sub> ± 0.9                                                                                 |      | ABLIKIM     | 17G BES3  | $e^+e^- \rightarrow \pi^+\pi^- h_c$                                    |
| 4209.5 ± 7.4 ± 1.4                                                                                                         | 6    | ABLIKIM     | 17V BES3  | $e^+e^- \rightarrow \pi^+\pi^- \psi(2S)$                               |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                              |      |             |           |                                                                        |
| 4231.9 ± 5.3 ± 4.9                                                                                                         |      | ABLIKIM     | 20N BES3  | $e^+e^- \rightarrow \pi^0 Z_c(3900)^0, Z_c^0 \rightarrow \pi^0 J/\psi$ |
| 4230 ± 8 ± 6                                                                                                               | 180  | 7           | ABLIKIM   | 15C BES3 $e^+e^- \rightarrow \omega\chi_{c0}$                          |

NODE=M222M

→ UNCHECKED ←

NEW

OCCUR=2

NODE=M222M;LINKAGE=H

NODE=M222M;LINKAGE=G

NODE=M222M;LINKAGE=C

NODE=M222M;LINKAGE=F

NODE=M222M;LINKAGE=E

NODE=M222M;LINKAGE=B

NODE=M222M;LINKAGE=A

- 1 Solution 1 of 8 with equal fit quality to the  $e^+e^- \rightarrow \mu^+\mu^-$  cross section between 3.8 and 4.6 GeV to the coherent sum of four resonant amplitudes. Other solutions range from  $4212.8 \pm 7.2 \pm 4.0$  to  $4219.4 \pm 11.2 \pm 4.1$  MeV.
- 2 From a fit of the measured cross section in the range  $\sqrt{s} = 3.808\text{--}4.600$  GeV.
- 3 From a fit of the measured cross section from  $\sqrt{s} = 4.178\text{--}4.278$  GeV. Supersedes ABLIKIM 15C.
- 4 Simultaneous fit to  $\chi_{c1} \rightarrow \omega J/\psi$  and  $\chi_{c1} \rightarrow \pi^+\pi^- J/\psi$ .
- 5 From a three-resonance fit.
- 6 From a fit to the cross section for  $e^+e^- \rightarrow \pi^+\pi^- \psi(2S) \rightarrow 2(\pi^+\pi^-)\ell^+\ell^-$  obtained from 16 center-of-mass energies between 4.008 and 4.600 GeV and comprising  $5.1 \text{ fb}^{-1}$ .
- 7 From a 3-parameter fit of measured cross sections from  $\sqrt{s} = 4.21\text{--}4.42$  GeV to a phase-space modified Breit-Wigner function, using the decays  $\chi_{c0} \rightarrow \pi^+\pi^-$ ,  $\chi_{c0} \rightarrow K^+K^-$ , and  $\omega \rightarrow \pi^+\pi^-\pi^0$ .

 **$\psi(4230)$  WIDTH**

NODE=M222W

| VALUE (MeV)                                                                                                                            | EVTS | DOCUMENT ID | TECN      | COMMENT                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------|------|-------------|-----------|------------------------------------------------------------------------|
| <b>20 to 100 OUR ESTIMATE</b>                                                                                                          |      |             |           |                                                                        |
| <b>50 ± 9 OUR AVERAGE</b> Error includes scale factor of 3.8. See the ideogram below. [44 ± 9 MeV OUR 2020 AVERAGE Scale factor = 3.3] |      |             |           |                                                                        |
| 47.2 ± 22.8 ± 10.5                                                                                                                     | 1    | ABLIKIM     | 20AG BES3 | $e^+e^- \rightarrow \mu^+\mu^-$                                        |
| 46.2 ± 4.7 ± 2.1                                                                                                                       | 2    | ABLIKIM     | 20N BES3  | $e^+e^- \rightarrow \pi^0\pi^0 J/\psi$                                 |
| 82.0 ± 5.7 ± 0.4                                                                                                                       | 2    | ABLIKIM     | 20O BES3  | $e^+e^- \rightarrow \eta J/\psi$                                       |
| 28.2 ± 3.9 ± 1.6                                                                                                                       | 3    | ABLIKIM     | 19AI BES3 | $e^+e^- \rightarrow \omega\chi_{c0}$                                   |
| 77.0 ± 6.8 ± 6.3                                                                                                                       |      | ABLIKIM     | 19R BES3  | $e^+e^- \rightarrow \pi^+D^0D^{*-} + \text{c.c.}$                      |
| 115 <sup>+38</sup> <sub>-26</sub> ± 12                                                                                                 | 4    | ABLIKIM     | 19V BES3  | $e^+e^- \rightarrow \gamma\chi_{c1}(3872)$                             |
| 44.1 ± 4.3 ± 2.0                                                                                                                       | 5    | ABLIKIM     | 17B BES3  | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$                                 |
| 66.0 <sup>+12.3</sup> <sub>-8.3</sub> ± 0.4                                                                                            |      | ABLIKIM     | 17G BES3  | $e^+e^- \rightarrow \pi^+\pi^- h_c$                                    |
| 80.1 ± 24.6 ± 2.9                                                                                                                      | 6    | ABLIKIM     | 17V BES3  | $e^+e^- \rightarrow \pi^+\pi^- \psi(2S)$                               |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                          |      |             |           |                                                                        |
| 41.2 ± 16.0 ± 16.4                                                                                                                     |      | ABLIKIM     | 20N BES3  | $e^+e^- \rightarrow \pi^0 Z_c(3900)^0, Z_c^0 \rightarrow \pi^0 J/\psi$ |
| 38 ± 12 ± 2                                                                                                                            | 180  | 7           | ABLIKIM   | 15C BES3 $e^+e^- \rightarrow \omega\chi_{c0}$                          |

NODE=M222W

→ UNCHECKED ←

NEW

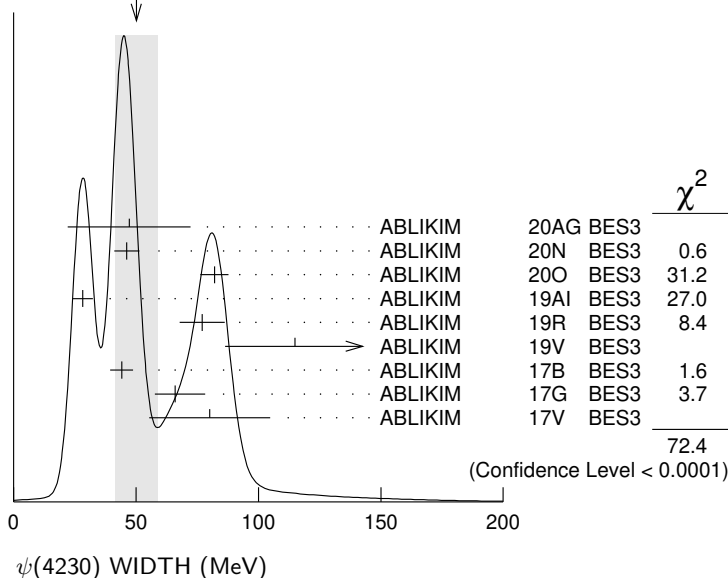
OCCUR=2

- <sup>1</sup> Solution 1 of 8 with equal fit quality to the  $e^+e^- \rightarrow \mu^+\mu^-$  cross section between 3.8 and 4.6 GeV to the coherent sum of four resonant amplitudes. Other solutions range from  $36.4 \pm 16.8 \pm 8.1$  to  $49.6 \pm 22.6 \pm 11.0$  MeV.
- <sup>2</sup> From a fit of the measured cross section in the range  $\sqrt{s} = 3.808\text{--}4.600$  GeV.
- <sup>3</sup> From a fit of the measured cross section from  $\sqrt{s} = 4.178\text{--}4.278$  GeV. Supersedes ABLIKIM 15C.
- <sup>4</sup> Simultaneous fit to  $\chi_{c1} \rightarrow \omega J/\psi$  and  $\chi_{c1} \rightarrow \pi^+\pi^- J/\psi$ .
- <sup>5</sup> From a three-resonance fit.
- <sup>6</sup> From a fit to the cross section for  $e^+e^- \rightarrow \pi^+\pi^-\psi(2S) \rightarrow 2(\pi^+\pi^-)\ell^+\ell^-$  obtained from 16 center-of-mass energies between 4.008 and 4.600 GeV and comprising  $5.1\text{ fb}^{-1}$ .
- <sup>7</sup> From a 3-parameter fit of measured cross sections from  $\sqrt{s} = 4.21\text{--}4.42$  GeV to a phase-space modified Breit-Wigner function, using the decays  $\chi_{c0} \rightarrow \pi^+\pi^-$ ,  $\chi_{c0} \rightarrow K^+K^-$ , and  $\omega \rightarrow \pi^+\pi^-\pi^0$ .

NODE=M222W;LINKAGE=G

NODE=M222W;LINKAGE=F  
NODE=M222W;LINKAGE=CNODE=M222W;LINKAGE=E  
NODE=M222W;LINKAGE=D  
NODE=M222W;LINKAGE=B

NODE=M222W;LINKAGE=A

WEIGHTED AVERAGE  
 $50 \pm 9$  (Error scaled by 3.8) **$\psi(4230)$  DECAY MODES**

NODE=M222215;NODE=M222

| Mode                                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------------|--------------------------------|
| $\Gamma_1$ $e^+e^-$                       |                                |
| $\Gamma_2$ $\mu^+\mu^-$                   |                                |
| $\Gamma_3$ $\omega\chi_{c0}$              | seen                           |
| $\Gamma_4$ $\pi^+\pi^-h_c$                | seen                           |
| $\Gamma_5$ $\pi^0\pi^0 J/\psi$            | seen                           |
| $\Gamma_6$ $\pi^+\pi^- J/\psi$            | seen                           |
| $\Gamma_7$ $\eta J/\psi$                  | seen                           |
| $\Gamma_8$ $\pi^+\pi^-\psi(2S)$           | seen                           |
| $\Gamma_9$ $\pi^+D^0D^{*-} + \text{c.c.}$ | seen                           |
| $\Gamma_{10}$ $\Xi^-\Xi^+$                |                                |
| $\Gamma_{11}$ $\gamma\chi_{c1}(3872)$     | seen                           |
| $\Gamma_{12}$ $\pi^+\pi^-\pi^0\eta_c$     | seen                           |
| $\Gamma_{13}$ $\pi^+\pi^-\eta_c$          | not seen                       |
| $\Gamma_{14}$ $\gamma\pi^0\eta_c$         | not seen                       |
| $\Gamma_{15}$ $p\bar{p}p\bar{p}$          | not seen                       |

DESIG=1  
DESIG=15  
DESIG=2  
DESIG=3  
DESIG=9  
DESIG=7  
DESIG=10  
DESIG=4  
DESIG=5  
DESIG=6  
DESIG=8  
DESIG=11  
DESIG=13  
DESIG=14  
DESIG=12 **$\psi(4230)$  PARTIAL WIDTHS**

NODE=M222235

| $\Gamma(\mu^+\mu^-)$                       |                        |           |                                 | $\Gamma_2$ |
|--------------------------------------------|------------------------|-----------|---------------------------------|------------|
| VALUE (keV)                                | DOCUMENT ID            | TECN      | COMMENT                         |            |
| <b><math>1.53 \pm 1.26 \pm 0.54</math></b> | <sup>1,2</sup> ABLIKIM | 20AG BES3 | $e^+e^- \rightarrow \mu^+\mu^-$ |            |

NODE=M222W2  
NODE=M222W2

- <sup>1</sup> From a fit to the  $e^+e^- \rightarrow \mu^+\mu^-$  cross section between 3.8 and 4.6 GeV to the coherent sum of four resonant amplitudes assuming  $\Gamma(\mu^+\mu^-) = \Gamma(e^+e^-)$ .
- <sup>2</sup> From solution 1 of 8 with equal fit quality. Other solutions range from  $1.09 \pm 0.84 \pm 0.39$  to  $1.53 \pm 1.26 \pm 0.54$  keV.

NODE=M222W2;LINKAGE=A

NODE=M222W2;LINKAGE=B

$\psi(4230) \Gamma(i) \Gamma(e^+ e^-) / \Gamma(\text{total})$ 

NODE=M222220

$$\Gamma(\omega \chi_{c0}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$$

$$\Gamma_3 \Gamma_1 / \Gamma$$

| VALUE (eV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|             |  |                      |          |                                        |
|-------------|--|----------------------|----------|----------------------------------------|
| 2.5±0.2±0.3 |  | <sup>1</sup> ABLIKIM | 19A BES3 | $e^+ e^- \rightarrow \omega \chi_{c0}$ |
|-------------|--|----------------------|----------|----------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|             |     |                      |          |                                        |
|-------------|-----|----------------------|----------|----------------------------------------|
| 2.7±0.5±0.4 | 180 | <sup>2</sup> ABLIKIM | 15C BES3 | $e^+ e^- \rightarrow \omega \chi_{c0}$ |
|-------------|-----|----------------------|----------|----------------------------------------|

<sup>1</sup> From a fit of the measured cross section from  $\sqrt{s} = 4.178\text{--}4.278$  GeV. Supersedes ABLIKIM 15C.<sup>2</sup> From a 3-parameter fit of measured cross sections from  $\sqrt{s} = 4.21\text{--}4.42$  GeV to a phase-space modified Breit-Wigner function, using the decays  $\chi_{c0} \rightarrow \pi^+ \pi^-$ ,  $\chi_{c0} \rightarrow K^+ K^-$ , and  $\omega \rightarrow \pi^+ \pi^- \pi^0$ .

NODE=M222G01;LINKAGE=B

NODE=M222G01;LINKAGE=A

$$\Gamma(\eta J/\psi) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$$

$$\Gamma_7 \Gamma_1 / \Gamma$$

| VALUE (eV) | DOCUMENT ID | TECN | COMMENT |
|------------|-------------|------|---------|
|------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |                      |          |                                   |
|---------|----------------------|----------|-----------------------------------|
| 8.0±1.7 | <sup>1</sup> ABLIKIM | 200 BES3 | $e^+ e^- \rightarrow \eta J/\psi$ |
|---------|----------------------|----------|-----------------------------------|

|         |                      |          |                                   |
|---------|----------------------|----------|-----------------------------------|
| 4.8±1.0 | <sup>2</sup> ABLIKIM | 200 BES3 | $e^+ e^- \rightarrow \eta J/\psi$ |
|---------|----------------------|----------|-----------------------------------|

|         |                      |          |                                   |
|---------|----------------------|----------|-----------------------------------|
| 7.0±1.5 | <sup>3</sup> ABLIKIM | 200 BES3 | $e^+ e^- \rightarrow \eta J/\psi$ |
|---------|----------------------|----------|-----------------------------------|

<sup>1</sup> Solution 1 of three equivalent fit solutions using three resonant structures.<sup>2</sup> Solution 2 of three equivalent fit solutions using three resonant structures.<sup>3</sup> Solution 3 of three equivalent fit solutions using three resonant structures.NODE=M222R10  
NODE=M222R10

OCCUR=2

OCCUR=3

NODE=M222R10;LINKAGE=A

NODE=M222R10;LINKAGE=B

NODE=M222R10;LINKAGE=C

$$\Gamma(\pi^+ \pi^- \psi(2S)) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$$

$$\Gamma_8 \Gamma_1 / \Gamma$$

| VALUE (eV) | DOCUMENT ID | TECN | COMMENT |
|------------|-------------|------|---------|
|------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |                      |          |                                            |
|---------|----------------------|----------|--------------------------------------------|
| 1.6±1.3 | <sup>1</sup> ABLIKIM | 19K BES3 | $e^+ e^- \rightarrow \pi^+ \pi^- \psi(2S)$ |
|---------|----------------------|----------|--------------------------------------------|

|         |                      |          |                                            |
|---------|----------------------|----------|--------------------------------------------|
| 1.8±1.4 | <sup>2</sup> ABLIKIM | 19K BES3 | $e^+ e^- \rightarrow \pi^+ \pi^- \psi(2S)$ |
|---------|----------------------|----------|--------------------------------------------|

<sup>1</sup> Solution I of two equivalent solutions in a fit using two interfering resonances.<sup>2</sup> Solution II of two equivalent solutions in a fit using two interfering resonances.NODE=M222R03  
NODE=M222R03

OCCUR=2

NODE=M222R03;LINKAGE=A

NODE=M222R03;LINKAGE=B

$$\Gamma(\Xi^- \Xi^+) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$$

$$\Gamma_{10} \Gamma_1 / \Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|                         |    |         |          |                                   |
|-------------------------|----|---------|----------|-----------------------------------|
| <3.3 × 10 <sup>-4</sup> | 90 | ABLIKIM | 20C BES3 | $e^+ e^- \rightarrow \Xi^- \Xi^+$ |
|-------------------------|----|---------|----------|-----------------------------------|

NODE=M222R05  
NODE=M222R05 $\psi(4230)$  BRANCHING RATIOS

NODE=M222225

$$\Gamma(\omega \chi_{c0}) / \Gamma_{\text{total}}$$

$$\Gamma_3 / \Gamma$$

| VALUE | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

|      |     |                      |          |                                        |
|------|-----|----------------------|----------|----------------------------------------|
| seen | 180 | <sup>1</sup> ABLIKIM | 15C BES3 | $e^+ e^- \rightarrow \omega \chi_{c0}$ |
|------|-----|----------------------|----------|----------------------------------------|

<sup>1</sup> From a 3-parameter fit of measured cross sections from  $\sqrt{s} = 4.21\text{--}4.42$  GeV to a phase-space modified Breit-Wigner function, using the decays  $\chi_{c0} \rightarrow \pi^+ \pi^-$ ,  $\chi_{c0} \rightarrow K^+ K^-$ , and  $\omega \rightarrow \pi^+ \pi^- \pi^0$ .NODE=M222R01  
NODE=M222R01

NODE=M222R01;LINKAGE=A

$$\Gamma(\pi^+ \pi^- h_c) / \Gamma_{\text{total}}$$

$$\Gamma_4 / \Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |         |          |                                       |
|------|---------|----------|---------------------------------------|
| seen | ABLIKIM | 17G BES3 | $e^+ e^- \rightarrow \pi^+ \pi^- h_c$ |
|------|---------|----------|---------------------------------------|

NODE=M222R00  
NODE=M222R00

$$\Gamma(\pi^0 \pi^0 J/\psi) / \Gamma_{\text{total}}$$

$$\Gamma_5 / \Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |                      |          |                                          |
|------|----------------------|----------|------------------------------------------|
| seen | <sup>1</sup> ABLIKIM | 20N BES3 | $e^+ e^- \rightarrow \pi^0 \pi^0 J/\psi$ |
|------|----------------------|----------|------------------------------------------|

<sup>1</sup> From a fit to the cross section  $e^+ e^- \rightarrow \pi^0 \pi^0 J/\psi$  at center-of-mass energies between 3.808 and 4.600 GeV.NODE=M222R08  
NODE=M222R08

NODE=M222R08;LINKAGE=A

$$\Gamma(\pi^+ \pi^- J/\psi) / \Gamma_{\text{total}}$$

$$\Gamma_6 / \Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |         |          |                                          |
|------|---------|----------|------------------------------------------|
| seen | ABLIKIM | 17B BES3 | $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$ |
|------|---------|----------|------------------------------------------|

NODE=M222R06  
NODE=M222R06

$$\Gamma(\eta J/\psi) / \Gamma_{\text{total}}$$

$$\Gamma_7 / \Gamma$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

|      |         |          |                                   |
|------|---------|----------|-----------------------------------|
| seen | ABLIKIM | 200 BES3 | $e^+ e^- \rightarrow \eta J/\psi$ |
|------|---------|----------|-----------------------------------|

NODE=M222R09  
NODE=M222R09

$\Gamma(\pi^+\pi^-\psi(2S))/\Gamma_{\text{total}}$ 
 $\Gamma_8/\Gamma$ 

| VALUE                                                                                                                                                                                                                                     | DOCUMENT ID          | TECN     | COMMENT                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|-----------------------------------------|
| <b>seen</b>                                                                                                                                                                                                                               | <sup>1</sup> ABLIKIM | 17V BES3 | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$ |
| <sup>1</sup> From a fit to the cross section for $e^+e^- \rightarrow \pi^+\pi^-\psi(2S) \rightarrow 2(\pi^+\pi^-)\ell^+\ell^-$ obtained from 16 center-of-mass energies between 4.008 and 4.600 GeV and comprising 5.1 fb <sup>-1</sup> . |                      |          |                                         |

NODE=M222R02  
NODE=M222R02

NODE=M222R02;LINKAGE=A

 $\Gamma(\pi^+D^0D^{*-} + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_9/\Gamma$ 

| VALUE       | DOCUMENT ID | TECN     | COMMENT                                           |
|-------------|-------------|----------|---------------------------------------------------|
| <b>seen</b> | ABLIKIM     | 19R BES3 | $e^+e^- \rightarrow \pi^+D^0D^{*-} + \text{c.c.}$ |

NODE=M222R04  
NODE=M222R04

 $\Gamma(\gamma\chi_{c1}(3872))/\Gamma_{\text{total}}$ 
 $\Gamma_{11}/\Gamma$ 

| VALUE       | DOCUMENT ID | TECN     | COMMENT                                    |
|-------------|-------------|----------|--------------------------------------------|
| <b>seen</b> | ABLIKIM     | 19V BES3 | $e^+e^- \rightarrow \gamma\chi_{c1}(3872)$ |

NODE=M222R07  
NODE=M222R07

 $\Gamma(\pi^+\pi^-\pi^0\eta_c)/\Gamma_{\text{total}}$ 
 $\Gamma_{12}/\Gamma$ 

| VALUE                                                                                                                                                                       | DOCUMENT ID          | TECN     | COMMENT                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|--------------------------------------------|
| <b>seen</b>                                                                                                                                                                 | <sup>1</sup> ABLIKIM | 21B BES3 | $e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta_c$ |
| <sup>1</sup> Seen as a peak in the $e^+e^- \rightarrow \pi^+\pi^-\pi^0\eta_c$ cross section with a peak value of $46.1^{+9.5}_{-9.4} \pm 6.6$ pb at $\sqrt{s} = 4.226$ GeV. |                      |          |                                            |

NODE=M222R11  
NODE=M222R11

NODE=M222R11;LINKAGE=A

 $\Gamma(\pi^+\pi^-\eta_c)/\Gamma_{\text{total}}$ 
 $\Gamma_{13}/\Gamma$ 

| VALUE                                                                                                                                                 | DOCUMENT ID          | TECN     | COMMENT                               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|---------------------------------------|
| <b>not seen</b>                                                                                                                                       | <sup>1</sup> ABLIKIM | 21B BES3 | $e^+e^- \rightarrow \pi^+\pi^-\eta_c$ |
| <sup>1</sup> Not seen in $e^+e^- \rightarrow \pi^+\pi^-\eta_c$ at $\sqrt{s} = 4.226$ GeV with a 90% C.L. upper limit on the cross section of 16.8 pb. |                      |          |                                       |

NODE=M222R13  
NODE=M222R13

NODE=M222R13;LINKAGE=A

 $\Gamma(\gamma\pi^0\eta_c)/\Gamma_{\text{total}}$ 
 $\Gamma_{14}/\Gamma$ 

| VALUE                                                                                                                                                  | DOCUMENT ID          | TECN     | COMMENT                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------|----------------------------------------|
| <b>not seen</b>                                                                                                                                        | <sup>1</sup> ABLIKIM | 21B BES3 | $e^+e^- \rightarrow \gamma\pi^0\eta_c$ |
| <sup>1</sup> Not seen in $e^+e^- \rightarrow \gamma\pi^0\eta_c$ at $\sqrt{s} = 4.226$ GeV with a 90% C.L. upper limit on the cross section of 11.2 pb. |                      |          |                                        |

NODE=M222R14  
NODE=M222R14

NODE=M222R14;LINKAGE=A

 $\Gamma(p\bar{p}p\bar{p})/\Gamma_{\text{total}}$ 
 $\Gamma_{15}/\Gamma$ 

| VALUE           | DOCUMENT ID | TECN     | COMMENT                                               |
|-----------------|-------------|----------|-------------------------------------------------------|
| <b>not seen</b> | ABLIKIM     | 21D BES3 | $4.0\text{--}4.6 e^+e^- \rightarrow p\bar{p}p\bar{p}$ |

NODE=M222R12  
NODE=M222R12

### $\psi(4230)$ REFERENCES

NODE=M222

|         |      |                      |                          |                  |             |
|---------|------|----------------------|--------------------------|------------------|-------------|
| ABLIKIM | 21B  | PR D103 032006       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=61029 |
| ABLIKIM | 21D  | PR D103 052003       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=61031 |
| ABLIKIM | 20AG | PR D102 112009       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=60744 |
| ABLIKIM | 20C  | PRL 124 032002       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=60215 |
| ABLIKIM | 20N  | PR D102 012009       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=60338 |
| ABLIKIM | 20O  | PR D102 031101       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=60344 |
| ABLIKIM | 19AI | PR D99 091103        | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=59871 |
| ABLIKIM | 19K  | PR D99 019903 (err.) | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=59611 |
| ABLIKIM | 19R  | PRL 122 102002       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=59765 |
| ABLIKIM | 19V  | PRL 122 232002       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=59796 |
| ABLIKIM | 17B  | PRL 118 092001       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=57755 |
| ABLIKIM | 17G  | PRL 118 092002       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=57915 |
| ABLIKIM | 17V  | PR D96 032004        | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=58029 |
| Also    |      | PR D99 019903 (err.) | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=59611 |
| ABLIKIM | 15C  | PRL 114 092003       | M. Ablikim <i>et al.</i> | (BESIII Collab.) | REFID=56401 |

$R_{c0}(4240)$

$I^G(J^{PC}) = 1^+(0^{--})$   
 $I, G, C$  need confirmation.

OMITTED FROM SUMMARY TABLE  
was  $X(4240)^\pm$

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

Spin and parity assignment  $J^P = 0^-$  is favored over  $1^-$ ,  $2^-$ , and  $2^+$  by  $8\sigma$  and over  $1^+$  by  $1\sigma$ , according to the four-dimensional amplitude analysis of AAIJ 14AG.

NODE=M216

NODE=M216

$R_{c0}(4240)$  MASS

NODE=M216M

| VALUE (MeV)               | DOCUMENT ID       | TECN      | COMMENT                              |
|---------------------------|-------------------|-----------|--------------------------------------|
| $4239 \pm 18^{+45}_{-10}$ | <sup>1</sup> AAIJ | 14AG LHCB | $B^0 \rightarrow K^+ \pi^- \psi(2S)$ |

NODE=M216M

<sup>1</sup> From a 4-dimensional analysis when a second, lower mass resonance is allowed in the  $Z_c(4430)$  fit, with significance  $6\sigma$  including systematic variations.

NODE=M216M;LINKAGE=AA

$R_{c0}(4240)$  WIDTH

NODE=M216W

| VALUE (MeV)               | DOCUMENT ID       | TECN      | COMMENT                              |
|---------------------------|-------------------|-----------|--------------------------------------|
| $220 \pm 47^{+108}_{-74}$ | <sup>1</sup> AAIJ | 14AG LHCB | $B^0 \rightarrow K^+ \pi^- \psi(2S)$ |

NODE=M216W

<sup>1</sup> From a 4-dimensional analysis when a second, lower mass resonance is allowed in the  $Z_c(4430)$  fit, with significance  $6\sigma$  including systematic variations.

NODE=M216W;LINKAGE=AA

$R_{c0}(4240)$  DECAY MODES

NODE=M216215;NODE=M216

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi^- \psi(2S)$ | seen                           |

DESIG=1

$R_{c0}(4240)$  BRANCHING RATIOS

NODE=M216225

| $\Gamma(\pi^- \psi(2S))/\Gamma_{\text{total}}$ |                   |           |                                      | $\Gamma_1/\Gamma$ |
|------------------------------------------------|-------------------|-----------|--------------------------------------|-------------------|
| VALUE                                          | DOCUMENT ID       | TECN      | COMMENT                              |                   |
| seen                                           | <sup>1</sup> AAIJ | 14AG LHCB | $B^0 \rightarrow K^+ \pi^- \psi(2S)$ |                   |

NODE=M216R01  
NODE=M216R01

<sup>1</sup> From a 4-dimensional analysis when a second, lower mass resonance is allowed in the  $Z_c(4430)$  fit. No partial branching fraction quoted.

NODE=M216R01;LINKAGE=AA

$R_{c0}(4240)$  REFERENCES

NODE=M216

|      |                     |                       |                |
|------|---------------------|-----------------------|----------------|
| AAIJ | 14AG PRL 112 222002 | R. Aaij <i>et al.</i> | (LHCb Collab.) |
|------|---------------------|-----------------------|----------------|

REFID=55896

**$X(4250)^\pm$** 

$$I^G(J^{PC}) = 1^-(?^{?+})$$

$I, G, C$  need confirmation.

## OMITTED FROM SUMMARY TABLE

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

Observed by MIZUK 08 in the  $\pi^+\chi_{c1}(1P)$  invariant mass distribution in  $\bar{B}^0 \rightarrow K^-\pi^+\chi_{c1}(1P)$  decays. Not seen by LEES 12B in this same mode after accounting for  $K\pi$  resonant mass and angular structure.

NODE=M192

NODE=M192

 **$X(4250)^\pm$  MASS**

| VALUE (MeV)                                 | DOCUMENT ID        | TECN | COMMENT                                            |
|---------------------------------------------|--------------------|------|----------------------------------------------------|
| <b><math>4248^{+44+180}_{-29-35}</math></b> | <sup>1</sup> MIZUK | 08   | BELL $\bar{B}^0 \rightarrow K^-\pi^+\chi_{c1}(1P)$ |

<sup>1</sup> From a Dalitz plot analysis with two Breit-Wigner amplitudes.

NODE=M192M

NODE=M192M

NODE=M192M;LINKAGE=MI

 **$X(4250)^\pm$  WIDTH**

| VALUE (MeV)                                | DOCUMENT ID        | TECN | COMMENT                                            |
|--------------------------------------------|--------------------|------|----------------------------------------------------|
| <b><math>177^{+54+316}_{-39-61}</math></b> | <sup>1</sup> MIZUK | 08   | BELL $\bar{B}^0 \rightarrow K^-\pi^+\chi_{c1}(1P)$ |

<sup>1</sup> From a Dalitz plot analysis with two Breit-Wigner amplitudes.

NODE=M192W

NODE=M192W

NODE=M192W;LINKAGE=MI

 **$X(4250)^\pm$  DECAY MODES**

| Mode                                | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi^+\chi_{c1}(1P)$ | seen                           |

NODE=M192215;NODE=M192

DESIG=1

 **$X(4250)^\pm$  BRANCHING RATIOS**

| $\Gamma(\pi^+\chi_{c1}(1P))/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$                                                        |
|----------------------------------------------------|--------------------------------------------------------------------------|
| VALUE                                              |                                                                          |
| <b>seen</b>                                        | <sup>1</sup> MIZUK 08 BELL $\bar{B}^0 \rightarrow K^-\pi^+\chi_{c1}(1P)$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen <sup>2</sup> LEES 12B BABR  $B \rightarrow K\pi\chi_{c1}(1P)$

<sup>1</sup> With a product branching fraction measurement of  $B(\bar{B}^0 \rightarrow K^-\chi_{c1}(1P)) \times B(X(4250)^+ \rightarrow \pi^+\chi_{c1}(1P)) = (4.0^{+2.3+19.7}_{-0.9-0.5}) \times 10^{-5}$ .

<sup>2</sup> With a product branching fraction limit of  $B(\bar{B}^0 \rightarrow X(4250)^+K^-) \times B(X(4250)^+ \rightarrow \chi_{c1}\pi^+) < 4.0 \times 10^{-5}$  at 90% CL.

NODE=M192225

NODE=M192R01  
NODE=M192R01

NODE=M192R01;LINKAGE=MI

NODE=M192R01;LINKAGE=LE

 **$X(4250)^\pm$  REFERENCES**

|       |     |               |                         |                 |
|-------|-----|---------------|-------------------------|-----------------|
| LEES  | 12B | PR D85 052003 | J.P. Lees <i>et al.</i> | (BABAR Collab.) |
| MIZUK | 08  | PR D78 072004 | R. Mizuk <i>et al.</i>  | (BELLE Collab.) |

NODE=M192

REFID=54042  
REFID=52535



NODE=M074

 **$\psi(4260)$** 

$$J^{PC} = 0^{-}(1^{-}-)$$

OMITTED FROM SUMMARY TABLE

also known as  $Y(4260)$ ; was  $X(4260)$ 

The state  $\psi(4260)$  received its mass label from a Breit-Wigner (BW) fit to the  $J/\psi\pi\pi$  data listed below. The symmetric BW placed the mass unavoidably into the center of the distribution. The most recent measurement in the 4260 MeV mass range in the same channel (ABLIKIM 17B), however, revealed that the distribution is asymmetric and that the state has a much lower mass consistent with the entry for particle  $\psi(4230)$ . Thus, in this edition we merged the measurement of ABLIKIM 17B with the  $\psi(4230)$  node and labeled the older measurements of this node as not used. For details see the review on "Spectroscopy of mesons containing two heavy quarks."

NODE=M074

 **$\psi(4260)$  MASS**

NODE=M074M

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID           | TECN      | COMMENT                                              |
|-------------------------------------------------------------------------------|------|-----------------------|-----------|------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |           |                                                      |
| $4209.1 \pm 6.8 \pm 7.0$                                                      |      | <sup>1</sup> ZHANG    | 17B RVUE  | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$              |
| $4223.3 \pm 1.6 \pm 2.5$                                                      |      | <sup>2</sup> ZHANG    | 17C RVUE  | $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ or $\psi(2S)$  |
| $4258.6 \pm 8.3 \pm 12.1$                                                     |      | <sup>3</sup> LIU      | 13B BELL  | $e^+e^- \rightarrow \gamma\pi^+\pi^-J/\psi$          |
| $4245 \pm 5 \pm 4$                                                            |      | <sup>4</sup> LEES     | 12AC BABR | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-J/\psi$    |
| $4247 \pm 12 \pm 17 \pm 32$                                                   |      | <sup>3,5</sup> YUAN   | 07 BELL   | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-J/\psi$    |
| $4284 \pm 17 \pm 16 \pm 413.6$                                                |      | HE                    | 06B CLEO  | $9.4-10.6 e^+e^- \rightarrow \gamma\pi^+\pi^-J/\psi$ |
| $4259 \pm 8 \pm 2 \pm 125$                                                    |      | <sup>6</sup> AUBERT,B | 05I BABR  | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-J/\psi$    |

NODE=M074M

OCCUR=2

<sup>1</sup> From a three-resonance fit.<sup>2</sup> From a combined fit of BELLE, BABAR and BES3  $e^+e^- \rightarrow \pi^+\pi^-J/\psi$  and  $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$  data.<sup>3</sup> From a two-resonance fit.<sup>4</sup> From a single-resonance fit. Supersedes AUBERT,B 05I.<sup>5</sup> Superseded by LIU 13B.<sup>6</sup> From a single-resonance fit. Two interfering resonances are not excluded. Superseded by LEES 12AC.

NODE=M074M;LINKAGE=D

NODE=M074M;LINKAGE=C

NODE=M074M;LINKAGE=YU

NODE=M074M;LINKAGE=LE

NODE=M074M;LINKAGE=YN

NODE=M074M;LINKAGE=AU

 **$\psi(4260)$  WIDTH**

NODE=M074W

| VALUE (MeV)                                                                   | EVTs | DOCUMENT ID           | TECN      | COMMENT                                              |
|-------------------------------------------------------------------------------|------|-----------------------|-----------|------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |           |                                                      |
| $76.6 \pm 14.2 \pm 2.4$                                                       |      | <sup>1</sup> ZHANG    | 17B RVUE  | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$              |
| $54.2 \pm 2.6 \pm 1.0$                                                        |      | <sup>2</sup> ZHANG    | 17C RVUE  | $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ or $\psi(2S)$  |
| $134.1 \pm 16.4 \pm 5.5$                                                      |      | <sup>3</sup> LIU      | 13B BELL  | $e^+e^- \rightarrow \gamma\pi^+\pi^-J/\psi$          |
| $114 \pm 16 \pm 15 \pm 7$                                                     |      | <sup>4</sup> LEES     | 12AC BABR | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-J/\psi$    |
| $108 \pm 19 \pm 10$                                                           |      | <sup>3,5</sup> YUAN   | 07 BELL   | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-J/\psi$    |
| $73 \pm 39 \pm 25 \pm 5 \pm 13.6$                                             |      | HE                    | 06B CLEO  | $9.4-10.6 e^+e^- \rightarrow \gamma\pi^+\pi^-J/\psi$ |
| $88 \pm 23 \pm 6 \pm 4 \pm 125$                                               |      | <sup>6</sup> AUBERT,B | 05I BABR  | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-J/\psi$    |

NODE=M074W

<sup>1</sup> From a three-resonance fit.<sup>2</sup> From a combined fit of BELLE, BABAR and BES3  $e^+e^- \rightarrow \pi^+\pi^-J/\psi$  and  $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$  data.<sup>3</sup> From a two-resonance fit.<sup>4</sup> From a single-resonance fit. Supersedes AUBERT,B 05I.<sup>5</sup> Superseded by LIU 13B.<sup>6</sup> From a single-resonance fit. Two interfering resonances are not excluded. Superseded by LEES 12AC.

NODE=M074W;LINKAGE=C

NODE=M074W;LINKAGE=B

NODE=M074W;LINKAGE=YU

NODE=M074W;LINKAGE=LE

NODE=M074W;LINKAGE=YN

NODE=M074W;LINKAGE=AU

**$\psi(4260)$  DECAY MODES**

NODE=M074215;NODE=M074

| Mode                                                                                                          | Fraction ( $\Gamma_i/\Gamma$ ) |                                 |
|---------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------------------|
| $\Gamma_1$ $e^+ e^-$                                                                                          |                                | DESIG=1                         |
| $\Gamma_2$ $J/\psi \pi^+ \pi^-$                                                                               | seen                           | DESIG=2;OUR EVAL;→ UNCHECKED ←  |
| $\Gamma_3$ $J/\psi f_0(980), f_0(980) \rightarrow \pi^+ \pi^-$                                                | seen                           | DESIG=41;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_4$ $Z_c(3900)^\pm \pi^\mp, Z_c^\pm \rightarrow J/\psi \pi^\pm$                                        | seen                           | DESIG=43;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_5$ $J/\psi \pi^0 \pi^0$                                                                               | seen                           | DESIG=4;OUR EVAL;→ UNCHECKED ←  |
| $\Gamma_6$ $J/\psi K^+ K^-$                                                                                   | seen                           | DESIG=5;OUR EVAL;→ UNCHECKED ←  |
| $\Gamma_7$ $J/\psi K_S^0 K_S^0$                                                                               | not seen                       | DESIG=44                        |
| $\Gamma_8$ $J/\psi \eta$                                                                                      | not seen                       | DESIG=6;OUR EVAL;→ UNCHECKED ←  |
| $\Gamma_9$ $J/\psi \pi^0$                                                                                     | not seen                       | DESIG=7;OUR EVAL;→ UNCHECKED ←  |
| $\Gamma_{10}$ $J/\psi \eta'$                                                                                  | not seen                       | DESIG=8;OUR EVAL;→ UNCHECKED ←  |
| $\Gamma_{11}$ $J/\psi \pi^+ \pi^- \pi^0$                                                                      | not seen                       | DESIG=9;OUR EVAL;→ UNCHECKED ←  |
| $\Gamma_{12}$ $J/\psi \eta \pi^0$                                                                             | not seen                       | DESIG=45                        |
| $\Gamma_{13}$ $J/\psi \eta \eta$                                                                              | not seen                       | DESIG=10;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{14}$ $\psi(2S) \pi^+ \pi^-$                                                                          | not seen                       | DESIG=11;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{15}$ $\psi(2S) \eta$                                                                                 | not seen                       | DESIG=12;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{16}$ $\chi_{c0} \omega$                                                                              | not seen                       | DESIG=13;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{17}$ $\chi_{c1} \pi^+ \pi^- \pi^0$                                                                   | not seen                       | DESIG=16;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{18}$ $\chi_{c2} \pi^+ \pi^- \pi^0$                                                                   | not seen                       | DESIG=17;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{19}$ $h_c(1P) \pi^+ \pi^-$                                                                           | not seen                       | DESIG=40;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{20}$ $\phi \pi^+ \pi^-$                                                                              | not seen                       | DESIG=18;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{21}$ $\phi f_0(980) \rightarrow \phi \pi^+ \pi^-$                                                    | not seen                       | DESIG=22;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{22}$ $D \bar{D}$                                                                                     | not seen                       | DESIG=19;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{23}$ $D^0 \bar{D}^0$                                                                                 | not seen                       | DESIG=31                        |
| $\Gamma_{24}$ $D^+ D^-$                                                                                       | not seen                       | DESIG=32                        |
| $\Gamma_{25}$ $D^* \bar{D} + c.c.$                                                                            | not seen                       | DESIG=23;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{26}$ $D^*(2007)^0 \bar{D}^0 + c.c.$                                                                  | not seen                       | DESIG=33                        |
| $\Gamma_{27}$ $D^*(2010)^+ D^- + c.c.$                                                                        | not seen                       | DESIG=34                        |
| $\Gamma_{28}$ $D^* \bar{D}^*$                                                                                 | not seen                       | DESIG=24;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{29}$ $D^*(2007)^0 \bar{D}^*(2007)^0$                                                                 | not seen                       | DESIG=35                        |
| $\Gamma_{30}$ $D^*(2010)^+ D^*(2010)^-$                                                                       | not seen                       | DESIG=36                        |
| $\Gamma_{31}$ $D \bar{D} \pi + c.c.$                                                                          |                                | DESIG=37                        |
| $\Gamma_{32}$ $D^0 D^- \pi^+ + c.c. \text{ (excl. } D^*(2007)^0 \bar{D}^{*0} + c.c., D^*(2010)^+ D^- + c.c.)$ | not seen                       | DESIG=38                        |
| $\Gamma_{33}$ $D \bar{D}^* \pi + c.c. \text{ (excl. } D^* \bar{D}^*)$                                         | not seen                       | DESIG=25                        |
| $\Gamma_{34}$ $D^0 D^{*-} \pi^+ + c.c. \text{ (excl. } D^*(2010)^+ D^*(2010)^-)$                              | not seen                       | DESIG=39                        |
| $\Gamma_{35}$ $D^0 D^*(2010)^- \pi^+ + c.c.$                                                                  | not seen                       | DESIG=30;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{36}$ $D_1(2420) \bar{D} + c.c.$                                                                      | not seen                       | DESIG=50                        |
| $\Gamma_{37}$ $D^* \bar{D}^* \pi$                                                                             | not seen                       | DESIG=26                        |
| $\Gamma_{38}$ $D_s^+ D_s^-$                                                                                   | not seen                       | DESIG=27                        |
| $\Gamma_{39}$ $D_s^{*+} D_s^- + c.c.$                                                                         | not seen                       | DESIG=28                        |
| $\Gamma_{40}$ $D_s^{*+} D_s^{*-}$                                                                             | not seen                       | DESIG=29                        |
| $\Gamma_{41}$ $p \bar{p}$                                                                                     | not seen                       | DESIG=3;OUR EVAL;→ UNCHECKED ←  |
| $\Gamma_{42}$ $p \bar{p} \pi^0$                                                                               | not seen                       | DESIG=46;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{43}$ $\Xi^- \Xi^+$                                                                                   |                                | DESIG=51                        |
| $\Gamma_{44}$ $K_S^0 K^\pm \pi^\mp$                                                                           | not seen                       | DESIG=20;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{45}$ $K_S^0 K^\pm \pi^\mp \pi^0$                                                                     |                                | DESIG=48                        |
| $\Gamma_{46}$ $K_S^0 K^\pm \pi^\mp \eta$                                                                      |                                | DESIG=49                        |
| $\Gamma_{47}$ $K^+ K^- \pi^0$                                                                                 | not seen                       | DESIG=21;OUR EVAL;→ UNCHECKED ← |
| <b>Radiative decays</b>                                                                                       |                                |                                 |
| $\Gamma_{48}$ $\eta_c(1S) \gamma$                                                                             | possibly seen                  | NODE=M074;CLUMP=C<br>DESIG=47   |
| $\Gamma_{49}$ $\chi_{c1} \gamma$                                                                              | not seen                       | DESIG=14;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{50}$ $\chi_{c2} \gamma$                                                                              | not seen                       | DESIG=15;OUR EVAL;→ UNCHECKED ← |
| $\Gamma_{51}$ $\chi_{c1}(3872) \gamma$                                                                        | seen                           | DESIG=42                        |

$\psi(4260) \Gamma(i) \times \Gamma(e^+ e^-) / \Gamma(\text{total})$ 

NODE=M074230

 $\Gamma(J/\psi \pi^+ \pi^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_2 \Gamma_1 / \Gamma$ 

| VALUE (eV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

**9.2±1.0 OUR AVERAGE**

|                                          |     |                   |           |                                                          |
|------------------------------------------|-----|-------------------|-----------|----------------------------------------------------------|
| 9.2±0.8±0.7                              |     | <sup>1</sup> LEES | 12AC BABR | 10.58 $e^+ e^- \rightarrow \gamma \pi^+ \pi^- J/\psi$    |
| 8.9 <sup>+3.9</sup> <sub>-3.1</sub> ±1.8 | 8.1 | HE                | 06B CLEO  | 9.4–10.6 $e^+ e^- \rightarrow \gamma \pi^+ \pi^- J/\psi$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                          |     |                       |          |                                                       |
|------------------------------------------|-----|-----------------------|----------|-------------------------------------------------------|
| 6.4±0.8±0.6                              |     | <sup>2</sup> LIU      | 13B BELL | $e^+ e^- \rightarrow \gamma \pi^+ \pi^- J/\psi$       |
| 20.5±1.4±2.0                             |     | <sup>3</sup> LIU      | 13B BELL | $e^+ e^- \rightarrow \gamma \pi^+ \pi^- J/\psi$       |
| 6.0±1.2 <sup>+4.7</sup> <sub>-0.5</sub>  | 2,4 | YUAN                  | 07 BELL  | 10.58 $e^+ e^- \rightarrow \gamma \pi^+ \pi^- J/\psi$ |
| 20.6±2.3 <sup>+9.1</sup> <sub>-1.7</sub> | 3,4 | YUAN                  | 07 BELL  | 10.58 $e^+ e^- \rightarrow \gamma \pi^+ \pi^- J/\psi$ |
| 5.5±1.0 <sup>+0.8</sup> <sub>-0.7</sub>  | 125 | <sup>5</sup> AUBERT,B | 05I BABR | 10.58 $e^+ e^- \rightarrow \gamma \pi^+ \pi^- J/\psi$ |

<sup>1</sup> From a single-resonance fit. Supersedes AUBERT,B 05I.<sup>2</sup> Solution I of two equivalent solutions in a fit using two interfering resonances.<sup>3</sup> Solution II of two equivalent solutions in a fit using two interfering resonances.<sup>4</sup> Superseded by LIU 13B.<sup>5</sup> From a single-resonance fit. Two interfering resonances are not excluded. Superseded by LEES 12AC.NODE=M074G1  
NODE=M074G1

OCCUR=2

OCCUR=2

NODE=M074G1;LINKAGE=LE  
NODE=M074G1;LINKAGE=YU  
NODE=M074G1;LINKAGE=YA  
NODE=M074G1;LINKAGE=YN  
NODE=M074G1;LINKAGE=AU $\Gamma(J/\psi K^+ K^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_6 \Gamma_1 / \Gamma$ 

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

**<1.7** 90 <sup>1</sup> SHEN 14 BELL 9.4–10.9  $e^+ e^- \rightarrow \gamma K^+ K^- J/\psi$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

<1.2 90 <sup>2</sup> YUAN 08 BELL  $e^+ e^- \rightarrow \gamma K^+ K^- J/\psi$ <sup>1</sup> From a fit of the broad  $K^+ K^- J/\psi$  enhancement including a coherent  $\psi(4260)$  amplitude with mass and width from LIU 13B. Supersedes YUAN 08. The shape of the cross section observed by ABLIKIM 18N between 2.2 and 2.3 GeV is incompatible with that of  $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$  in ABLIKIM 13T and ABLIKIM 17B. They also observe a broad enhancement around 2.5 GeV.<sup>2</sup> From a fit of the broad  $K^+ K^- J/\psi$  enhancement including a coherent  $\psi(4260)$  amplitude with mass and width from YUAN 07.NODE=M074G3  
NODE=M074G3

NODE=M074G3;LINKAGE=A

NODE=M074G3;LINKAGE=YU

 $\Gamma(J/\psi K_S^0 K_S^0) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_7 \Gamma_1 / \Gamma$ 

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

**<0.85** 90 <sup>1</sup> SHEN 14 BELL 9.4–10.9  $e^+ e^- \rightarrow \gamma K_S^0 K_S^0 J/\psi$ <sup>1</sup> From a fit of the  $K_S^0 K_S^0 J/\psi$  mass range from 4.4 to 5.5 GeV including a coherent  $\psi(4260)$  amplitude with mass and width from LIU 13B.NODE=M074G02  
NODE=M074G02

NODE=M074G02;LINKAGE=A

 $\Gamma(J/\psi \eta) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_8 \Gamma_1 / \Gamma$ 

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

<14.2 90 WANG 13B BELL  $e^+ e^- \rightarrow J/\psi \eta \gamma$ NODE=M074G01  
NODE=M074G01 $\Gamma(J/\psi \eta') \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_{10} \Gamma_1 / \Gamma$ 

| VALUE (eV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |    |                        |          |                                    |
|-----------|----|------------------------|----------|------------------------------------|
| 0.06±0.03 | 46 | <sup>1,2</sup> ABLIKIM | 20A BES3 | $e^+ e^- \rightarrow \eta' J/\psi$ |
| 1.38±0.11 | 46 | <sup>1,3</sup> ABLIKIM | 20A BES3 | $e^+ e^- \rightarrow \eta' J/\psi$ |

<sup>1</sup> Based on a fit to  $\sigma(e^+ e^- \rightarrow \eta' J/\psi)$  from  $\sqrt{s} = 4.18$  to 4.60 GeV assuming interfering  $\psi(4160)$  and  $\psi(4260)$  contributions. At  $\sqrt{s} = 4.23$  GeV,  $\sigma(e^+ e^- \rightarrow \eta' J/\psi) = 3.6 \pm 0.6 \pm 0.3$  pb.<sup>2</sup> Solution I of the fit, corresponding to a phase of  $-0.03 \pm 0.44$  rad.<sup>3</sup> Solution II of the fit, corresponding to a phase of  $2.54 \pm 0.04$  rad.NODE=M074R34  
NODE=M074R34

OCCUR=2

NODE=M074R34;LINKAGE=A

NODE=M074R34;LINKAGE=B  
NODE=M074R34;LINKAGE=C $\Gamma(\psi(2S) \pi^+ \pi^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_{14} \Gamma_1 / \Gamma$ 

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                     |    |                  |          |                                                         |
|-------------------------------------|----|------------------|----------|---------------------------------------------------------|
| <4.3                                | 90 | <sup>1</sup> LIU | 08H RVUE | 10.58 $e^+ e^- \rightarrow \psi(2S) \pi^+ \pi^- \gamma$ |
| 7.4 <sup>+2.1</sup> <sub>-1.7</sub> |    | <sup>2</sup> LIU | 08H RVUE | 10.58 $e^+ e^- \rightarrow \psi(2S) \pi^+ \pi^- \gamma$ |

<sup>1</sup> For constructive interference with the  $\psi(4360)$  in a combined fit of AUBERT 07S and WANG 07D data with three resonances.<sup>2</sup> For destructive interference with the  $\psi(4360)$  in a combined fit of AUBERT 07S and WANG 07D data with three resonances.NODE=M074G7  
NODE=M074G7

OCCUR=2

NODE=M074G7;LINKAGE=LI

NODE=M074G7;LINKAGE=LU

$$\Gamma(\phi\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{20}\Gamma_1/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID   | TECN | COMMENT                                          |
|------------|-----|---------------|------|--------------------------------------------------|
| <0.4       | 90  | AUBERT,BE 06D | BABR | 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$ |

NODE=M074G2  
NODE=M074G2

$$\Gamma(\phi f_0(980) \rightarrow \phi\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{21}\Gamma_1/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID              | TECN | COMMENT                                          |
|------------|-----|--------------------------|------|--------------------------------------------------|
| <0.28      | 90  | <sup>1</sup> AUBERT 07AK | BABR | 10.6 $e^+e^- \rightarrow \pi^+\pi^-K^+K^-\gamma$ |

NODE=M074G6  
NODE=M074G6

<sup>1</sup> AUBERT 07AK reports  $[\Gamma(\psi(4260) \rightarrow \phi f_0(980) \rightarrow \phi\pi^+\pi^-) \times \Gamma(\psi(4260) \rightarrow e^+e^-)/\Gamma_{\text{total}}] \times [B(\phi(1020) \rightarrow K^+K^-)] < 0.14$  eV which we divide by our best value  $B(\phi(1020) \rightarrow K^+K^-) = 49.2 \times 10^{-2}$ .

NODE=M074G6;LINKAGE=AU

$$\Gamma(\Xi^-\Xi^+) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{43}\Gamma_1/\Gamma$$

| VALUE (eV)            | CL% | DOCUMENT ID | TECN | COMMENT                              |
|-----------------------|-----|-------------|------|--------------------------------------|
| <2.7 $\times 10^{-4}$ | 90  | ABLIKIM     | 20C  | BES3 $e^+e^- \rightarrow \Xi^-\Xi^+$ |

NODE=M074R35  
NODE=M074R35

$$\Gamma(K_S^0 K^\pm \pi^\mp) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{44}\Gamma_1/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

NODE=M074G4  
NODE=M074G4

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                |                      |      |      |                                                      |
|--------------------------------|----------------------|------|------|------------------------------------------------------|
| 2.04 $\pm 0.19 \pm 0.09$       | <sup>1</sup> ABLIKIM | 19AE | BES3 | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$             |
| 0.0027 $\pm 0.0023 \pm 0.0001$ | <sup>2</sup> ABLIKIM | 19AE | BES3 | $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp$             |
| < 0.5 at 90% CL                | AUBERT               | 08S  | BABR | 10.6 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp \gamma$ |

OCCUR=2

<sup>1</sup> Solution I of the fit including the  $\psi(4160)$  with mass  $4191 \pm 5$  MeV and width  $70 \pm 10$  MeV from PDG 16 and the  $\psi(4230)$  with mass  $4219.6 \pm 3.3 \pm 5.1$  MeV and width  $56.0 \pm 3.6 \pm 6.9$  MeV from GAO 17.

NODE=M074G4;LINKAGE=A

<sup>2</sup> Solution II of the fit including the  $\psi(4160)$  with mass  $4191 \pm 5$  MeV and width  $70 \pm 10$  MeV from PDG 16 and the  $\psi(4230)$  with mass  $4219.6 \pm 3.3 \pm 5.1$  MeV and width  $56.0 \pm 3.6 \pm 6.9$  MeV from GAO 17.

NODE=M074G4;LINKAGE=B

$$\Gamma(K_S^0 K^\pm \pi^\mp \pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{45}\Gamma_1/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT                                             |
|------------|-----|-------------|------|-----------------------------------------------------|
| <0.05      | 90  | ABLIKIM     | 19   | BES3 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp \pi^0$ |

NODE=M074R31  
NODE=M074R31

$$\Gamma(K_S^0 K^\pm \pi^\mp \eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{46}\Gamma_1/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT                                            |
|------------|-----|-------------|------|----------------------------------------------------|
| <0.19      | 90  | ABLIKIM     | 19   | BES3 $e^+e^- \rightarrow K_S^0 K^\pm \pi^\mp \eta$ |

NODE=M074R32  
NODE=M074R32

$$\Gamma(K^+K^-\pi^0) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{47}\Gamma_1/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

NODE=M074G5  
NODE=M074G5

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |        |     |                                                  |
|------|----|--------|-----|--------------------------------------------------|
| <0.6 | 90 | AUBERT | 08S | BABR 10.6 $e^+e^- \rightarrow K^+K^-\pi^0\gamma$ |
|------|----|--------|-----|--------------------------------------------------|

$$\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{49}\Gamma_1/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID      | TECN | COMMENT                                         |
|------------|-----|------------------|------|-------------------------------------------------|
| <1.4       | 90  | <sup>1</sup> HAN | 15   | BELL 10.58 $e^+e^- \rightarrow \chi_{c1}\gamma$ |

NODE=M074G03  
NODE=M074G03

<sup>1</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M074G03;LINKAGE=A

$$\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}} \quad \Gamma_{50}\Gamma_1/\Gamma$$

| VALUE (eV) | CL% | DOCUMENT ID      | TECN | COMMENT                                         |
|------------|-----|------------------|------|-------------------------------------------------|
| <4.0       | 90  | <sup>1</sup> HAN | 15   | BELL 10.58 $e^+e^- \rightarrow \chi_{c2}\gamma$ |

NODE=M074G04  
NODE=M074G04

<sup>1</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M074G04;LINKAGE=A

### $\psi(4260)$ BRANCHING RATIOS

NODE=M074225

$$\Gamma(J/\psi f_0(980), f_0(980) \rightarrow \pi^+\pi^-)/\Gamma(J/\psi \pi^+\pi^-) \quad \Gamma_3/\Gamma_2$$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M074R02  
NODE=M074R02

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                 |                   |      |                                                         |
|-----------------|-------------------|------|---------------------------------------------------------|
| 0.17 $\pm 0.13$ | <sup>1</sup> LEES | 12AC | BABR 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- J/\psi$ |
|-----------------|-------------------|------|---------------------------------------------------------|

<sup>1</sup> Systematic uncertainties not estimated.

NODE=M074R02;LINKAGE=LE

$$\Gamma(Z_c(3900)^\pm \pi^\mp, Z_c^\pm \rightarrow J/\psi \pi^\pm)/\Gamma(J/\psi \pi^+ \pi^-) \quad \Gamma_4/\Gamma_2$$

| VALUE                                                                         | DOCUMENT ID          | TECN     | COMMENT                                         |
|-------------------------------------------------------------------------------|----------------------|----------|-------------------------------------------------|
| <b>0.215 ± 0.033 ± 0.075</b>                                                  | <sup>1</sup> ABLIKIM | 13T BES3 | $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |          |                                                 |
| 0.29 ± 0.08                                                                   | <sup>2</sup> LIU     | 13B BELL | $e^+ e^- \rightarrow \gamma \pi^+ \pi^- J/\psi$ |

<sup>1</sup> Assuming that the cross section of  $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$  is fully due to the  $\psi(4260)$ .

<sup>2</sup> Systematic error not evaluated.

NODE=M074R01  
NODE=M074R01

NODE=M074R01;LINKAGE=AB  
NODE=M074R01;LINKAGE=A

$$\Gamma(J/\psi K_S^0 K_S^0)/\Gamma_{\text{total}} \quad \Gamma_7/\Gamma$$

| VALUE           | DOCUMENT ID | TECN    | COMMENT                                                  |
|-----------------|-------------|---------|----------------------------------------------------------|
| <b>not seen</b> | SHEN        | 14 BELL | 9.4–10.9 $e^+ e^- \rightarrow \gamma K_S^0 K_S^0 J/\psi$ |

NODE=M074R27  
NODE=M074R27

$$\Gamma(J/\psi \eta \pi^0)/\Gamma_{\text{total}} \quad \Gamma_{12}/\Gamma$$

| VALUE           | DOCUMENT ID | TECN     | COMMENT                                         |
|-----------------|-------------|----------|-------------------------------------------------|
| <b>not seen</b> | ABLIKIM     | 15Q BES3 | 4.0–4.6 $e^+ e^- \rightarrow J/\psi \eta \pi^0$ |

NODE=M074R28  
NODE=M074R28

$$\Gamma(\psi(2S) \pi^+ \pi^-)/\Gamma(J/\psi \pi^+ \pi^-) \quad \Gamma_{14}/\Gamma_2$$

| VALUE                                                                         | DOCUMENT ID        | TECN     | COMMENT                                                |
|-------------------------------------------------------------------------------|--------------------|----------|--------------------------------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                    |          |                                                        |
| (0.11 ± 0.03 ± 0.03) to (0.55 ± 0.18 ± 0.19)                                  | <sup>1</sup> ZHANG | 17C RVUE | $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$ or $\psi(2S)$ |

<sup>1</sup> From a combined fit of BELLE, BABAR and BES3  $e^+ e^- \rightarrow \pi^+ \pi^- J/\psi$  and  $e^+ e^- \rightarrow \pi^+ \pi^- \psi(2S)$  data.

NODE=M074R30  
NODE=M074R30

NODE=M074R30;LINKAGE=A

$$\Gamma(h_c(1P) \pi^+ \pi^-)/\Gamma(J/\psi \pi^+ \pi^-) \quad \Gamma_{19}/\Gamma_2$$

| VALUE          | CL% | DOCUMENT ID         | TECN    | COMMENT                                   |
|----------------|-----|---------------------|---------|-------------------------------------------|
| <b>&lt;1.0</b> | 90  | <sup>1</sup> PEDLAR | 11 CLEO | $e^+ e^- \rightarrow h_c(1P) \pi^+ \pi^-$ |

<sup>1</sup> At  $\sqrt{s} = 4260$  MeV, PEDLAR 11 measures  $\sigma(e^+ e^- \rightarrow h_c(1P) \pi^+ \pi^-) = 32 \pm 17 \pm 6 \pm 6$  pb, where the errors are statistical, systematic, and due to uncertainty in  $B(\psi(2S) \rightarrow \pi^0 h_c(1P))$ , respectively.

NODE=M074R25  
NODE=M074R25

NODE=M074R25;LINKAGE=PE

$$\Gamma(D\bar{D})/\Gamma(J/\psi \pi^+ \pi^-) \quad \Gamma_{22}/\Gamma_2$$

| VALUE          | CL% | DOCUMENT ID         | TECN      | COMMENT                               |
|----------------|-----|---------------------|-----------|---------------------------------------|
| <b>&lt;1.0</b> | 90  | <sup>1</sup> AUBERT | 07BE BABR | $e^+ e^- \rightarrow D\bar{D} \gamma$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<4.0 90 CRONIN-HEN..09 CLEO  $e^+ e^-$

<sup>1</sup> Using 4259 ± 10 MeV for the mass and 88 ± 24 MeV for the width of  $\psi(4260)$ .

NODE=M074R2  
NODE=M074R2

NODE=M074R2;LINKAGE=AU

$$\Gamma(D^0 \bar{D}^0)/\Gamma_{\text{total}} \quad \Gamma_{23}/\Gamma$$

| VALUE           | DOCUMENT ID    | TECN | COMMENT                             |
|-----------------|----------------|------|-------------------------------------|
| <b>not seen</b> | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^0 \bar{D}^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen AUBERT 09M BABR  $e^+ e^- \rightarrow D^0 \bar{D}^0 \gamma$

not seen PAKHLOVA 08 BELL  $e^+ e^- \rightarrow D^0 \bar{D}^0 \gamma$

NODE=M074R12  
NODE=M074R12

$$\Gamma(D^+ D^-)/\Gamma_{\text{total}} \quad \Gamma_{24}/\Gamma$$

| VALUE           | DOCUMENT ID    | TECN | COMMENT                       |
|-----------------|----------------|------|-------------------------------|
| <b>not seen</b> | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^+ D^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen AUBERT 09M BABR  $e^+ e^- \rightarrow D^+ D^- \gamma$

not seen PAKHLOVA 08 BELL  $e^+ e^- \rightarrow D^+ D^- \gamma$

NODE=M074R13  
NODE=M074R13

$$\Gamma(D^* \bar{D} + \text{c.c.})/\Gamma(J/\psi \pi^+ \pi^-) \quad \Gamma_{25}/\Gamma_2$$

| VALUE         | CL% | DOCUMENT ID | TECN     | COMMENT                                  |
|---------------|-----|-------------|----------|------------------------------------------|
| <b>&lt;34</b> | 90  | AUBERT      | 09M BABR | $e^+ e^- \rightarrow \gamma D^* \bar{D}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<45 90 CRONIN-HEN..09 CLEO  $e^+ e^-$

NODE=M074R03  
NODE=M074R03

$$\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{26}/\Gamma$$

| VALUE           | DOCUMENT ID    | TECN | COMMENT                                |
|-----------------|----------------|------|----------------------------------------|
| <b>not seen</b> | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^{*0} \bar{D}^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

not seen AUBERT 09M BABR  $e^+ e^- \rightarrow D^{*0} \bar{D}^0 \gamma$

NODE=M074R14  
NODE=M074R14

$\Gamma(D^*(2010)^+ D^- + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{27}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID    | TECN | COMMENT                                 |
|-------------------------------------------------------------------------------|----------------|------|-----------------------------------------|
| not seen                                                                      | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^{*+} D^-$        |
| not seen                                                                      | PAKHLOVA 07    | BELL | $e^+ e^- \rightarrow D^{*+} D^- \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                |      |                                         |
| not seen                                                                      | AUBERT 09M     | BABR | $e^+ e^- \rightarrow D^{*+} D^- \gamma$ |

NODE=M074R15  
NODE=M074R15

 $\Gamma(D^* \bar{D}^*)/\Gamma(J/\psi \pi^+ \pi^-)$ 
 $\Gamma_{28}/\Gamma_2$ 

| VALUE                                                                         | CL% | DOCUMENT ID    | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|-----|----------------|------|--------------------------------------------|
| <11                                                                           | 90  | CRONIN-HEN..09 | CLEO | $e^+ e^-$                                  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                |      |                                            |
| <40                                                                           | 90  | AUBERT 09M     | BABR | $e^+ e^- \rightarrow \gamma D^* \bar{D}^*$ |

NODE=M074R04  
NODE=M074R04

 $\Gamma(D^*(2007)^0 \bar{D}^*(2007)^0)/\Gamma_{\text{total}}$ 
 $\Gamma_{29}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID    | TECN | COMMENT                                          |
|-------------------------------------------------------------------------------|----------------|------|--------------------------------------------------|
| not seen                                                                      | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^{*0} \bar{D}^{*0}$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                |      |                                                  |
| not seen                                                                      | AUBERT 09M     | BABR | $e^+ e^- \rightarrow D^{*0} \bar{D}^{*0} \gamma$ |

NODE=M074R17  
NODE=M074R17

 $\Gamma(D^*(2010)^+ D^*(2010)^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{30}/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID    | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|----------------|------|--------------------------------------------|
| not seen                                                                      | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^{*+} D^{*-}$        |
| not seen                                                                      | PAKHLOVA 07    | BELL | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                |      |                                            |
| not seen                                                                      | AUBERT 09M     | BABR | $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |

NODE=M074R18  
NODE=M074R18

 $\Gamma(D^0 D^- \pi^+ + \text{c.c. (excl. } D^*(2007)^0 \bar{D}^{*0} + \text{c.c., } D^*(2010)^+ D^- + \text{c.c.}))/\Gamma_{\text{total}}$ 
 $\Gamma_{32}/\Gamma$ 

| VALUE    | DOCUMENT ID  | TECN | COMMENT                                         |
|----------|--------------|------|-------------------------------------------------|
| not seen | PAKHLOVA 08A | BELL | $10.6 e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma$ |

NODE=M074R16  
NODE=M074R16

 $\Gamma(D \bar{D}^* \pi + \text{c.c. (excl. } D^* \bar{D}^*))/\Gamma_{\text{total}}$ 
 $\Gamma_{33}/\Gamma$ 

| VALUE    | DOCUMENT ID    | TECN | COMMENT                               |
|----------|----------------|------|---------------------------------------|
| not seen | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^* \bar{D} \pi$ |

NODE=M074R22  
NODE=M074R22

 $\Gamma(D \bar{D}^* \pi + \text{c.c. (excl. } D^* \bar{D}^*))/\Gamma(J/\psi \pi^+ \pi^-)$ 
 $\Gamma_{33}/\Gamma_2$ 

| VALUE | CL% | DOCUMENT ID    | TECN | COMMENT   |
|-------|-----|----------------|------|-----------|
| <15   | 90  | CRONIN-HEN..09 | CLEO | $e^+ e^-$ |

NODE=M074R05  
NODE=M074R05

 $\Gamma(D^0 D^{*-} \pi^+ + \text{c.c. (excl. } D^*(2010)^+ D^*(2010)^-))/\Gamma_{\text{total}}$ 
 $\Gamma_{34}/\Gamma$ 

| VALUE    | DOCUMENT ID | TECN | COMMENT                                       |
|----------|-------------|------|-----------------------------------------------|
| not seen | PAKHLOVA 09 | BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+ \gamma$ |

NODE=M074R23  
NODE=M074R23

 $\Gamma(D^0 D^*(2010)^- \pi^+ + \text{c.c.})/\Gamma(J/\psi \pi^+ \pi^-)$ 
 $\Gamma_{35}/\Gamma_2$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT                                |
|-------|-----|-------------|------|----------------------------------------|
| <9    | 90  | PAKHLOVA 09 | BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+$ |

NODE=M074R10  
NODE=M074R10

 $\Gamma(D^0 D^*(2010)^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{35}/\Gamma \times \Gamma_1/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID              | TECN | COMMENT                                |
|------------------------|-----|--------------------------|------|----------------------------------------|
| <0.42 $\times 10^{-6}$ | 90  | <sup>1</sup> PAKHLOVA 09 | BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+$ |

NODE=M074R11  
NODE=M074R11

<sup>1</sup> Using  $4263^{+8}_{-9}$  MeV for the mass of  $\psi(4260)$ .

NODE=M074R11;LINKAGE=PA

 $\Gamma(D^* \bar{D}^* \pi)/\Gamma_{\text{total}}$ 
 $\Gamma_{37}/\Gamma$ 

| VALUE    | DOCUMENT ID    | TECN | COMMENT                                 |
|----------|----------------|------|-----------------------------------------|
| not seen | CRONIN-HEN..09 | CLEO | $e^+ e^- \rightarrow D^* \bar{D}^* \pi$ |

NODE=M074R24  
NODE=M074R24

 $\Gamma(D^* \bar{D}^* \pi)/\Gamma(J/\psi \pi^+ \pi^-)$ 
 $\Gamma_{37}/\Gamma_2$ 

| VALUE | CL% | DOCUMENT ID    | TECN | COMMENT   |
|-------|-----|----------------|------|-----------|
| <8.2  | 90  | CRONIN-HEN..09 | CLEO | $e^+ e^-$ |

NODE=M074R06  
NODE=M074R06

$$\Gamma(D_1(2420)\bar{D} + \text{c.c.})/\Gamma_{\text{total}}$$

$$\Gamma_{36}/\Gamma$$

| VALUE                                                                                                                                        | DOCUMENT ID          | TECN      | COMMENT                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------|------------------------------------------|
| not seen                                                                                                                                     | <sup>1</sup> ABLIKIM | 19AR BES3 | $e^+e^- \rightarrow \pi^+\pi^- D\bar{D}$ |
| <sup>1</sup> Results from a measurement of $\sigma(e^+e^- \rightarrow D_1(2420)\bar{D} + \text{c.c.})$ between $\sqrt{s} = 4.3$ and 4.6 GeV. |                      |           |                                          |

NODE=M074R33  
NODE=M074R33

NODE=M074R33;LINKAGE=A

$$\Gamma(D_s^+ D_s^-)/\Gamma_{\text{total}}$$

$$\Gamma_{38}/\Gamma$$

| VALUE                                                                         | DOCUMENT ID     | TECN | COMMENT                                 |
|-------------------------------------------------------------------------------|-----------------|------|-----------------------------------------|
| not seen                                                                      | DEL-AMO-SA..10N | BABR | $e^+e^- \rightarrow D_s^+ D_s^- \gamma$ |
| not seen                                                                      | CRONIN-HEN..09  | CLEO | $e^+e^- \rightarrow D_s^+ D_s^-$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                 |      |                                         |
| not seen                                                                      | PAKHLOVA 11     | BELL | $e^+e^- \rightarrow D_s^+ D_s^- \gamma$ |

NODE=M074R19  
NODE=M074R19

$$\Gamma(D_s^+ D_s^-)/\Gamma(J/\psi\pi^+\pi^-)$$

$$\Gamma_{38}/\Gamma_2$$

| VALUE                                                                         | CL% | DOCUMENT ID     | TECN | COMMENT       |
|-------------------------------------------------------------------------------|-----|-----------------|------|---------------|
| <0.7                                                                          | 95  | DEL-AMO-SA..10N | BABR | $10.6 e^+e^-$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                 |      |               |
| <1.3                                                                          | 90  | CRONIN-HEN..09  | CLEO | $e^+e^-$      |

NODE=M074R07  
NODE=M074R07

$$\Gamma(D_s^{*+} D_s^- + \text{c.c.})/\Gamma_{\text{total}}$$

$$\Gamma_{39}/\Gamma$$

| VALUE                                                                         | DOCUMENT ID     | TECN | COMMENT                                    |
|-------------------------------------------------------------------------------|-----------------|------|--------------------------------------------|
| not seen                                                                      | DEL-AMO-SA..10N | BABR | $e^+e^- \rightarrow D_s^{*+} D_s^- \gamma$ |
| not seen                                                                      | CRONIN-HEN..09  | CLEO | $e^+e^- \rightarrow D_s^{*+} D_s^-$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                 |      |                                            |
| not seen                                                                      | PAKHLOVA 11     | BELL | $e^+e^- \rightarrow D_s^{*+} D_s^- \gamma$ |

NODE=M074R20  
NODE=M074R20

$$\Gamma(D_s^{*+} D_s^- + \text{c.c.})/\Gamma(J/\psi\pi^+\pi^-)$$

$$\Gamma_{39}/\Gamma_2$$

| VALUE                                                                         | CL% | DOCUMENT ID     | TECN | COMMENT       |
|-------------------------------------------------------------------------------|-----|-----------------|------|---------------|
| < 0.8                                                                         | 90  | CRONIN-HEN..09  | CLEO | $e^+e^-$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                 |      |               |
| <44                                                                           | 95  | DEL-AMO-SA..10N | BABR | $10.6 e^+e^-$ |

NODE=M074R08  
NODE=M074R08

$$\Gamma(D_s^{*+} D_s^{*-})/\Gamma_{\text{total}}$$

$$\Gamma_{40}/\Gamma$$

| VALUE                                                                         | DOCUMENT ID     | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|-----------------|------|-----------------------------------------------|
| not seen                                                                      | CRONIN-HEN..09  | CLEO | $e^+e^- \rightarrow D_s^{*+} D_s^{*-}$        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                 |      |                                               |
| not seen                                                                      | PAKHLOVA 11     | BELL | $e^+e^- \rightarrow D_s^{*+} D_s^{*-} \gamma$ |
| not seen                                                                      | DEL-AMO-SA..10N | BABR | $e^+e^- \rightarrow D_s^{*+} D_s^{*-} \gamma$ |

NODE=M074R21  
NODE=M074R21

$$\Gamma(D_s^{*+} D_s^{*-})/\Gamma(J/\psi\pi^+\pi^-)$$

$$\Gamma_{40}/\Gamma_2$$

| VALUE                                                                         | CL% | DOCUMENT ID     | TECN | COMMENT       |
|-------------------------------------------------------------------------------|-----|-----------------|------|---------------|
| < 9.5                                                                         | 90  | CRONIN-HEN..09  | CLEO | $e^+e^-$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                 |      |               |
| <30                                                                           | 95  | DEL-AMO-SA..10N | BABR | $10.6 e^+e^-$ |

NODE=M074R09  
NODE=M074R09

$$\Gamma(p\bar{p})/\Gamma(J/\psi\pi^+\pi^-)$$

$$\Gamma_{41}/\Gamma_2$$

| VALUE                                                                                                 | CL% | DOCUMENT ID         | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------------------------------|-----|---------------------|----------|-------------------------------------|
| <0.13                                                                                                 | 90  | <sup>1</sup> AUBERT | 06B BABR | $e^+e^- \rightarrow p\bar{p}\gamma$ |
| <sup>1</sup> Using $4259 \pm 10$ MeV for the mass and $88 \pm 24$ MeV for the width of $\psi(4260)$ . |     |                     |          |                                     |

NODE=M074R1  
NODE=M074R1

NODE=M074R1;LINKAGE=AU

$$\Gamma(p\bar{p}\pi^0)/\Gamma(J/\psi\pi^+\pi^-)$$

$$\Gamma_{42}/\Gamma_2$$

| VALUE                 | CL% | DOCUMENT ID | TECN     | COMMENT                                                    |
|-----------------------|-----|-------------|----------|------------------------------------------------------------|
| <2 × 10 <sup>-4</sup> | 90  | ABLIKIM     | 17F BES3 | $e^+e^- \rightarrow \psi(4260) \rightarrow \text{hadrons}$ |

NODE=M074R00  
NODE=M074R00  
OCCUR=2

### Radiative decays

$$\Gamma(\eta_c(1S)\gamma)/\Gamma_{\text{total}}$$

$$\Gamma_{48}/\Gamma$$

| VALUE         | DOCUMENT ID          | COMMENT                                   |
|---------------|----------------------|-------------------------------------------|
| possibly seen | <sup>1</sup> ABLIKIM | 17W $e^+e^- \rightarrow \gamma\eta_c(1S)$ |

NODE=M074310

NODE=M074R29  
NODE=M074R29

<sup>1</sup> Significance ranges from 4.2  $\sigma$  to as low as 1.5  $\sigma$  for a flat component plus  $\psi(4260)$  spectrum. Needs confirmation.

NODE=M074R29;LINKAGE=A

| $\Gamma(\chi_{c1}(3872)\gamma)/\Gamma_{\text{total}}$ |            |             |      |         | $\Gamma_{51}/\Gamma$                           |
|-------------------------------------------------------|------------|-------------|------|---------|------------------------------------------------|
| VALUE                                                 | EVS        | DOCUMENT ID | TECN | COMMENT |                                                |
| seen                                                  | 20 $\pm$ 5 | ABLIKIM     | 14   | BES3    | $e^+e^- \rightarrow J/\psi \pi^+ \pi^- \gamma$ |

NODE=M074R26  
NODE=M074R26

## $\psi(4260)$ REFERENCES

NODE=M074

|               |      |                |                                  |                  |             |
|---------------|------|----------------|----------------------------------|------------------|-------------|
| ABLIKIM       | 20A  | PR D101 012008 | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=60210 |
| ABLIKIM       | 20C  | PRL 124 032002 | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=60215 |
| ABLIKIM       | 19   | PR D99 012003  | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=59515 |
| ABLIKIM       | 19AE | PR D99 072005  | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=59856 |
| ABLIKIM       | 19AR | PR D100 032005 | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=59910 |
| ABLIKIM       | 18N  | PR D97 071101  | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=58914 |
| ABLIKIM       | 17B  | PRL 118 092001 | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=57755 |
| ABLIKIM       | 17F  | PL B771 45     | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=57909 |
| ABLIKIM       | 17W  | PR D96 051101  | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=58212 |
| GAO           | 17   | PR D95 092007  | X.Y. Gao, C.P. Shen, C.Z. Yuan   |                  | REFID=57991 |
| ZHANG         | 17B  | PR D96 054008  | J. Zhang, J. Zhang               |                  | REFID=58219 |
| ZHANG         | 17C  | EPJ C77 727    | J. Zhang, L. Yuan                |                  | REFID=58463 |
| PDG           | 16   | CP C40 100001  | C. Patrignani <i>et al.</i>      | (PDG Collab.)    | REFID=57140 |
| ABLIKIM       | 15Q  | PR D92 012008  | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=56782 |
| HAN           | 15   | PR D92 012011  | Y.L. Han <i>et al.</i>           | (BELLE Collab.)  | REFID=56816 |
| ABLIKIM       | 14   | PRL 112 092001 | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=55647 |
| SHEN          | 14   | PR D89 072015  | C.P. Shen <i>et al.</i>          | (BELLE Collab.)  | REFID=55944 |
| ABLIKIM       | 13T  | PRL 110 252001 | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=55409 |
| LIU           | 13B  | PRL 110 252002 | Z.Q. Liu <i>et al.</i>           | (BELLE Collab.)  | REFID=55410 |
| WANG          | 13B  | PR D87 051101  | X.L. Wang <i>et al.</i>          | (BELLE Collab.)  | REFID=55377 |
| LEES          | 12AC | PR D86 051102  | J.P. Lees <i>et al.</i>          | (BABAR Collab.)  | REFID=54750 |
| PAKHLOVA      | 11   | PR D83 011101  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)  | REFID=53638 |
| PEDLAR        | 11   | PRL 107 041803 | T. Pedlar <i>et al.</i>          | (CLEO Collab.)   | REFID=16787 |
| DEL-AMO-SA... | 10N  | PR D82 052004  | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)  | REFID=53532 |
| AUBERT        | 09M  | PR D79 092001  | B. Aubert <i>et al.</i>          | (BABAR Collab.)  | REFID=52724 |
| CRONIN-HEN... | 09   | PR D80 072001  | D. Cronin-Hennessy <i>et al.</i> | (CLEO Collab.)   | REFID=53114 |
| PAKHLOVA      | 09   | PR D80 091101  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)  | REFID=53143 |
| AUBERT        | 08S  | PR D77 092002  | B. Aubert <i>et al.</i>          | (BABAR Collab.)  | REFID=52242 |
| LIU           | 08H  | PR D78 014032  | Z.Q. Liu, X.S. Qin, C.Z. Yuan    |                  | REFID=52296 |
| PAKHLOVA      | 08   | PR D77 011103  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)  | REFID=52132 |
| PAKHLOVA      | 08A  | PRL 100 062001 | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)  | REFID=52134 |
| YUAN          | 08   | PR D77 011105  | C.Z. Yuan <i>et al.</i>          | (BELLE Collab.)  | REFID=52135 |
| AUBERT        | 07AK | PR D76 012008  | B. Aubert <i>et al.</i>          | (BABAR Collab.)  | REFID=51908 |
| AUBERT        | 07BE | PR D76 111105  | B. Aubert <i>et al.</i>          | (BABAR Collab.)  | REFID=52074 |
| AUBERT        | 07S  | PRL 98 212001  | B. Aubert <i>et al.</i>          | (BABAR Collab.)  | REFID=51724 |
| PAKHLOVA      | 07   | PRL 98 092001  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)  | REFID=51628 |
| WANG          | 07D  | PRL 99 142002  | X.L. Wang <i>et al.</i>          | (BELLE Collab.)  | REFID=51959 |
| YUAN          | 07   | PRL 99 182004  | C.Z. Yuan <i>et al.</i>          | (BELLE Collab.)  | REFID=51960 |
| AUBERT        | 06B  | PR D73 012005  | B. Aubert <i>et al.</i>          | (BABAR Collab.)  | REFID=51026 |
| AUBERT,BE     | 06D  | PR D74 091103  | B. Aubert <i>et al.</i>          | (BABAR Collab.)  | REFID=51511 |
| HE            | 06B  | PR D74 091104  | Q. He <i>et al.</i>              | (CLEO Collab.)   | REFID=51523 |
| AUBERT,B      | 05I  | PRL 95 142001  | B. Aubert <i>et al.</i>          | (BABAR Collab.)  | REFID=50776 |



$\chi_{c1}(4274)$

$I^G(J^{PC}) = 0^+(1^{++})$

NODE=M233

was  $X(4274)$

This state shows properties different from a conventional  $q\bar{q}$  state.  
A candidate for an exotic structure. See the review on non- $q\bar{q}$  states.

NODE=M233

Seen by AAIJ 17C in  $B^+ \rightarrow \chi_{c1} K^+$ ,  $\chi_{c1} \rightarrow J/\psi \phi$  using an amplitude analysis of  $B^+ \rightarrow J/\psi \phi K^+$  with a significance (accounting for systematic uncertainties) of  $6.0 \sigma$ .

$\chi_{c1}(4274)$  MASS

NODE=M233M

| VALUE (MeV)                                                                                                                  | EVTS | DOCUMENT ID           | TECN     | COMMENT                           |
|------------------------------------------------------------------------------------------------------------------------------|------|-----------------------|----------|-----------------------------------|
| <b>4274 <math>\pm 8</math><br/>-6 OUR AVERAGE</b>                                                                            |      |                       |          |                                   |
| 4273.3 $\pm 8.3^{+17.2}_{-3.6}$                                                                                              | 4289 | <sup>1</sup> AAIJ     | 17C LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |
| 4274.4 $\pm 8.4^{+8.4}_{-6.7} \pm 1.9$                                                                                       | 22   | <sup>2</sup> AALTONEN | 17 CDF   | $B^+ \rightarrow J/\psi \phi K^+$ |
| <sup>1</sup> From an amplitude analysis of the decay $B^+ \rightarrow J/\psi \phi K^+$ with a significance of $6.0 \sigma$ . |      |                       |          |                                   |
| <sup>2</sup> From a fit to the invariant mass spectrum with a significance of $3.1 \sigma$ .                                 |      |                       |          |                                   |

NODE=M233M

NODE=M233M;LINKAGE=A  
NODE=M233M;LINKAGE=B

$\chi_{c1}(4274)$  WIDTH

NODE=M233W

| VALUE (MeV)                                                                                                                  | EVTS | DOCUMENT ID           | TECN     | COMMENT                           |
|------------------------------------------------------------------------------------------------------------------------------|------|-----------------------|----------|-----------------------------------|
| <b>49 <math>\pm 12</math> OUR AVERAGE</b>                                                                                    |      |                       |          |                                   |
| 56 $\pm 11^{+8}_{-11}$                                                                                                       | 4289 | <sup>1</sup> AAIJ     | 17C LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |
| 32.3 $\pm 21.9^{+21.9}_{-15.3} \pm 7.6$                                                                                      | 22   | <sup>2</sup> AALTONEN | 17 CDF   | $B^+ \rightarrow J/\psi \phi K^+$ |
| <sup>1</sup> From an amplitude analysis of the decay $B^+ \rightarrow J/\psi \phi K^+$ with a significance of $6.0 \sigma$ . |      |                       |          |                                   |
| <sup>2</sup> From a fit to the invariant mass spectrum with a significance of $3.1 \sigma$ .                                 |      |                       |          |                                   |

NODE=M233W

NODE=M233W;LINKAGE=A  
NODE=M233W;LINKAGE=B

$\chi_{c1}(4274)$  DECAY MODES

NODE=M233215;NODE=M233

| Mode                     | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------|--------------------------------|
| $\Gamma_1$ $J/\psi \phi$ | seen                           |

DESIG=1

$\chi_{c1}(4274)$  BRANCHING RATIOS

NODE=M233220

| $\Gamma(J/\psi\phi)/\Gamma_{\text{total}}$                                                                                  |      |                   |          |                                  | $\Gamma_1/\Gamma$ |
|-----------------------------------------------------------------------------------------------------------------------------|------|-------------------|----------|----------------------------------|-------------------|
| VALUE                                                                                                                       | EVTS | DOCUMENT ID       | TECN     | COMMENT                          |                   |
| seen                                                                                                                        | 4289 | <sup>1</sup> AAIJ | 17C LHCB | $B^+ \rightarrow J/\psi\phi K^+$ |                   |
| <sup>1</sup> From an amplitude analysis of the decay $B^+ \rightarrow J/\psi\phi K^+$ with a significance of 6.0 $\sigma$ . |      |                   |          |                                  |                   |

NODE=M233R01  
NODE=M233R01

NODE=M233R01;LINKAGE=A

$\chi_{c1}(4274)$  REFERENCES

NODE=M233

|          |     |                 |                          |                   |
|----------|-----|-----------------|--------------------------|-------------------|
| AAIJ     | 17C | PRL 118 022003  | R. Aaij <i>et al.</i>    | (LHCb Collab.) JP |
| Also     |     | PR D95 012002   | R. Aaij <i>et al.</i>    | (LHCb Collab.)    |
| AALTONEN | 17  | MPL A32 1750139 | T. Altonen <i>et al.</i> | (CDF Collab.)     |

REFID=57657  
REFID=57636  
REFID=58161

**X(4350)**

$$J^{PC} = 0^{+}(??^{+})$$

OMITTED FROM SUMMARY TABLE

Seen by SHEN 10 in the  $\gamma\gamma \rightarrow J/\psi\phi$ . Needs confirmation.**X(4350) MASS**

| VALUE (MeV)                                             | EVTS                | DOCUMENT ID       | TECN | COMMENT                                                 |
|---------------------------------------------------------|---------------------|-------------------|------|---------------------------------------------------------|
| $4350.6^{+4.6}_{-5.1} \pm 0.7$                          | $8.8^{+4.2}_{-3.2}$ | <sup>1</sup> SHEN | 10   | BELL 10.6 $e^{+}e^{-} \rightarrow e^{+}e^{-}J/\psi\phi$ |
| <sup>1</sup> Statistical significance of 3.2 $\sigma$ . |                     |                   |      |                                                         |

**X(4350) WIDTH**

| VALUE (MeV)                                             | EVTS                | DOCUMENT ID       | TECN | COMMENT                                                 |
|---------------------------------------------------------|---------------------|-------------------|------|---------------------------------------------------------|
| $13^{+18}_{-9} \pm 4$                                   | $8.8^{+4.2}_{-3.2}$ | <sup>1</sup> SHEN | 10   | BELL 10.6 $e^{+}e^{-} \rightarrow e^{+}e^{-}J/\psi\phi$ |
| <sup>1</sup> Statistical significance of 3.2 $\sigma$ . |                     |                   |      |                                                         |

**X(4350) DECAY MODES**

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------|--------------------------------|
| $\Gamma_1$ $J/\psi\phi$   | seen                           |
| $\Gamma_2$ $\gamma\gamma$ | seen                           |

**X(4350)  $\Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

| $\Gamma(\gamma\gamma) \times \Gamma(J/\psi\phi)/\Gamma_{\text{total}}$        |                     |                   |      |         | $\Gamma_2\Gamma_1/\Gamma$                    |
|-------------------------------------------------------------------------------|---------------------|-------------------|------|---------|----------------------------------------------|
| VALUE (eV)                                                                    | EVTS                | DOCUMENT ID       | TECN | COMMENT |                                              |
| $6.7^{+3.2}_{-2.4} \pm 1.1$                                                   | $8.8^{+4.2}_{-3.2}$ | <sup>1</sup> SHEN | 10   | BELL    | $10.6\ e^+e^- \rightarrow e^+e^- J/\psi\phi$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                     |                   |      |         |                                              |
| $1.5^{+0.7}_{-0.6} \pm 0.3$                                                   | $8.8^{+4.2}_{-3.2}$ | <sup>2</sup> SHEN | 10   | BELL    | $10.6\ e^+e^- \rightarrow e^+e^- J/\psi\phi$ |
| <sup>1</sup> For $J^P = 0^+$ . Statistical significance of 3.2 $\sigma$ .     |                     |                   |      |         |                                              |
| <sup>2</sup> For $J^P = 2^+$ . Statistical significance of 3.2 $\sigma$ .     |                     |                   |      |         |                                              |

**X(4350) BRANCHING RATIOS**

| $\Gamma(J/\psi\phi)/\Gamma_{\text{total}}$              | $\Gamma_1/\Gamma$  |             |                |                                             |
|---------------------------------------------------------|--------------------|-------------|----------------|---------------------------------------------|
| <u>VALUE</u>                                            | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                                             |
| <b>seen</b>                                             | <sup>1</sup> SHEN  | 10          | BELL           | 10.6 $e^+e^- \rightarrow e^+e^- J/\psi\phi$ |
| <sup>1</sup> Statistical significance of 3.2 $\sigma$ . |                    |             |                |                                             |
| $\Gamma(\gamma\gamma)/\Gamma_{\text{total}}$            | $\Gamma_2/\Gamma$  |             |                |                                             |
| <u>VALUE</u>                                            | <u>DOCUMENT ID</u> | <u>TECN</u> | <u>COMMENT</u> |                                             |
| <b>seen</b>                                             | <sup>1</sup> SHEN  | 10          | BELL           | 10.6 $e^+e^- \rightarrow e^+e^- J/\psi\phi$ |
| <sup>1</sup> Statistical significance of 3.2 $\sigma$ . |                    |             |                |                                             |

**X(4350) REFERENCES**

|      |    |                |                         |                 |
|------|----|----------------|-------------------------|-----------------|
| SHEN | 10 | PRL 104 112004 | C.P. Shen <i>et al.</i> | (BELLE Collab.) |
|------|----|----------------|-------------------------|-----------------|

NODE=M194

NODE=M194

NODE=M194M

NODE=M194M

NODE=M194M;LINKAGE=SH

NODE=M194W

NODE=M194W

NODE=M194W;LINKAGE=SH

NODE=M194215;NODE=M194

DESIG=1

DESIG=2

NODE=M194220

NODE=M194G01  
NODE=M194G01

OCCUR=2

NODE=M194G01;LINKAGE=S0  
NODE=M194G01;LINKAGE=S2

NODE=M194225

NODE=M194R01  
NODE=M194R01

NODE=M194R01;LINKAGE=SH

NODE=M194R02  
NODE=M194R02

NODE=M194R02;LINKAGE=SH

NODE=M194

REFID=53235

**$\psi(4360)$** 

$$I^G(J^{PC}) = 0^-(1^{--})$$

also known as  $Y(4360)$ ; was  $X(4360)$

This state shows properties different from a conventional  $q\bar{q}$  state.  
A candidate for an exotic structure. See the review on non- $q\bar{q}$  states.

Seen in radiative return from  $e^+e^-$  collisions at  $\sqrt{s} = 9.54\text{--}10.58$  GeV by AUBERT 07S, WANG 07D, and LEES 14F. See also the review on "Spectroscopy of mesons containing two heavy quarks."

NODE=M181

NODE=M181

 **$\psi(4360)$  MASS**

NODE=M181M

NODE=M181M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID                                                 | TECN     | COMMENT                                              |
|-------------------------------------------------------------------------------|------|-------------------------------------------------------------|----------|------------------------------------------------------|
| <b>4368 ± 13 OUR AVERAGE</b>                                                  |      | Error includes scale factor of 3.7. See the ideogram below. |          |                                                      |
| 4320.0 ± 10.4 ± 7.0                                                           |      | <sup>1</sup> ABLIKIM                                        | 17B BES3 | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$               |
| 4383.8 ± 4.2 ± 0.8                                                            |      | <sup>2</sup> ABLIKIM                                        | 17V BES3 | $e^+e^- \rightarrow \pi^+\pi^- \psi(2S)$             |
| 4347 ± 6 ± 3                                                                  | 279  | <sup>3</sup> WANG                                           | 15A BELL | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- \psi(2S)$ |
| 4340 ± 16 ± 9                                                                 | 37   | <sup>4</sup> LEES                                           | 14F BABR | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- \psi(2S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                                                             |          |                                                      |
| 4383.7 ± 2.9 ± 6.2                                                            |      | <sup>5</sup> ZHANG                                          | 17B RVUE | $e^+e^- \rightarrow \pi^+\pi^- \psi(2S)$             |
| 4386.4 ± 2.1 ± 6.4                                                            |      | <sup>6</sup> ZHANG                                          | 17C RVUE | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$ or $\psi(2S)$ |
| 4355 $^{+9}_{-10}$ ± 9                                                        | 74   | <sup>7</sup> LIU                                            | 08H RVUE | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- \psi(2S)$ |
| 4324 ± 24                                                                     |      | <sup>8</sup> AUBERT                                         | 07S BABR | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- \psi(2S)$ |
| 4361 ± 9 ± 9                                                                  | 47   | <sup>4</sup> WANG                                           | 07D BELL | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^- \psi(2S)$ |

<sup>1</sup> From a three-resonance fit.

<sup>2</sup> From a fit to the cross section for  $e^+e^- \rightarrow \pi^+\pi^- \psi(2S) \rightarrow 2(\pi^+\pi^-)\ell^+\ell^-$  obtained from 16 center-of-mass energies between 4.008 and 4.600 GeV and comprising 5.1 fb<sup>-1</sup>.

<sup>3</sup> From a two-resonance fit. Supersedes WANG 07D.

<sup>4</sup> From a two-resonance fit.

<sup>5</sup> From a three-resonance fit.

<sup>6</sup> From a combined fit of BELLE, BABAR and BES3  $e^+e^- \rightarrow \pi^+\pi^- J/\psi$  and  $e^+e^- \rightarrow \pi^+\pi^- \psi(2S)$  data.

<sup>7</sup> From a combined fit of AUBERT 07S and WANG 07D data with two resonances.

<sup>8</sup> From a single-resonance fit. Systematic errors not estimated.

NODE=M181M;LINKAGE=B

NODE=M181M;LINKAGE=C

NODE=M181M;LINKAGE=A

NODE=M181M;LINKAGE=WA

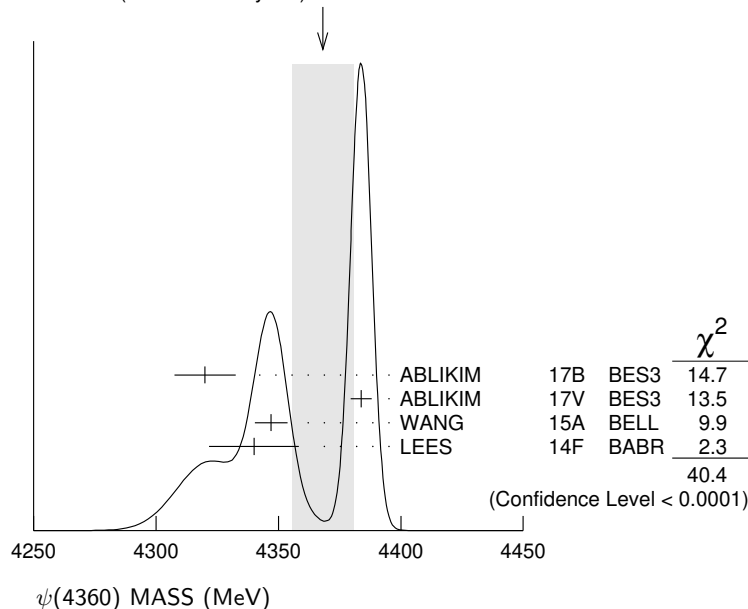
NODE=M181M;LINKAGE=E

NODE=M181M;LINKAGE=D

NODE=M181M;LINKAGE=LI

NODE=M181M;LINKAGE=AU

WEIGHTED AVERAGE  
4368 ± 13 (Error scaled by 3.7)

 **$\psi(4360)$  WIDTH**

NODE=M181W

NODE=M181W

| VALUE (MeV)                     | EVTS | DOCUMENT ID          | TECN     | COMMENT                                |
|---------------------------------|------|----------------------|----------|----------------------------------------|
| <b>96 ± 7 OUR AVERAGE</b>       |      |                      |          |                                        |
| 101.4 $^{+25.3}_{-19.7}$ ± 10.2 |      | <sup>1</sup> ABLIKIM | 17B BES3 | $e^+e^- \rightarrow \pi^+\pi^- J/\psi$ |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |         |     |      |                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------|-----|------|-----------------------------------------------------|
| 84.2±12.5± 2.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2 | ABLIKIM | 17V | BES3 | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$             |
| 103 ± 9 ± 5 279                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3 | WANG    | 15A | BELL | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 94 ±32 ±13 37                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4 | LEES    | 14F | BABR | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |   |         |     |      |                                                     |
| 94.2± 7.3± 2.0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 5 | ZHANG   | 17B | RVUE | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$             |
| 96.0± 6.7± 2.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 6 | ZHANG   | 17C | RVUE | $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ or $\psi(2S)$ |
| 103 $\begin{smallmatrix} +17 \\ -15 \end{smallmatrix}$ ±11 74                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 7 | LIU     | 08H | RVUE | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 172 ±33                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 8 | AUBERT  | 07S | BABR | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 74 ±15 ±10 47                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4 | WANG    | 07D | BELL | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| <sup>1</sup> From a three-resonance fit.<br><sup>2</sup> From a fit to the cross section for $e^+e^- \rightarrow \pi^+\pi^-\psi(2S) \rightarrow 2(\pi^+\pi^-)\ell^+\ell^-$ obtained from 16 center-of-mass energies between 4.008 and 4.600 GeV and comprising 5.1 fb <sup>-1</sup> .<br><sup>3</sup> From a two-resonance fit. Supersedes WANG 07D.<br><sup>4</sup> From a two-resonance fit.<br><sup>5</sup> From a three-resonance fit.<br><sup>6</sup> From a combined fit of BELLE, BABAR and BES3 $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ and $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$ data.<br><sup>7</sup> From a combined fit of AUBERT 07S and WANG 07D data with two resonances.<br><sup>8</sup> From a single-resonance fit. Systematic errors not estimated. |   |         |     |      |                                                     |

NODE=M181W;LINKAGE=B  
 NODE=M181W;LINKAGE=C

NODE=M181W;LINKAGE=A  
 NODE=M181W;LINKAGE=WA  
 NODE=M181W;LINKAGE=E  
 NODE=M181W;LINKAGE=D

NODE=M181W;LINKAGE=LI  
 NODE=M181W;LINKAGE=AU

### $\psi(4360)$ DECAY MODES

NODE=M181215;NODE=M181

| Mode                                        | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------------------|--------------------------------|
| $\Gamma_1$ $e^+e^-$                         |                                |
| $\Gamma_2$ $J/\psi\pi^+\pi^-$               |                                |
| $\Gamma_3$ $\psi(2S)\pi^+\pi^-$             | seen                           |
| $\Gamma_4$ $\psi_2(3823)\pi^+\pi^-$         | possibly seen                  |
| $\Gamma_5$ $J/\psi\eta$                     |                                |
| $\Gamma_6$ $D^0D^{*-}\pi^+$                 |                                |
| $\Gamma_7$ $D_1(2420)\bar{D} + \text{c.c.}$ | possibly seen                  |
| $\Gamma_8$ $\chi_{c1}\gamma$                |                                |
| $\Gamma_9$ $\chi_{c2}\gamma$                |                                |

DESIG=1  
 DESIG=8  
 DESIG=2;OUR EVAL;→ UNCHECKED ←  
 DESIG=5  
 DESIG=4  
 DESIG=3  
 DESIG=10  
 DESIG=6  
 DESIG=7

### $\psi(4360) \Gamma(i) \times \Gamma(e^+e^-)/\Gamma(\text{total})$

NODE=M181230

| $\Gamma(\psi(2S)\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$      |      |             |      |         | $\Gamma_3\Gamma_1/\Gamma$                           |
|-------------------------------------------------------------------------------|------|-------------|------|---------|-----------------------------------------------------|
| VALUE (eV)                                                                    | EVTS | DOCUMENT ID | TECN | COMMENT |                                                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |      |         |                                                     |
| 7.3±2.8                                                                       |      | 1 ABLIKIM   | 19K  | BES3    | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$             |
| 11.0±3.8                                                                      |      | 2 ABLIKIM   | 19K  | BES3    | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$             |
| 9.2±0.6±0.6 279                                                               |      | 3 WANG      | 15A  | BELL    | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 10.9±0.6±0.7 279                                                              |      | 4 WANG      | 15A  | BELL    | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 6.0±1.0±0.5 37                                                                |      | 1 LEES      | 14F  | BABR    | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 7.2±1.0±0.6 37                                                                |      | 2 LEES      | 14F  | BABR    | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 11.1 $\begin{smallmatrix} +1.3 \\ -1.2 \end{smallmatrix}$ 74                  |      | 5 LIU       | 08H  | RVUE    | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 12.3±1.2 74                                                                   |      | 6 LIU       | 08H  | RVUE    | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 10.4±1.7±1.5 47                                                               |      | 1 WANG      | 07D  | BELL    | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |
| 11.8±1.8±1.4 47                                                               |      | 2 WANG      | 07D  | BELL    | 10.58 $e^+e^- \rightarrow \gamma\pi^+\pi^-\psi(2S)$ |

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=2

- <sup>1</sup> Solution I of two equivalent solutions in a fit using two interfering resonances.  
<sup>2</sup> Solution II of two equivalent solutions in a fit using two interfering resonances.  
<sup>3</sup> Solution I of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D.  
<sup>4</sup> Solution II of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D.  
<sup>5</sup> Solution I in a combined fit of AUBERT 07S and WANG 07D data with two resonances.  
<sup>6</sup> Solution II in a combined fit of AUBERT 07S and WANG 07D data with two resonances.

NODE=M181G1;LINKAGE=WA  
 NODE=M181G1;LINKAGE=WN  
 NODE=M181G1;LINKAGE=A

NODE=M181G1;LINKAGE=B

NODE=M181G1;LINKAGE=LI  
 NODE=M181G1;LINKAGE=LU

| $\Gamma(J/\psi\eta) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$              |     |             |      |         | $\Gamma_5\Gamma_1/\Gamma$                  |
|-------------------------------------------------------------------------------|-----|-------------|------|---------|--------------------------------------------|
| VALUE (eV)                                                                    | CL% | DOCUMENT ID | TECN | COMMENT |                                            |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |         |                                            |
| <6.8                                                                          |     | 90          | WANG | 13B     | BELL $e^+e^- \rightarrow J/\psi\eta\gamma$ |

NODE=M181G01  
 NODE=M181G01

| $\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$        |     |                  |      |         | $\Gamma_8\Gamma_1/\Gamma$                  |
|------------------------------------------------------------------------------|-----|------------------|------|---------|--------------------------------------------|
| VALUE (eV)                                                                   | CL% | DOCUMENT ID      | TECN | COMMENT |                                            |
| <b>&lt;0.57</b>                                                              | 90  | <sup>1</sup> HAN | 15   | BELL    | 10.58 $e^+e^- \rightarrow \chi_{c1}\gamma$ |
| <sup>1</sup> Using $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ . |     |                  |      |         |                                            |

NODE=M181G02  
NODE=M181G02

NODE=M181G02;LINKAGE=A

| $\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$        |     |                  |      |         | $\Gamma_9\Gamma_1/\Gamma$                  |
|------------------------------------------------------------------------------|-----|------------------|------|---------|--------------------------------------------|
| VALUE (eV)                                                                   | CL% | DOCUMENT ID      | TECN | COMMENT |                                            |
| <b>&lt;1.9</b>                                                               | 90  | <sup>1</sup> HAN | 15   | BELL    | 10.58 $e^+e^- \rightarrow \chi_{c2}\gamma$ |
| <sup>1</sup> Using $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ . |     |                  |      |         |                                            |

NODE=M181G03  
NODE=M181G03

NODE=M181G03;LINKAGE=A

### $\psi(4360)$ BRANCHING RATIOS

NODE=M181225

| $\Gamma(D^0 D^{*-} \pi^+)/\Gamma(\psi(2S)\pi^+\pi^-)$ |     |             |      |         | $\Gamma_6/\Gamma_3$                                          |
|-------------------------------------------------------|-----|-------------|------|---------|--------------------------------------------------------------|
| VALUE                                                 | CL% | DOCUMENT ID | TECN | COMMENT |                                                              |
| <b>&lt;8</b>                                          | 90  | PAKHOVA     | 09   | BELL    | $e^+e^- \rightarrow \psi(4360) \rightarrow D^0 D^{*-} \pi^+$ |

NODE=M181R01  
NODE=M181R01

| $\Gamma(\psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$                                                                                                                                                                                        |                      |      |         | $\Gamma_3/\Gamma$                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|---------|-----------------------------------------|
| VALUE                                                                                                                                                                                                                                     | DOCUMENT ID          | TECN | COMMENT |                                         |
| <b>seen</b>                                                                                                                                                                                                                               | <sup>1</sup> ABLIKIM | 17V  | BES3    | $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$ |
| <sup>1</sup> From a fit to the cross section for $e^+e^- \rightarrow \pi^+\pi^-\psi(2S) \rightarrow 2(\pi^+\pi^-)\ell^+\ell^-$ obtained from 16 center-of-mass energies between 4.008 and 4.600 GeV and comprising 5.1 fb <sup>-1</sup> . |                      |      |         |                                         |

NODE=M181R00  
NODE=M181R00

NODE=M181R00;LINKAGE=A

| $\Gamma(\psi(2S)\pi^+\pi^-)/\Gamma(J/\psi\pi^+\pi^-)$                                                                                             |                    |      |         | $\Gamma_3/\Gamma_2$                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|------|---------|-----------------------------------------------------|
| VALUE                                                                                                                                             | DOCUMENT ID        | TECN | COMMENT |                                                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                     |                    |      |         |                                                     |
| (0.81 ± 0.12 ± 0.13) to (42 ± 15 ± 15)                                                                                                            | <sup>1</sup> ZHANG | 17C  | RVUE    | $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ or $\psi(2S)$ |
| <sup>1</sup> From a combined fit of BELLE, BABAR and BES3 $e^+e^- \rightarrow \pi^+\pi^-J/\psi$ and $e^+e^- \rightarrow \pi^+\pi^-\psi(2S)$ data. |                    |      |         |                                                     |

NODE=M181R04  
NODE=M181R04

NODE=M181R04;LINKAGE=A

| $\Gamma(\psi_2(3823)\pi^+\pi^-)/\Gamma_{\text{total}}$                                                                                                                                                                                |      |                      |      |         | $\Gamma_4/\Gamma$                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|------|---------|------------------------------------------------|
| VALUE                                                                                                                                                                                                                                 | EVTS | DOCUMENT ID          | TECN | COMMENT |                                                |
| <b>possibly seen</b>                                                                                                                                                                                                                  | 19   | <sup>1</sup> ABLIKIM | 15S  | BES3    | $e^+e^- \rightarrow \pi^+\pi^-\chi_{c1}\gamma$ |
| <sup>1</sup> From a fit of $e^+e^- \rightarrow \pi^+\pi^-\psi_2(3823)$ , $\psi_2(3823) \rightarrow \chi_{c1}\gamma$ cross sections taken at $\sqrt{s}$ values of 4.23, 4.26, 4.36, 4.42, and 4.60 GeV to the $\psi(4360)$ line shape. |      |                      |      |         |                                                |

NODE=M181R03  
NODE=M181R03

NODE=M181R03;LINKAGE=A

| $\Gamma(D^0 D^{*-} \pi^+)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |     |                      |      |         | $\Gamma_6/\Gamma \times \Gamma_1/\Gamma$                     |
|----------------------------------------------------------------------------------------------|-----|----------------------|------|---------|--------------------------------------------------------------|
| VALUE                                                                                        | CL% | DOCUMENT ID          | TECN | COMMENT |                                                              |
| <b>&lt;0.72 × 10<sup>-6</sup></b>                                                            | 90  | <sup>1</sup> PAKHOVA | 09   | BELL    | $e^+e^- \rightarrow \psi(4360) \rightarrow D^0 D^{*-} \pi^+$ |
| <sup>1</sup> Using $4355^{+9}_{-10} \pm 9$ MeV for the mass of $\psi(4360)$ .                |     |                      |      |         |                                                              |

NODE=M181R02  
NODE=M181R02

NODE=M181R02;LINKAGE=PA

| $\Gamma(D_1(2420)\bar{D} + \text{c.c.})/\Gamma_{\text{total}}$                                                                                |                      |      |         | $\Gamma_7/\Gamma$                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------|---------|-----------------------------------------|
| VALUE                                                                                                                                         | DOCUMENT ID          | TECN | COMMENT |                                         |
| <b>possibly seen</b>                                                                                                                          | <sup>1</sup> ABLIKIM | 19AR | BES3    | $e^+e^- \rightarrow \pi^+\pi^-D\bar{D}$ |
| <sup>1</sup> Evidence for $e^+e^- \rightarrow D_1(2420)\bar{D} + \text{c.c.}$ between $\sqrt{s} = 4.3$ and 4.6 GeV, not necessarily resonant. |                      |      |         |                                         |

NODE=M181R05  
NODE=M181R05

NODE=M181R05;LINKAGE=A

### $\psi(4360)$ REFERENCES

NODE=M181

|         |      |                        |                               |                  |             |
|---------|------|------------------------|-------------------------------|------------------|-------------|
| ABLIKIM | 19AR | PR D100 032005         | M. Ablikim <i>et al.</i>      | (BESIII Collab.) | REFID=59910 |
| ABLIKIM | 19K  | PR D99 019903 (errat.) | M. Ablikim <i>et al.</i>      | (BESIII Collab.) | REFID=59611 |
| ABLIKIM | 17B  | PRL 118 092001         | M. Ablikim <i>et al.</i>      | (BESIII Collab.) | REFID=57755 |
| ABLIKIM | 17V  | PR D96 032004          | M. Ablikim <i>et al.</i>      | (BESIII Collab.) | REFID=58029 |
| Also    |      | PR D99 019903 (errat.) | M. Ablikim <i>et al.</i>      | (BESIII Collab.) | REFID=59611 |
| ZHANG   | 17B  | PR D96 054008          | J. Zhang, J. Zhang            |                  | REFID=58219 |
| ZHANG   | 17C  | EPJ C77 727            | J. Zhang, L. Yuan             |                  | REFID=58463 |
| ABLIKIM | 15S  | PRL 115 011803         | M. Ablikim <i>et al.</i>      | (BESIII Collab.) | REFID=56784 |
| HAN     | 15   | PR D92 012011          | Y.L. Han <i>et al.</i>        | (BELLE Collab.)  | REFID=56816 |
| WANG    | 15A  | PR D91 112007          | X.L. Wang <i>et al.</i>       | (BELLE Collab.)  | REFID=56839 |
| LEES    | 14F  | PR D89 111103          | J.P. Lees <i>et al.</i>       | (BABAR Collab.)  | REFID=55938 |
| WANG    | 13B  | PR D87 051101          | X.L. Wang <i>et al.</i>       | (BELLE Collab.)  | REFID=55377 |
| PAKHOVA | 09   | PR D80 091101          | G. Pakhlova <i>et al.</i>     | (BELLE Collab.)  | REFID=53143 |
| LIU     | 08H  | PR D78 014032          | Z.Q. Liu, X.S. Qin, C.Z. Yuan |                  | REFID=52296 |
| AUBERT  | 07S  | PRL 98 212001          | B. Aubert <i>et al.</i>       | (BABAR Collab.)  | REFID=51724 |
| WANG    | 07D  | PRL 99 142002          | X.L. Wang <i>et al.</i>       | (BELLE Collab.)  | REFID=51959 |

$\psi(4390)$ 
 $I^G(J^{PC}) = 0^-(1^{--})$   
 $I$  needs confirmation.

OMITTED FROM SUMMARY TABLE

was  $X(4390)$ This state shows properties different from a conventional  $q\bar{q}$  state.A candidate for an exotic structure. See the review on non- $q\bar{q}$  states.

NODE=M236

NODE=M236

 $\psi(4390)$  MASS

| VALUE (MeV)                                | DOCUMENT ID          | TECN     | COMMENT                             |
|--------------------------------------------|----------------------|----------|-------------------------------------|
| <b>4390 <math>\pm</math> 6 OUR AVERAGE</b> |                      |          |                                     |
| [4392 $\pm$ 7 MeV OUR 2020 AVERAGE]        |                      |          |                                     |
| 4382.0 $\pm$ 13.3 $\pm$ 1.7                | <sup>1</sup> ABLIKIM | 200 BES3 | $e^+e^- \rightarrow \eta J/\psi$    |
| 4391.5 $^{+6.3}_{-6.8}$ $\pm$ 1.0          | ABLIKIM              | 17G BES3 | $e^+e^- \rightarrow \pi^+\pi^- h_c$ |

<sup>1</sup> From a fit of the measured cross section in the range  $\sqrt{s} = 3.808\text{--}4.600$  GeV.

NODE=M236M

NODE=M236M

NEW

NODE=M236M;LINKAGE=B

 $\psi(4390)$  WIDTH

| VALUE (MeV)                                      | DOCUMENT ID          | TECN     | COMMENT                             |
|--------------------------------------------------|----------------------|----------|-------------------------------------|
| <b>139 <math>^{+16}_{-20}</math> OUR AVERAGE</b> |                      |          |                                     |
| [140 $^{+16}_{-21}$ MeV OUR 2020 AVERAGE]        |                      |          |                                     |
| 135.8 $\pm$ 60.8 $\pm$ 22.5                      | <sup>1</sup> ABLIKIM | 200 BES3 | $e^+e^- \rightarrow \eta J/\psi$    |
| 139.5 $^{+16.2}_{-20.6}$ $\pm$ 0.6               | ABLIKIM              | 17G BES3 | $e^+e^- \rightarrow \pi^+\pi^- h_c$ |

<sup>1</sup> From a fit of the measured cross section in the range  $\sqrt{s} = 3.808\text{--}4.600$  GeV.

NODE=M236W

NODE=M236W

NEW

NODE=M236W;LINKAGE=B

 $\psi(4390)$  DECAY MODES

| Mode                               | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------------|--------------------------------|
| $\Gamma_1$ $e^+e^-$                |                                |
| $\Gamma_2$ $\pi^+\pi^- h_c$        | seen                           |
| $\Gamma_3$ $\eta J/\psi$           | seen                           |
| $\Gamma_4$ $\pi^+\pi^- \psi(3770)$ | possibly seen                  |

DESIG=5

DESIG=1

DESIG=4

DESIG=3

NODE=M236215;NODE=M236

 $\psi(4390)$   $\Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$  $\Gamma(\eta J/\psi) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$   $\Gamma_3\Gamma_1/\Gamma$ 

| VALUE (eV)                                                                    | DOCUMENT ID          | TECN     | COMMENT                          |
|-------------------------------------------------------------------------------|----------------------|----------|----------------------------------|
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                      |          |                                  |
| 3.4 $\pm$ 2.2                                                                 | <sup>1</sup> ABLIKIM | 200 BES3 | $e^+e^- \rightarrow \eta J/\psi$ |
| 1.5 $\pm$ 1.0                                                                 | <sup>2</sup> ABLIKIM | 200 BES3 | $e^+e^- \rightarrow \eta J/\psi$ |
| 1.7 $\pm$ 1.1                                                                 | <sup>3</sup> ABLIKIM | 200 BES3 | $e^+e^- \rightarrow \eta J/\psi$ |

<sup>1</sup> Solution 1 of three equivalent fit solutions using three resonant structures.<sup>2</sup> Solution 2 of three equivalent fit solutions using three resonant structures.<sup>3</sup> Solution 3 of three equivalent fit solutions using three resonant structures.

NODE=M236218

NODE=M236R04

NODE=M236R04

OCCUR=2

OCCUR=3

NODE=M236R04;LINKAGE=A

NODE=M236R04;LINKAGE=B

NODE=M236R04;LINKAGE=C

 $\psi(4390)$  BRANCHING RATIOS $\Gamma(\pi^+\pi^- h_c)/\Gamma_{\text{total}}$   $\Gamma_2/\Gamma$ 

| VALUE | DOCUMENT ID | TECN     | COMMENT                             |
|-------|-------------|----------|-------------------------------------|
| seen  | ABLIKIM     | 17G BES3 | $e^+e^- \rightarrow \pi^+\pi^- h_c$ |

NODE=M236R01

NODE=M236R01

 $\Gamma(\eta J/\psi)/\Gamma_{\text{total}}$   $\Gamma_3/\Gamma$ 

| VALUE | DOCUMENT ID          | TECN     | COMMENT                          |
|-------|----------------------|----------|----------------------------------|
| seen  | <sup>1</sup> ABLIKIM | 200 BES3 | $e^+e^- \rightarrow \eta J/\psi$ |

<sup>1</sup> With a significance of 6.0  $\sigma$ .

NODE=M236R03

NODE=M236R03

NODE=M236R03;LINKAGE=A

NODE=M236220

$\Gamma(\pi^+\pi^-\psi(3770))/\Gamma_{\text{total}}$ 
 $\Gamma_4/\Gamma$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

possibly seen

|                      |           |                                          |
|----------------------|-----------|------------------------------------------|
| <sup>1</sup> ABLIKIM | 19AR BES3 | $e^+e^- \rightarrow \pi^+\pi^- D\bar{D}$ |
|----------------------|-----------|------------------------------------------|

<sup>1</sup> Observe  $e^+e^- \rightarrow \pi^+\pi^-\psi(3770)$  at  $\sqrt{s} = 4.26, 4.36, \text{ and } 4.42 \text{ GeV}$  but cannot establish if continuum or resonant.

NODE=M236R02  
NODE=M236R02

NODE=M236R02;LINKAGE=A

### $\psi(4390)$ REFERENCES

|         |      |                |                          |                  |
|---------|------|----------------|--------------------------|------------------|
| ABLIKIM | 200  | PR D102 031101 | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| ABLIKIM | 19AR | PR D100 032005 | M. Ablikim <i>et al.</i> | (BESIII Collab.) |
| ABLIKIM | 17G  | PRL 118 092002 | M. Ablikim <i>et al.</i> | (BESIII Collab.) |

NODE=M236

REFID=60344  
REFID=59910  
REFID=57915

NODE=M073

 $\psi(4415)$ 

$$J^{PC} = 0^-(1^{--})$$

### $\psi(4415)$ MASS

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**4421 ± 4 OUR ESTIMATE**

|                     |                      |          |                                     |
|---------------------|----------------------|----------|-------------------------------------|
| <b>4415.1 ± 7.9</b> | <sup>1</sup> ABLIKIM | 08D BES2 | $e^+e^- \rightarrow \text{hadrons}$ |
|---------------------|----------------------|----------|-------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |                       |          |                                                |
|-----------|-----------------------|----------|------------------------------------------------|
| 4412 ± 15 | <sup>2</sup> MO       | 10 RVUE  | $e^+e^- \rightarrow \text{hadrons}$            |
| 4411 ± 7  | <sup>3</sup> PAKHLOVA | 08A BELL | $10.6 e^+e^- \rightarrow D^0 D^- \pi^+ \gamma$ |
| 4425 ± 6  | <sup>4</sup> SETH     | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$            |
| 4429 ± 9  | <sup>5</sup> SETH     | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$            |
| 4417 ± 10 | BRANDELIK             | 78C DASP | $e^+e^-$                                       |
| 4414 ± 7  | SIEGRIST              | 76 MRK1  | $e^+e^-$                                       |

<sup>1</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the  $\psi(3770)$ ,  $\psi(4040)$ ,  $\psi(4160)$ , and  $\psi(4415)$  resonances. Phase angle fixed in the fit to  $\delta = (234 \pm 88)^\circ$ .

<sup>2</sup> Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the  $\psi(4040)$ ,  $\psi(4160)$  and  $\psi(4415)$  resonances and including interference effects.

<sup>3</sup> Systematic uncertainties not estimated.

<sup>4</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>5</sup> From a fit to BES (BAI 02C) data.

NODE=M073M

NODE=M073M  
→ UNCHECKED ←

OCCUR=2

NODE=M073M;LINKAGE=AB

NODE=M073M;LINKAGE=MO

NODE=M073M;LINKAGE=NS  
NODE=M073M;LINKAGE=ST  
NODE=M073M;LINKAGE=SE

### $\psi(4415)$ WIDTH

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**62 ± 20 OUR ESTIMATE**

|                    |                      |          |                                     |
|--------------------|----------------------|----------|-------------------------------------|
| <b>71.5 ± 19.0</b> | <sup>6</sup> ABLIKIM | 08D BES2 | $e^+e^- \rightarrow \text{hadrons}$ |
|--------------------|----------------------|----------|-------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |                       |          |                                                |
|----------|-----------------------|----------|------------------------------------------------|
| 118 ± 32 | <sup>7</sup> MO       | 10 RVUE  | $e^+e^- \rightarrow \text{hadrons}$            |
| 77 ± 20  | <sup>8</sup> PAKHLOVA | 08A BELL | $10.6 e^+e^- \rightarrow D^0 D^- \pi^+ \gamma$ |
| 119 ± 16 | <sup>9</sup> SETH     | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$            |
| 118 ± 35 | <sup>10</sup> SETH    | 05A RVUE | $e^+e^- \rightarrow \text{hadrons}$            |
| 66 ± 15  | BRANDELIK             | 78C DASP | $e^+e^-$                                       |
| 33 ± 10  | SIEGRIST              | 76 MRK1  | $e^+e^-$                                       |

<sup>6</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the  $\psi(3770)$ ,  $\psi(4040)$ ,  $\psi(4160)$ , and  $\psi(4415)$  resonances. Phase angle fixed in the fit to  $\delta = (234 \pm 88)^\circ$ .

<sup>7</sup> Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the  $\psi(4040)$ ,  $\psi(4160)$  and  $\psi(4415)$  resonances and including interference effects.

<sup>8</sup> Systematic uncertainties not estimated.

<sup>9</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>10</sup> From a fit to BES (BAI 02C) data.

NODE=M073W

NODE=M073W  
→ UNCHECKED ←

OCCUR=2

NODE=M073W;LINKAGE=AB

NODE=M073W;LINKAGE=MO

NODE=M073W;LINKAGE=NS  
NODE=M073W;LINKAGE=ST  
NODE=M073W;LINKAGE=SE

**$\psi(4415)$  DECAY MODES**

Due to the complexity of the  $c\bar{c}$  threshold region, in this listing, “seen” (“not seen”) means that a cross section for the mode in question has been measured at effective  $\sqrt{s}$  near this particle’s central mass value, more (less) than  $2\sigma$  above zero, without regard to any peaking behavior in  $\sqrt{s}$  or absence thereof. See mode listing(s) for details and references.

NODE=M073215;NODE=M073

NODE=M073

| Mode                                                                                        | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|---------------------------------------------------------------------------------------------|--------------------------------|------------------|
| $\Gamma_1$ $D\bar{D}$                                                                       | seen                           |                  |
| $\Gamma_2$ $D^0\bar{D}^0$                                                                   | seen                           |                  |
| $\Gamma_3$ $D^+D^-$                                                                         | seen                           |                  |
| $\Gamma_4$ $D^*\bar{D} + \text{c.c.}$                                                       | seen                           |                  |
| $\Gamma_5$ $D^*(2007)^0\bar{D}^0 + \text{c.c.}$                                             | seen                           |                  |
| $\Gamma_6$ $D^*(2010)^+D^- + \text{c.c.}$                                                   | seen                           |                  |
| $\Gamma_7$ $D^*\bar{D}^*$                                                                   | seen                           |                  |
| $\Gamma_8$ $D^*(2007)^0\bar{D}^*(2007)^0 + \text{c.c.}$                                     | seen                           |                  |
| $\Gamma_9$ $D^*(2010)^+D^*(2010)^- + \text{c.c.}$                                           | seen                           |                  |
| $\Gamma_{10}$ $D^0D^-\pi^+$ (excl. $D^*(2007)^0\bar{D}^0$<br>+c.c., $D^*(2010)^+D^-$ +c.c.) | $< 2.3 \quad \%$               | 90%              |
| $\Gamma_{11}$ $D\bar{D}_2^*(2460) \rightarrow D^0D^-\pi^+ + \text{c.c.}$                    | $(10 \pm 4) \%$                |                  |
| $\Gamma_{12}$ $D^0\bar{D}^{*-}\pi^+ + \text{c.c.}$                                          | $< 11 \quad \%$                | 90%              |
| $\Gamma_{13}$ $D_1(2420)\bar{D} + \text{c.c.}$                                              | possibly seen                  |                  |
| $\Gamma_{14}$ $D_s^+D_s^-$                                                                  | not seen                       |                  |
| $\Gamma_{15}$ $\omega\chi_{c2}$                                                             | possibly seen                  |                  |
| $\Gamma_{16}$ $D_s^{*+}D_s^- + \text{c.c.}$                                                 | seen                           |                  |
| $\Gamma_{17}$ $D_s^{*+}D_s^{*-}$                                                            | not seen                       |                  |
| $\Gamma_{18}$ $\psi_2(3823)\pi^+\pi^-$                                                      | possibly seen                  |                  |
| $\Gamma_{19}$ $\psi(3770)\pi^+\pi^-$                                                        | possibly seen                  |                  |
| $\Gamma_{20}$ $J/\psi\eta$                                                                  | $< 6 \times 10^{-3}$           | 90%              |
| $\Gamma_{21}$ $\chi_{c1}\gamma$                                                             | $< 8 \times 10^{-4}$           | 90%              |
| $\Gamma_{22}$ $\chi_{c2}\gamma$                                                             | $< 4 \times 10^{-3}$           | 90%              |
| $\Gamma_{23}$ $e^+e^-$                                                                      | $(9.4 \pm 3.2) \times 10^{-6}$ |                  |
| $\Gamma_{24}$ $\mu^+\mu^-$                                                                  | $(2.0 \pm 1.0) \times 10^{-5}$ |                  |

DESIG=7;OUR EVAL;→ UNCHECKED ←  
DESIG=8  
DESIG=9  
DESIG=10;OUR EVAL;→ UNCHECKED ←  
DESIG=11  
DESIG=12  
DESIG=13;OUR EVAL;→ UNCHECKED ←  
DESIG=14  
DESIG=15  
DESIG=4  
  
DESIG=5  
DESIG=6  
DESIG=25  
DESIG=16  
DESIG=20  
DESIG=17  
DESIG=18  
DESIG=21  
DESIG=24  
DESIG=19  
DESIG=22  
DESIG=23  
DESIG=1  
DESIG=26

 **$\psi(4415)$  PARTIAL WIDTHS**

NODE=M073220

 **$\Gamma(e^+e^-)$**  **$\Gamma_{23}$** 

VALUE (keV)

DOCUMENT ID

TECN

COMMENT

**0.58±0.07 OUR ESTIMATE****0.35±0.12**

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.4 to 0.8

0.72±0.11

0.64±0.23

0.49±0.13

0.44±0.14

11 ABLIKIM 08D BES2  $e^+e^- \rightarrow \text{hadrons}$ 12 MO 10 RVUE  $e^+e^- \rightarrow \text{hadrons}$ 13 SETH 05A RVUE  $e^+e^- \rightarrow \text{hadrons}$ 14 SETH 05A RVUE  $e^+e^- \rightarrow \text{hadrons}$ BRANDELIK 78C DASP  $e^+e^-$ SIEGRIST 76 MRK1  $e^+e^-$ 

<sup>11</sup> Reanalysis of data presented in BAI 02C. From a global fit over the center-of-mass energy region 3.7–5.0 GeV covering the  $\psi(3770)$ ,  $\psi(4040)$ ,  $\psi(4160)$ , and  $\psi(4415)$  resonances. Phase angle fixed in the fit to  $\delta = (234 \pm 88)^\circ$ .

<sup>12</sup> Reanalysis of data presented in BAI 00 and BAI 02C. From a global fit over the center-of-mass energy 3.8–4.8 GeV covering the  $\psi(4040)$ ,  $\psi(4160)$  and  $\psi(4415)$  resonances and including interference effects. Four sets of solutions are obtained with the same fit quality, mass and total width, but with different  $e^+e^-$  partial widths. We quote only the range of values.

<sup>13</sup> From a fit to Crystal Ball (OSTERHELD 86) data.

<sup>14</sup> From a fit to BES (BAI 02C) data.

NODE=M073W1  
NODE=M073W1  
→ UNCHECKED ←

OCCUR=2

NODE=M073W1;LINKAGE=AB

NODE=M073W1;LINKAGE=MO

NODE=M073W1;LINKAGE=ST  
NODE=M073W1;LINKAGE=SE

 **$\Gamma(\mu^+\mu^-)$**  **$\Gamma_{24}$** 

VALUE (keV)

DOCUMENT ID

TECN

COMMENT

**1.25±0.28±0.35**15,16 ABLIKIM 20AG BES3  $e^+e^- \rightarrow \mu^+\mu^-$ 

<sup>15</sup> From a fit to the  $e^+e^- \rightarrow \mu^+\mu^-$  cross section between 3.8 and 4.6 GeV to the coherent sum of four resonant amplitudes assuming  $\Gamma(\mu^+\mu^-) = \Gamma(e^+e^-)$ .

<sup>16</sup> From solution 1 of 8 with equal fit quality. Other solutions range from  $1.24 \pm 0.28 \pm 0.35$  to  $1.27 \pm 0.41 \pm 0.36$  keV.

NODE=M073W2  
NODE=M073W2

NODE=M073W2;LINKAGE=A

NODE=M073W2;LINKAGE=B



$\psi(4415) \Gamma(i) \times \Gamma(e^+ e^-) / \Gamma(\text{total})$ 

NODE=M073230

| $\Gamma(J/\psi\eta) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$ |     | $\Gamma_{20}\Gamma_{23}/\Gamma$ |      |                                             |
|---------------------------------------------------------------------|-----|---------------------------------|------|---------------------------------------------|
| VALUE (eV)                                                          | CL% | DOCUMENT ID                     | TECN | COMMENT                                     |
| <3.6                                                                | 90  | WANG                            | 13B  | BELL $e^+ e^- \rightarrow J/\psi\eta\gamma$ |

NODE=M073G01  
NODE=M073G01

| $\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$ |     | $\Gamma_{21}\Gamma_{23}/\Gamma$ |      |                                                  |
|--------------------------------------------------------------------------|-----|---------------------------------|------|--------------------------------------------------|
| VALUE (eV)                                                               | CL% | DOCUMENT ID                     | TECN | COMMENT                                          |
| <0.47                                                                    | 90  | 17 HAN                          | 15   | BELL $10.58 e^+ e^- \rightarrow \chi_{c1}\gamma$ |

NODE=M073G02  
NODE=M073G02<sup>17</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M073G02;LINKAGE=A

| $\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$ |     | $\Gamma_{22}\Gamma_{23}/\Gamma$ |      |                                                  |
|--------------------------------------------------------------------------|-----|---------------------------------|------|--------------------------------------------------|
| VALUE (eV)                                                               | CL% | DOCUMENT ID                     | TECN | COMMENT                                          |
| <2.3                                                                     | 90  | 18 HAN                          | 15   | BELL $10.58 e^+ e^- \rightarrow \chi_{c2}\gamma$ |

NODE=M073G03  
NODE=M073G03<sup>18</sup> Using  $B(\eta \rightarrow \gamma\gamma) = (39.41 \pm 0.21)\%$ .

NODE=M073G03;LINKAGE=A

 $\psi(4415)$  BRANCHING RATIOS

NODE=M073225

| $\Gamma(D^0 \bar{D}^0) / \Gamma_{\text{total}}$                               |  | $\Gamma_2 / \Gamma$ |      |                                                 |
|-------------------------------------------------------------------------------|--|---------------------|------|-------------------------------------------------|
| VALUE                                                                         |  | DOCUMENT ID         | TECN | COMMENT                                         |
| seen                                                                          |  | PAKHLOVA            | 08   | BELL $e^+ e^- \rightarrow D^0 \bar{D}^0 \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |                     |      |                                                 |
| not seen                                                                      |  | AUBERT              | 09M  | BABR $e^+ e^- \rightarrow D^0 \bar{D}^0 \gamma$ |

NODE=M073R04  
NODE=M073R04

| $\Gamma(D^+ D^-) / \Gamma_{\text{total}}$                                     |  | $\Gamma_3 / \Gamma$ |      |                                           |
|-------------------------------------------------------------------------------|--|---------------------|------|-------------------------------------------|
| VALUE                                                                         |  | DOCUMENT ID         | TECN | COMMENT                                   |
| seen                                                                          |  | PAKHLOVA            | 08   | BELL $e^+ e^- \rightarrow D^+ D^- \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |  |                     |      |                                           |
| not seen                                                                      |  | AUBERT              | 09M  | BABR $e^+ e^- \rightarrow D^+ D^- \gamma$ |

NODE=M073R05  
NODE=M073R05

| $\Gamma(D \bar{D}) / \Gamma(D^* \bar{D}^*)$ |  | $\Gamma_1 / \Gamma_7$ |      |                                                         |
|---------------------------------------------|--|-----------------------|------|---------------------------------------------------------|
| VALUE                                       |  | DOCUMENT ID           | TECN | COMMENT                                                 |
| $0.14 \pm 0.12 \pm 0.03$                    |  | AUBERT                | 09M  | BABR $e^+ e^- \rightarrow \gamma D^{(*)} \bar{D}^{(*)}$ |

NODE=M073R02  
NODE=M073R02

| $\Gamma(D^*(2007)^0 \bar{D}^0 + \text{c.c.}) / \Gamma_{\text{total}}$ |  | $\Gamma_5 / \Gamma$ |      |                                                    |
|-----------------------------------------------------------------------|--|---------------------|------|----------------------------------------------------|
| VALUE                                                                 |  | DOCUMENT ID         | TECN | COMMENT                                            |
| seen                                                                  |  | AUBERT              | 09M  | BABR $e^+ e^- \rightarrow D^{*0} \bar{D}^0 \gamma$ |

NODE=M073R06  
NODE=M073R06

| $\Gamma(D^*(2010)^+ D^- + \text{c.c.}) / \Gamma_{\text{total}}$               |    | $\Gamma_6 / \Gamma$ |      |                                              |
|-------------------------------------------------------------------------------|----|---------------------|------|----------------------------------------------|
| VALUE                                                                         |    | DOCUMENT ID         | TECN | COMMENT                                      |
| seen                                                                          | 19 | ZHUKOVA             | 18   | BELL $e^+ e^- \rightarrow D^{*+} D^- \gamma$ |
| seen                                                                          |    | AUBERT              | 09M  | BABR $e^+ e^- \rightarrow D^{*+} D^- \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |    |                     |      |                                              |
| seen                                                                          |    | PAKHLOVA            | 07   | BELL $e^+ e^- \rightarrow D^{*+} D^- \gamma$ |
| <sup>19</sup> Supersedes PAKHLOVA 07.                                         |    |                     |      |                                              |

NODE=M073R07  
NODE=M073R07

NODE=M073R07;LINKAGE=A

| $\Gamma(D^* \bar{D} + \text{c.c.}) / \Gamma(D^* \bar{D}^*)$ |  | $\Gamma_4 / \Gamma_7$ |      |                                                         |
|-------------------------------------------------------------|--|-----------------------|------|---------------------------------------------------------|
| VALUE                                                       |  | DOCUMENT ID           | TECN | COMMENT                                                 |
| $0.17 \pm 0.25 \pm 0.03$                                    |  | AUBERT                | 09M  | BABR $e^+ e^- \rightarrow \gamma D^{(*)} \bar{D}^{(*)}$ |

NODE=M073R03  
NODE=M073R03

| $\Gamma(D^*(2007)^0 \bar{D}^*(2007)^0 + \text{c.c.}) / \Gamma_{\text{total}}$ |  | $\Gamma_8 / \Gamma$ |      |                                                       |
|-------------------------------------------------------------------------------|--|---------------------|------|-------------------------------------------------------|
| VALUE                                                                         |  | DOCUMENT ID         | TECN | COMMENT                                               |
| seen                                                                          |  | AUBERT              | 09M  | BABR $e^+ e^- \rightarrow D^{*0} \bar{D}^{*0} \gamma$ |

NODE=M073R08  
NODE=M073R08

| $\Gamma(D^*(2010)^+ D^*(2010)^- + \text{c.c.}) / \Gamma_{\text{total}}$       |    | $\Gamma_9 / \Gamma$ |      |                                                 |
|-------------------------------------------------------------------------------|----|---------------------|------|-------------------------------------------------|
| VALUE                                                                         |    | DOCUMENT ID         | TECN | COMMENT                                         |
| seen                                                                          | 20 | ZHUKOVA             | 18   | BELL $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| seen                                                                          |    | AUBERT              | 09M  | BABR $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |    |                     |      |                                                 |
| seen                                                                          |    | PAKHLOVA            | 07   | BELL $e^+ e^- \rightarrow D^{*+} D^{*-} \gamma$ |
| <sup>20</sup> Supersedes PAKHLOVA 07.                                         |    |                     |      |                                                 |

NODE=M073R09  
NODE=M073R09

NODE=M073R09;LINKAGE=A

$$\Gamma(D\bar{D}_2^*(2460) \rightarrow D^0 D^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{11}/\Gamma$$

| VALUE (units $10^{-2}$ )                 | DOCUMENT ID | TECN | COMMENT                                              |
|------------------------------------------|-------------|------|------------------------------------------------------|
| <b><math>10.5 \pm 2.4 \pm 3.8</math></b> | 21 PAKHLOVA | 08A  | BELL $10.6 e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma$ |

<sup>21</sup> Using  $4421 \pm 4$  MeV for the mass and  $62 \pm 20$  MeV for the width of  $\psi(4415)$ .

NODE=M073R3  
NODE=M073R3

NODE=M073R3;LINKAGE=PA

$$\Gamma(D^0 D^- \pi^+ (\text{excl. } D^*(2007)^0 \bar{D}^0 + \text{c.c.}, D^*(2010)^+ D^- + \text{c.c.})/\Gamma(D\bar{D}_2^*(2460) \rightarrow D^0 D^- \pi^+ + \text{c.c.}) \quad \Gamma_{10}/\Gamma_{11}$$

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                                              |
|-----------------|-----|-------------|------|------------------------------------------------------|
| <b>&lt;0.22</b> | 90  | 22 PAKHLOVA | 08A  | BELL $10.6 e^+ e^- \rightarrow D^0 D^- \pi^+ \gamma$ |

<sup>22</sup> Using  $4421 \pm 4$  MeV for the mass and  $62 \pm 20$  MeV for the width of  $\psi(4415)$ .

NODE=M073R4  
NODE=M073R4

NODE=M073R4;LINKAGE=PA

$$\Gamma(D^0 D^{*-} \pi^+ + \text{c.c.})/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}} \quad \Gamma_{12}/\Gamma \times \Gamma_{23}/\Gamma$$

| VALUE                                       | CL% | DOCUMENT ID | TECN | COMMENT                                     |
|---------------------------------------------|-----|-------------|------|---------------------------------------------|
| <b>&lt;0.99 <math>\times 10^{-6}</math></b> | 90  | 23 PAKHLOVA | 09   | BELL $e^+ e^- \rightarrow D^0 D^{*-} \pi^+$ |

<sup>23</sup> Using  $4421 \pm 4$  MeV for the mass of  $\psi(4415)$ .

NODE=M073R01  
NODE=M073R01

NODE=M073R01;LINKAGE=PA

$$\Gamma(D_1(2420) \bar{D} + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{13}/\Gamma$$

| VALUE                | DOCUMENT ID | TECN | COMMENT                                          |
|----------------------|-------------|------|--------------------------------------------------|
| <b>possibly seen</b> | 24 ABLIKIM  | 19AR | BES3 $e^+ e^- \rightarrow \pi^+ \pi^- D \bar{D}$ |

<sup>24</sup> Evidence for  $e^+ e^- \rightarrow D_1(2420) \bar{D} + \text{c.c.}$  between  $\sqrt{s} = 4.3$  and  $4.6$  GeV, not necessarily resonant.

NODE=M073R15  
NODE=M073R15

NODE=M073R15;LINKAGE=A

$$\Gamma(D_s^+ D_s^-)/\Gamma_{\text{total}} \quad \Gamma_{14}/\Gamma$$

| VALUE           | DOCUMENT ID      | TECN | COMMENT                                       |
|-----------------|------------------|------|-----------------------------------------------|
| <b>not seen</b> | PAKHLOVA         | 11   | BELL $e^+ e^- \rightarrow D_s^+ D_s^- \gamma$ |
| <b>not seen</b> | DEL-AMO-SA...10N | BABR | $e^+ e^- \rightarrow D_s^+ D_s^- \gamma$      |

NODE=M073R10  
NODE=M073R10

$$\Gamma(\omega \chi_{c2})/\Gamma_{\text{total}} \quad \Gamma_{15}/\Gamma$$

| VALUE                | DOCUMENT ID | TECN | COMMENT                                                           |
|----------------------|-------------|------|-------------------------------------------------------------------|
| <b>possibly seen</b> | ABLIKIM     | 16A  | BES3 $e^+ e^- \rightarrow \gamma \pi^+ \pi^- \pi^0 \ell^+ \ell^-$ |

NODE=M073R00  
NODE=M073R00

$$\Gamma(D_s^{*+} D_s^- + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_{16}/\Gamma$$

| VALUE       | DOCUMENT ID      | TECN | COMMENT                                          |
|-------------|------------------|------|--------------------------------------------------|
| <b>seen</b> | PAKHLOVA         | 11   | BELL $e^+ e^- \rightarrow D_s^{*+} D_s^- \gamma$ |
| <b>seen</b> | DEL-AMO-SA...10N | BABR | $e^+ e^- \rightarrow D_s^{*+} D_s^- \gamma$      |

NODE=M073R11  
NODE=M073R11

$$\Gamma(D_s^{*+} D_s^{*-})/\Gamma_{\text{total}} \quad \Gamma_{17}/\Gamma$$

| VALUE           | DOCUMENT ID      | TECN | COMMENT                                             |
|-----------------|------------------|------|-----------------------------------------------------|
| <b>not seen</b> | PAKHLOVA         | 11   | BELL $e^+ e^- \rightarrow D_s^{*+} D_s^{*-} \gamma$ |
| <b>not seen</b> | DEL-AMO-SA...10N | BABR | $e^+ e^- \rightarrow D_s^{*+} D_s^{*-} \gamma$      |

NODE=M073R12  
NODE=M073R12

$$\Gamma(\psi(3770) \pi^+ \pi^-)/\Gamma_{\text{total}} \quad \Gamma_{19}/\Gamma$$

| VALUE                | DOCUMENT ID | TECN | COMMENT                                          |
|----------------------|-------------|------|--------------------------------------------------|
| <b>possibly seen</b> | 25 ABLIKIM  | 19AR | BES3 $e^+ e^- \rightarrow \pi^+ \pi^- D \bar{D}$ |

<sup>25</sup> Observe  $e^+ e^- \rightarrow \pi^+ \pi^- \psi(3770)$  at  $\sqrt{s} = 4.26, 4.36$ , and  $4.42$  GeV but cannot establish if continuum or resonant.

NODE=M073R14  
NODE=M073R14

NODE=M073R14;LINKAGE=A

$$\Gamma(\psi_2(3823) \pi^+ \pi^-)/\Gamma_{\text{total}} \quad \Gamma_{18}/\Gamma$$

| VALUE                | EVTS | DOCUMENT ID | TECN | COMMENT                                                 |
|----------------------|------|-------------|------|---------------------------------------------------------|
| <b>possibly seen</b> | 19   | 26 ABLIKIM  | 15S  | BES3 $e^+ e^- \rightarrow \pi^+ \pi^- \chi_{c1} \gamma$ |

<sup>26</sup> From a fit of  $e^+ e^- \rightarrow \pi^+ \pi^- \psi_2(3823)$ ,  $\psi_2(3823) \rightarrow \chi_{c1} \gamma$  cross sections taken at  $\sqrt{s}$  values of  $4.23, 4.26, 4.36, 4.42$ , and  $4.60$  GeV to the  $\psi(4415)$  line shape.

NODE=M073R13  
NODE=M073R13

NODE=M073R13;LINKAGE=A

## $\psi(4415)$ REFERENCES

|                  |      |                |                                  |                  |             |
|------------------|------|----------------|----------------------------------|------------------|-------------|
| ABLIKIM          | 20AG | PR D102 112009 | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=60744 |
| ABLIKIM          | 19AR | PR D100 032005 | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=59910 |
| ZHUKOVA          | 18   | PR D97 012002  | V. Zhukova <i>et al.</i>         | (BELLE Collab.)  | REFID=58710 |
| ABLIKIM          | 16A  | PR D93 011102  | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=57122 |
| ABLIKIM          | 15S  | PRL 115 011803 | M. Ablikim <i>et al.</i>         | (BESIII Collab.) | REFID=56784 |
| HAN              | 15   | PR D92 012011  | Y.L. Han <i>et al.</i>           | (BELLE Collab.)  | REFID=56816 |
| WANG             | 13B  | PR D87 051101  | X.L. Wang <i>et al.</i>          | (BELLE Collab.)  | REFID=55377 |
| PAKHLOVA         | 11   | PR D83 011101  | G. Pakhlova <i>et al.</i>        | (BELLE Collab.)  | REFID=53638 |
| DEL-AMO-SA...10N | 10N  | PR D82 052004  | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)  | REFID=53532 |
| MO               | 10   | PR D82 077501  | X.H. Mo, C.Z. Yuan, P. Wang      | (BHEP)           | REFID=53540 |
| AUBERT           | 09M  | PR D79 092001  | B. Aubert <i>et al.</i>          | (BABAR Collab.)  | REFID=52724 |

NODE=M073

|           |     |                |                             |                             |
|-----------|-----|----------------|-----------------------------|-----------------------------|
| PAKHLOVA  | 09  | PR D80 091101  | G. Pakhlova <i>et al.</i>   | (BELLE Collab.)             |
| ABLIKIM   | 08D | PL B660 315    | M. Ablikim <i>et al.</i>    | (BES Collab.)               |
| PAKHLOVA  | 08  | PR D77 011103  | G. Pakhlova <i>et al.</i>   | (BELLE Collab.)             |
| PAKHLOVA  | 08A | PRL 100 062001 | G. Pakhlova <i>et al.</i>   | (BELLE Collab.)             |
| PAKHLOVA  | 07  | PRL 98 092001  | G. Pakhlova <i>et al.</i>   | (BELLE Collab.)             |
| SETH      | 05A | PR D72 017501  | K.K. Seth                   |                             |
| BAI       | 02C | PRL 88 101802  | J.Z. Bai <i>et al.</i>      | (BES Collab.)               |
| BAI       | 00  | PRL 84 594     | J.Z. Bai <i>et al.</i>      | (BES Collab.)               |
| OSTERHELD | 86  | SLAC-PUB-4160  | A. Osterheld <i>et al.</i>  | (SLAC Crystal Ball Collab.) |
| BRANDELIK | 78C | PL 76B 361     | R. Brandelik <i>et al.</i>  | (DASP Collab.)              |
| SIEGRIST  | 76  | PRL 36 700     | J.L. Siegrist <i>et al.</i> | (LBL, SLAC)                 |

REFID=53143  
REFID=52142  
REFID=52132  
REFID=52134  
REFID=51628  
REFID=50813  
REFID=50506  
REFID=50503  
REFID=51064  
REFID=22232  
REFID=22243

NODE=M195

**$Z_c(4430)$**

$$I^G(J^{PC}) = 1^+(1^{+-})$$

$G, C$  need confirmation.

was  $X(4430)^\pm$

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

NODE=M195

First seen by CHOI 08 in  $B \rightarrow K\pi^+\psi(2S)$  decays, confirmed by AAIJ 14AG, and confirmed in a model-independent way by AAIJ 15BH. Also seen by CHILIKIN 14 in  $B \rightarrow K^+\pi J/\psi$  decays.  $J^P$  was determined by CHILIKIN 13 and AAIJ 14AG.

### $Z_c(4430)$ MASS

NODE=M195M

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN      | COMMENT                            |
|-------------------------------------------------------------------------------|-----------------------|-----------|------------------------------------|
| <b><math>4478^{+15}_{-18}</math> OUR AVERAGE</b>                              |                       |           |                                    |
| $4475 \pm 7^{+15}_{-25}$                                                      | <sup>1</sup> AAIJ     | 14AG LHCB | $B^0 \rightarrow K^+\pi^-\psi(2S)$ |
| $4485 \pm 22^{+28}_{-11}$                                                     | <sup>1</sup> CHILIKIN | 13 BELL   | $B^0 \rightarrow K^+\pi^-\psi(2S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |           |                                    |
| $4443^{+15+19}_{-12-13}$                                                      | <sup>2</sup> MIZUK    | 09 BELL   | $B \rightarrow K\pi^+\psi(2S)$     |
| $4433 \pm 4 \pm 2$                                                            | <sup>3</sup> CHOI     | 08 BELL   | $B \rightarrow K\pi^+\psi(2S)$     |
| <sup>1</sup> From a four-dimensional amplitude analysis.                      |                       |           |                                    |
| <sup>2</sup> From a Dalitz plot analysis. Superseded by CHILIKIN 13.          |                       |           |                                    |
| <sup>3</sup> Superseded by MIZUK 09 and CHILIKIN 13.                          |                       |           |                                    |

NODE=M195M

NODE=M195M;LINKAGE=A  
NODE=M195M;LINKAGE=MI  
NODE=M195M;LINKAGE=CH

### $Z_c(4430)$ WIDTH

NODE=M195W

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN      | COMMENT                            |
|-------------------------------------------------------------------------------|-----------------------|-----------|------------------------------------|
| <b><math>181 \pm 31</math> OUR AVERAGE</b>                                    |                       |           |                                    |
| $172 \pm 13^{+37}_{-34}$                                                      | <sup>1</sup> AAIJ     | 14AG LHCB | $B^0 \rightarrow K^+\pi^-\psi(2S)$ |
| $200^{+41+26}_{-46-35}$                                                       | <sup>1</sup> CHILIKIN | 13 BELL   | $B^0 \rightarrow K^+\pi^-\psi(2S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |           |                                    |
| $107^{+86+74}_{-43-56}$                                                       | <sup>2</sup> MIZUK    | 09 BELL   | $B \rightarrow K\pi^+\psi(2S)$     |
| $45^{+18+30}_{-13-13}$                                                        | <sup>3</sup> CHOI     | 08 BELL   | $B \rightarrow K\pi^+\psi(2S)$     |
| <sup>1</sup> From a four-dimensional amplitude analysis.                      |                       |           |                                    |
| <sup>2</sup> From a Dalitz plot analysis. Superseded by CHILIKIN 13.          |                       |           |                                    |
| <sup>3</sup> Superseded by MIZUK 09 and CHILIKIN 13.                          |                       |           |                                    |

NODE=M195W

NODE=M195W;LINKAGE=A  
NODE=M195W;LINKAGE=MI  
NODE=M195W;LINKAGE=CH

### $Z_c(4430)$ DECAY MODES

NODE=M195215;NODE=M195

| Mode                           | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------|--------------------------------|
| $\Gamma_1 \quad \pi^+\psi(2S)$ | seen                           |
| $\Gamma_2 \quad \pi^+J/\psi$   | seen                           |

DESIG=1

DESIG=2

**$Z_c(4430)$  BRANCHING RATIOS** $\Gamma(\pi^+\psi(2S))/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID           | TECN      | COMMENT                            |
|-------------------------------------------------------------------------------|-----------------------|-----------|------------------------------------|
| seen                                                                          | <sup>1</sup> AAIJ     | 14AG LHCb | $B^0 \rightarrow K^+\pi^-\psi(2S)$ |
| seen                                                                          | <sup>2</sup> CHILIKIN | 13 BELL   | $B^0 \rightarrow K^+\pi^-\psi(2S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |           |                                    |
| not seen                                                                      | <sup>3</sup> AUBERT   | 09AA BABR | $B \rightarrow K\pi^+\psi(2S)$     |
| seen                                                                          | <sup>4</sup> MIZUK    | 09 BELL   | $B \rightarrow K\pi^+\psi(2S)$     |

<sup>1</sup> From a four-dimensional amplitude analysis. No product of branching fractions quoted.<sup>2</sup> From a four-dimensional amplitude analysis. Measured a product of branching fractions  $B(B^0 \rightarrow Z_c(4430)^- K^+) \times B(Z_c(4430)^- \rightarrow \psi(2S)\pi^-) = (6.0^{+1.7+2.5}_{-2.0-1.4}) \times 10^{-5}$ .<sup>3</sup> AUBERT 09AA quotes  $B(B^+ \rightarrow \bar{K}^0 Z_c(4430)^+) \times B(Z_c(4430)^+ \rightarrow \pi^+\psi(2S)) < 4.7 \times 10^{-5}$  and  $B(\bar{B}^0 \rightarrow K^- Z_c(4430)^+) \times B(Z_c(4430)^+ \rightarrow \pi^+\psi(2S)) < 3.1 \times 10^{-5}$  at 95% CL.<sup>4</sup> Measured a product of branching fractions  $B(\bar{B}^0 \rightarrow K^- Z_c(4430)^+) \times B(Z_c(4430)^+ \rightarrow \pi^+\psi(2S)) = (3.2^{+1.8+5.3}_{-0.9-1.6}) \times 10^{-5}$ . Superseded by CHILIKIN 13.

NODE=M195225

NODE=M195R01  
NODE=M195R01

NODE=M195R01;LINKAGE=AA

NODE=M195R01;LINKAGE=A

NODE=M195R01;LINKAGE=AU

NODE=M195R01;LINKAGE=MI

 $\Gamma(\pi^+ J/\psi)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE                                                                         | DOCUMENT ID             | TECN      | COMMENT                                 |
|-------------------------------------------------------------------------------|-------------------------|-----------|-----------------------------------------|
| seen                                                                          | <sup>1,2</sup> CHILIKIN | 14 BELL   | $\bar{B}^0 \rightarrow K^-\pi^+ J/\psi$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                         |           |                                         |
| not seen                                                                      | <sup>3</sup> AUBERT     | 09AA BABR | $B \rightarrow K\pi^+ J/\psi$           |

<sup>1</sup> CHILIKIN 14 reports  $B(\bar{B}^0 \rightarrow Z_c(4430)^+ K^-) \times B(Z_c(4430)^+ \rightarrow J/\psi\pi^+) = (5.4^{+4.0+1.1}_{-1.0-0.9}) \times 10^{-6}$ .<sup>2</sup> A broad enhancement seen by AAIJ 19R in the decays  $B^0 \rightarrow J/\psi\pi^+ K^-$  at 4600 MeV can be due to an interplay of  $Z_c(4430)$ ,  $Z_c(4200)$  and the fitting polynomials.<sup>3</sup> AUBERT 09AA quotes  $B(B^+ \rightarrow \bar{K}^0 Z_c(4430)^+) \times B(Z_c(4430)^+ \rightarrow \pi^+ J/\psi) < 1.5 \times 10^{-5}$  and  $B(\bar{B}^0 \rightarrow K^- Z_c(4430)^+) \times B(Z_c(4430)^+ \rightarrow \pi^+ J/\psi) < 0.4 \times 10^{-5}$  at 95% CL.NODE=M195R02  
NODE=M195R02

NODE=M195R02;LINKAGE=A

NODE=M195R02;LINKAGE=E

NODE=M195R02;LINKAGE=AU

 **$Z_c(4430)$  REFERENCES**

|          |      |                |                           |                    |
|----------|------|----------------|---------------------------|--------------------|
| AAIJ     | 19R  | PRL 122 152002 | R. Aaij <i>et al.</i>     | (LHCb Collab.)     |
| AAIJ     | 15BH | PR D92 112009  | R. Aaij <i>et al.</i>     | (LHCb Collab.)     |
| AAIJ     | 14AG | PRL 112 222002 | R. Aaij <i>et al.</i>     | (LHCb Collab.) JP  |
| CHILIKIN | 14   | PR D90 112009  | K. Chilikin <i>et al.</i> | (BELLE Collab.)    |
| CHILIKIN | 13   | PR D88 074026  | K. Chilikin <i>et al.</i> | (BELLE Collab.) JP |
| AUBERT   | 09AA | PR D79 112001  | B. Aubert <i>et al.</i>   | (BABAR Collab.)    |
| MIZUK    | 09   | PR D80 031104  | R. Mizuk <i>et al.</i>    | (BELLE Collab.)    |
| CHOI     | 08   | PRL 100 142001 | S.-K. Choi <i>et al.</i>  | (BELLE Collab.)    |

NODE=M195

REFID=59776  
REFID=57110  
REFID=55896  
REFID=56344  
REFID=55551  
REFID=52940  
REFID=52960  
REFID=52178

NODE=M234

 $\chi_{c0}(4500)$ 

$$I^G(J^{PC}) = 0^+(0^{++})$$

OMITTED FROM SUMMARY TABLE  
was  $X(4500)$ This state shows properties different from a conventional  $q\bar{q}$  state.  
A candidate for an exotic structure. See the review on non- $q\bar{q}$  states.Seen by AAIJ 17C in  $B^+ \rightarrow \chi_{c0} K^+$ ,  $\chi_{c0} \rightarrow J/\psi\phi$  using an amplitude analysis of  $B^+ \rightarrow J/\psi\phi K^+$  with a significance (accounting for systematic uncertainties) of  $6.1\sigma$ .

NODE=M234

 **$\chi_{c0}(4500)$  MASS**

NODE=M234M

| VALUE (MeV)               | EVTS | DOCUMENT ID       | TECN     | COMMENT                          |
|---------------------------|------|-------------------|----------|----------------------------------|
| $4506 \pm 11^{+12}_{-15}$ | 4289 | <sup>1</sup> AAIJ | 17C LHCb | $B^+ \rightarrow J/\psi\phi K^+$ |

NODE=M234M

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi\phi K^+$  with a significance of  $6.1\sigma$ .

NODE=M234M;LINKAGE=A

 **$\chi_{c0}(4500)$  WIDTH**

NODE=M234W

| VALUE (MeV)             | EVTS | DOCUMENT ID       | TECN     | COMMENT                          |
|-------------------------|------|-------------------|----------|----------------------------------|
| $92 \pm 21^{+21}_{-20}$ | 4289 | <sup>1</sup> AAIJ | 17C LHCb | $B^+ \rightarrow J/\psi\phi K^+$ |

NODE=M234W

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi\phi K^+$  with a significance of  $6.1\sigma$ .

NODE=M234W;LINKAGE=A

$\chi_{c0}(4500)$  DECAY MODES

NODE=M234215;NODE=M234

| Mode                         |
|------------------------------|
| $\Gamma_1 \quad J/\psi \phi$ |

DESIG=1

 $\chi_{c0}(4500)$  BRANCHING RATIOS

NODE=M234220

| $\Gamma(J/\psi \phi)/\Gamma_{\text{total}}$                                                                                  |      |                   |          |                                   | $\Gamma_1/\Gamma$ |
|------------------------------------------------------------------------------------------------------------------------------|------|-------------------|----------|-----------------------------------|-------------------|
| VALUE                                                                                                                        | EVTS | DOCUMENT ID       | TECN     | COMMENT                           |                   |
| seen                                                                                                                         | 4289 | <sup>1</sup> AAIJ | 17C LHCb | $B^+ \rightarrow J/\psi \phi K^+$ |                   |
| <sup>1</sup> From an amplitude analysis of the decay $B^+ \rightarrow J/\psi \phi K^+$ with a significance of 6.1 $\sigma$ . |      |                   |          |                                   |                   |

NODE=M234R01  
NODE=M234R01

NODE=M234R01;LINKAGE=A

 $\chi_{c0}(4500)$  REFERENCES

NODE=M234

|      |     |                |                       |                   |
|------|-----|----------------|-----------------------|-------------------|
| AAIJ | 17C | PRL 118 022003 | R. Aaij <i>et al.</i> | (LHCb Collab.) JP |
| Also |     | PR D95 012002  | R. Aaij <i>et al.</i> | (LHCb Collab.)    |

REFID=57657  
REFID=57636

NODE=M189

$$\psi(4660) \quad I^G(J^{PC}) = 0^-(1^{--})$$

also known as  $Y(4660)$ ; was  $X(4660)$ 

This state shows properties different from a conventional  $q\bar{q}$  state.  
A candidate for an exotic structure. See the review on non- $q\bar{q}$  states.

NODE=M189

Seen in radiative return from  $e^+e^-$  collisions at  $\sqrt{s} = 9.54\text{--}10.58$  GeV by WANG 07D. Also obtained in a combined fit of WANG 07D, AUBERT 07S, and LEES 14F. See also the review on "Spectroscopy of mesons containing two heavy quarks."

 $\psi(4660)$  MASS

NODE=M189M

| VALUE (MeV)                                            | EVTS | DOCUMENT ID                                                 | TECN | COMMENT |
|--------------------------------------------------------|------|-------------------------------------------------------------|------|---------|
| <b>4630 <math>\pm</math> 6 OUR AVERAGE</b>             |      | Error includes scale factor of 1.4. See the ideogram below. |      |         |
| [4633 $\pm$ 7 MeV OUR 2020 AVERAGE Scale factor = 1.4] |      |                                                             |      |         |

NODE=M189M  
NEW

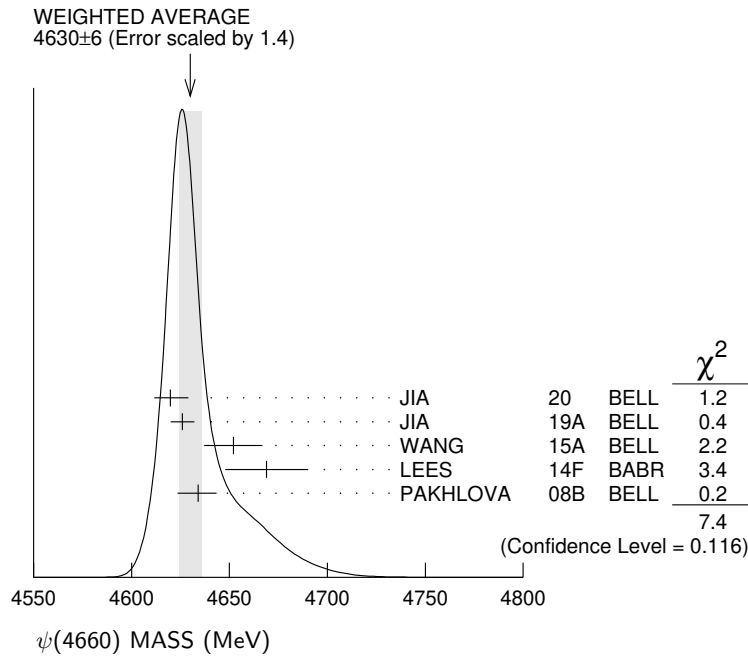
|                                                                                            |     |                       |          |                                                        |
|--------------------------------------------------------------------------------------------|-----|-----------------------|----------|--------------------------------------------------------|
| 4619.8 <sup>+</sup> <sub>8.0</sub> <sup>+</sup> <sub>2.3</sub>                             | 66  | <sup>1</sup> JIA      | 20 BELL  | $e^+e^- \rightarrow \gamma D_s^+ D_{s2}^{*-}(2573)^-$  |
| 4625.9 <sup>+</sup> <sub>6.2</sub> <sup>+</sup> <sub>6.0</sub> <sup>+</sup> <sub>0.4</sub> | 89  | <sup>2</sup> JIA      | 19A BELL | $e^+e^- \rightarrow \gamma D_s^+ D_{s1}(2536)^-$       |
| 4652 $\pm$ 10 $\pm$ 11                                                                     | 279 | <sup>3</sup> WANG     | 15A BELL | 10.58 $e^+e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |
| 4669 $\pm$ 21 $\pm$ 3                                                                      | 37  | <sup>4</sup> LEES     | 14F BABR | 10.58 $e^+e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |
| 4634 $\pm$ 8 $\pm$ 5<br><sub>7 <sub>8</sub></sub>                                          | 142 | <sup>5</sup> PAKHLOVA | 08B BELL | $e^+e^- \rightarrow \Lambda_c^+ \Lambda_c^-$           |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                      |                    |          |                                                        |
|--------------------------------------|--------------------|----------|--------------------------------------------------------|
| 4652.5 $\pm$ 3.4 $\pm$ 1.1           | <sup>6</sup> DAI   | 17 RVUE  | $e^+e^- \rightarrow \Lambda_c^+ \Lambda_c^-$           |
| 4645.2 $\pm$ 9.5 $\pm$ 6.0           | <sup>7</sup> ZHANG | 17B RVUE | $e^+e^- \rightarrow \pi^+ \pi^- \psi(2S)$              |
| 4646.4 $\pm$ 9.7 $\pm$ 4.8           | <sup>8</sup> ZHANG | 17C RVUE | $e^+e^- \rightarrow \pi^+ \pi^- J/\psi$ or $\psi(2S)$  |
| 4661 $\pm$ 9 $\pm$ 6<br><sub>8</sub> | <sup>9</sup> LIU   | 08H RVUE | 10.58 $e^+e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |
| 4664 $\pm$ 11 $\pm$ 5                | 44 WANG            | 07D BELL | 10.58 $e^+e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |

<sup>1</sup> Using  $D_{s2}^{*}(2573)^- \rightarrow \bar{D}^0 K^-$  decays.<sup>2</sup> From a fit of a Breit-Wigner convolved with a Gaussian.<sup>3</sup> From a two-resonance fit. Supersedes WANG 07D.<sup>4</sup> From a two-resonance fit.<sup>5</sup> The  $\pi^+ \pi^- \psi(2S)$  and  $\Lambda_c^+ \Lambda_c^-$  states are not necessarily the same.<sup>6</sup> The pole parameters are extracted from the speed plot.<sup>7</sup> From a three-resonance fit.<sup>8</sup> From a combined fit of BELLE, BABAR and BES3  $e^+e^- \rightarrow \pi^+ \pi^- J/\psi$  and  $e^+e^- \rightarrow \pi^+ \pi^- \psi(2S)$  data.<sup>9</sup> From a combined fit of AUBERT 07S and WANG 07D data with two resonances.NODE=M189M;LINKAGE=F  
NODE=M189M;LINKAGE=E  
NODE=M189M;LINKAGE=A  
NODE=M189M;LINKAGE=LENODE=M189M;LINKAGE=PA  
NODE=M189M;LINKAGE=C  
NODE=M189M;LINKAGE=D  
NODE=M189M;LINKAGE=B

NODE=M189M;LINKAGE=LI



### ψ(4660) WIDTH

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID | TECN     | COMMENT                                                                                                        |
|-------------------------------------------------------------------------------|------|-------------|----------|----------------------------------------------------------------------------------------------------------------|
| <b>62 ± 9 OUR AVERAGE</b>                                                     |      |             |          |                                                                                                                |
| [64 ± 9 MeV OUR 2020 AVERAGE]                                                 |      |             |          |                                                                                                                |
| 47.0 <sup>+31.3</sup> <sub>-14.8</sub> ± 4.6                                  | 66   | 1 JIA       | 20 BELL  | e <sup>+</sup> e <sup>-</sup> → γ D <sub>s</sub> <sup>+</sup> D <sub>s2</sub> <sup>*</sup> (2573) <sup>-</sup> |
| 49.8 <sup>+13.9</sup> <sub>-11.5</sub> ± 4.0                                  | 89   | 2 JIA       | 19A BELL | e <sup>+</sup> e <sup>-</sup> → γ D <sub>s</sub> <sup>+</sup> D <sub>s1</sub> (2536) <sup>-</sup>              |
| 68 ± 11 ± 5                                                                   | 279  | 3 WANG      | 15A BELL | 10.58 e <sup>+</sup> e <sup>-</sup> → γ π <sup>+</sup> π <sup>-</sup> ψ(2S)                                    |
| 104 ± 48 ± 10                                                                 | 37   | 4 LEES      | 14F BABR | 10.58 e <sup>+</sup> e <sup>-</sup> → γ π <sup>+</sup> π <sup>-</sup> ψ(2S)                                    |
| 92 <sup>+40</sup> <sub>-24</sub> ± 10                                         | 142  | 5 PAKHOVA   | 08B BELL | e <sup>+</sup> e <sup>-</sup> → Λ <sub>c</sub> <sup>+</sup> Λ <sub>c</sub> <sup>-</sup>                        |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |          |                                                                                                                |
| 62.6 ± 5.6 ± 4.3                                                              | 6    | DAI         | 17 RVUE  | e <sup>+</sup> e <sup>-</sup> → Λ <sub>c</sub> <sup>+</sup> Λ <sub>c</sub> <sup>-</sup>                        |
| 113.8 ± 18.1 ± 3.4                                                            | 7    | ZHANG       | 17B RVUE | e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> ψ(2S)                                            |
| 103.5 ± 15.6 ± 4.0                                                            | 8    | ZHANG       | 17C RVUE | e <sup>+</sup> e <sup>-</sup> → π <sup>+</sup> π <sup>-</sup> J/ψ or ψ(2S)                                     |
| 42 <sup>+17</sup> <sub>-12</sub> ± 6                                          | 44   | 9 LIU       | 08H RVUE | 10.58 e <sup>+</sup> e <sup>-</sup> → γ π <sup>+</sup> π <sup>-</sup> ψ(2S)                                    |
| 48 ± 15 ± 3                                                                   | 44   | WANG        | 07D BELL | 10.58 e <sup>+</sup> e <sup>-</sup> → γ π <sup>+</sup> π <sup>-</sup> ψ(2S)                                    |

<sup>1</sup> Using D<sub>s2</sub><sup>\*</sup>(2573)<sup>-</sup> → D<sup>0</sup> K<sup>-</sup> decays.

<sup>2</sup> From a fit of a Breit-Wigner convolved with a Gaussian.

<sup>3</sup> From a two-resonance fit. Supersedes WANG 07D.

<sup>4</sup> From a two-resonance fit.

<sup>5</sup> The π<sup>+</sup> π<sup>-</sup> ψ(2S) and Λ<sub>c</sub><sup>+</sup> Λ<sub>c</sub><sup>-</sup> states are not necessarily the same.

<sup>6</sup> The pole parameters are extracted from the speed plot.

<sup>7</sup> From a three-resonance fit.

<sup>8</sup> From a combined fit of BELLE, BABAR and BES3 e<sup>+</sup>e<sup>-</sup> → π<sup>+</sup> π<sup>-</sup> J/ψ and e<sup>+</sup>e<sup>-</sup> → π<sup>+</sup> π<sup>-</sup> ψ(2S) data.

<sup>9</sup> From a combined fit of AUBERT 07S and WANG 07D data with two resonances.

### ψ(4660) DECAY MODES

| Mode                                                                                        | Fraction (Γ <sub>i</sub> /Γ) |
|---------------------------------------------------------------------------------------------|------------------------------|
| Γ <sub>1</sub> e <sup>+</sup> e <sup>-</sup>                                                | not seen                     |
| Γ <sub>2</sub> ψ(2S) π <sup>+</sup> π <sup>-</sup>                                          | seen                         |
| Γ <sub>3</sub> J/ψ η                                                                        | not seen                     |
| Γ <sub>4</sub> D <sup>0</sup> D <sup>*-</sup> π <sup>+</sup>                                | not seen                     |
| Γ <sub>5</sub> χ <sub>c1</sub> γ                                                            | not seen                     |
| Γ <sub>6</sub> χ <sub>c2</sub> γ                                                            | not seen                     |
| Γ <sub>7</sub> Λ <sub>c</sub> <sup>+</sup> Λ <sub>c</sub> <sup>-</sup>                      | seen                         |
| Γ <sub>8</sub> D <sub>s</sub> <sup>+</sup> D <sub>s1</sub> (2536) <sup>-</sup>              | seen                         |
| Γ <sub>9</sub> D <sub>s</sub> <sup>+</sup> D <sub>s2</sub> <sup>*</sup> (2573) <sup>-</sup> |                              |

NODE=M189W

NODE=M189W

NEW

NODE=M189W;LINKAGE=G  
NODE=M189W;LINKAGE=F  
NODE=M189W;LINKAGE=A  
NODE=M189W;LINKAGE=LE

NODE=M189W;LINKAGE=B  
NODE=M189W;LINKAGE=D  
NODE=M189W;LINKAGE=E  
NODE=M189W;LINKAGE=C

NODE=M189W;LINKAGE=LI

NODE=M189215;NODE=M189

DESIG=1;OUR EVAL;→ UNCHECKED ←  
DESIG=2;OUR EVAL;→ UNCHECKED ←  
DESIG=4;OUR EVAL;→ UNCHECKED ←  
DESIG=3;OUR EVAL;→ UNCHECKED ←  
DESIG=6;OUR EVAL;→ UNCHECKED ←  
DESIG=7;OUR EVAL;→ UNCHECKED ←  
DESIG=5;OUR EVAL;→ UNCHECKED ←  
DESIG=8;OUR EVAL;→ UNCHECKED ←  
DESIG=9

$\psi(4660) \Gamma(i) \times \Gamma(e^+ e^-) / \Gamma(\text{total})$ 

NODE=M189230

 $\Gamma(\psi(2S)\pi^+\pi^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_2 \Gamma_1 / \Gamma$ NODE=M189G1  
NODE=M189G1

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |     |                   |     |      |                                                         |
|-----------------------|-----|-------------------|-----|------|---------------------------------------------------------|
| $2.0 \pm 0.3 \pm 0.2$ | 279 | <sup>1</sup> WANG | 15A | BELL | $10.58 e^+ e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |
| $8.1 \pm 1.1 \pm 1.0$ | 279 | <sup>2</sup> WANG | 15A | BELL | $10.58 e^+ e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |
| $2.7 \pm 1.3 \pm 0.5$ | 37  | <sup>3</sup> LEES | 14F | BABR | $10.58 e^+ e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |
| $7.5 \pm 1.7 \pm 0.7$ | 37  | <sup>4</sup> LEES | 14F | BABR | $10.58 e^+ e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |
| $2.2^{+0.7}_{-0.6}$   | 44  | <sup>5</sup> LIU  | 08H | RVUE | $10.58 e^+ e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |
| $5.9 \pm 1.6$         | 44  | <sup>6</sup> LIU  | 08H | RVUE | $10.58 e^+ e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |
| $3.0 \pm 0.9 \pm 0.3$ | 44  | <sup>3</sup> WANG | 07D | BELL | $10.58 e^+ e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |
| $7.6 \pm 1.8 \pm 0.8$ | 44  | <sup>4</sup> WANG | 07D | BELL | $10.58 e^+ e^- \rightarrow \gamma \pi^+ \pi^- \psi(2S)$ |

OCCUR=2

OCCUR=2

OCCUR=2

OCCUR=2

<sup>1</sup> Solution I of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D.

NODE=M189G1;LINKAGE=A

<sup>2</sup> Solution II of two equivalent solutions from a fit using two interfering resonances. Supersedes WANG 07D.

NODE=M189G1;LINKAGE=B

<sup>3</sup> Solution I of two equivalent solutions in a fit using two interfering resonances.

NODE=M189G1;LINKAGE=WA

<sup>4</sup> Solution II of two equivalent solutions in a fit using two interfering resonances.

NODE=M189G1;LINKAGE=WN

<sup>5</sup> Solution I in a combined fit of AUBERT 07S and WANG 07D data with two resonances.

NODE=M189G1;LINKAGE=LI

<sup>6</sup> Solution II in a combined fit of AUBERT 07S and WANG 07D data with two resonances.

NODE=M189G1;LINKAGE=LU

 $\Gamma(J/\psi\eta) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_3 \Gamma_1 / \Gamma$ NODE=M189G01  
NODE=M189G01

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|         |    |      |     |      |                                          |
|---------|----|------|-----|------|------------------------------------------|
| $<0.94$ | 90 | WANG | 13B | BELL | $e^+ e^- \rightarrow J/\psi \eta \gamma$ |
|---------|----|------|-----|------|------------------------------------------|

 $\Gamma(\chi_{c1}\gamma) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_5 \Gamma_1 / \Gamma$ NODE=M189G02  
NODE=M189G02

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|                 |    |                  |    |      |                                              |
|-----------------|----|------------------|----|------|----------------------------------------------|
| <b>&lt;0.45</b> | 90 | <sup>1</sup> HAN | 15 | BELL | $10.58 e^+ e^- \rightarrow \chi_{c1} \gamma$ |
|-----------------|----|------------------|----|------|----------------------------------------------|

<sup>1</sup> Using  $B(\eta \rightarrow \gamma \gamma) = (39.41 \pm 0.21)\%$ .

NODE=M189G02;LINKAGE=A

 $\Gamma(\chi_{c2}\gamma) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_6 \Gamma_1 / \Gamma$ NODE=M189G03  
NODE=M189G03

| VALUE (eV) | CL% | DOCUMENT ID | TECN | COMMENT |
|------------|-----|-------------|------|---------|
|------------|-----|-------------|------|---------|

|                |    |                  |    |      |                                              |
|----------------|----|------------------|----|------|----------------------------------------------|
| <b>&lt;2.1</b> | 90 | <sup>1</sup> HAN | 15 | BELL | $10.58 e^+ e^- \rightarrow \chi_{c2} \gamma$ |
|----------------|----|------------------|----|------|----------------------------------------------|

<sup>1</sup> Using  $B(\eta \rightarrow \gamma \gamma) = (39.41 \pm 0.21)\%$ .

NODE=M189G03;LINKAGE=A

 $\Gamma(D_s^+ D_{s1}(2536)^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_8 \Gamma_1 / \Gamma$ NODE=M189R00  
NODE=M189R00

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                              |    |                  |     |      |                                                   |
|------------------------------|----|------------------|-----|------|---------------------------------------------------|
| $14.3^{+2.8}_{-2.6} \pm 1.5$ | 89 | <sup>1</sup> JIA | 19A | BELL | $e^+ e^- \rightarrow \gamma D_s^+ D_{s1}(2536)^-$ |
|------------------------------|----|------------------|-----|------|---------------------------------------------------|

<sup>1</sup> Assuming  $B(D_{s1}(2536)^- \rightarrow \bar{D}^{*0} K^-) = 1$ .

NODE=M189R00;LINKAGE=A

 $\Gamma(D_s^+ D_{s2}^*(2573)^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_9 \Gamma_1 / \Gamma$ NODE=M189R04  
NODE=M189R04

| VALUE (eV) | EVTS | DOCUMENT ID | TECN | COMMENT |
|------------|------|-------------|------|---------|
|------------|------|-------------|------|---------|

|                              |    |                  |    |      |                                                     |
|------------------------------|----|------------------|----|------|-----------------------------------------------------|
| $14.7^{+5.9}_{-4.5} \pm 3.6$ | 66 | <sup>1</sup> JIA | 20 | BELL | $e^+ e^- \rightarrow \gamma D_s^+ D_{s2}^*(2573)^-$ |
|------------------------------|----|------------------|----|------|-----------------------------------------------------|

<sup>1</sup> Assuming  $B(D_{s2}^*(2573)^- \rightarrow \bar{D}^0 K^-) = 1$ .

NODE=M189R04;LINKAGE=A

 $\psi(4660)$  BRANCHING RATIOS

NODE=M189225

 $\Gamma(D^0 D^{*-} \pi^+) / \Gamma(\psi(2S)\pi^+\pi^-)$  $\Gamma_4 / \Gamma_2$ NODE=M189R01  
NODE=M189R01

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|               |    |          |    |      |                                        |
|---------------|----|----------|----|------|----------------------------------------|
| <b>&lt;10</b> | 90 | PAKHLOVA | 09 | BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+$ |
|---------------|----|----------|----|------|----------------------------------------|

 $\Gamma(D^0 D^{*-} \pi^+) / \Gamma_{\text{total}} \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$  $\Gamma_4 / \Gamma \times \Gamma_1 / \Gamma$ NODE=M189R02  
NODE=M189R02

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                                             |    |                       |    |      |                                        |
|---------------------------------------------|----|-----------------------|----|------|----------------------------------------|
| <b>&lt;0.37 <math>\times 10^{-6}</math></b> | 90 | <sup>1</sup> PAKHLOVA | 09 | BELL | $e^+ e^- \rightarrow D^0 D^{*-} \pi^+$ |
|---------------------------------------------|----|-----------------------|----|------|----------------------------------------|

<sup>1</sup> Using  $4664 \pm 11 \pm 5$  MeV for the mass of  $\psi(4660)$ .

NODE=M189R02;LINKAGE=PA

| $\Gamma(\Lambda_c^+ \Lambda_c^-)/\Gamma_{\text{total}} \times \Gamma(e^+ e^-)/\Gamma_{\text{total}}$ |      |                       |          |                                               | $\Gamma_7/\Gamma \times \Gamma_1/\Gamma$ |
|------------------------------------------------------------------------------------------------------|------|-----------------------|----------|-----------------------------------------------|------------------------------------------|
| VALUE (units $10^{-6}$ )                                                                             | EVTS | DOCUMENT ID           | TECN     | COMMENT                                       |                                          |
| $0.68^{+0.16+0.29}_{-0.15-0.30}$                                                                     | 142  | <sup>1</sup> PAKHLOVA | 08B BELL | $e^+ e^- \rightarrow \Lambda_c^+ \Lambda_c^-$ |                                          |

<sup>1</sup> The  $\pi^+ \pi^- \psi(2S)$  and  $\Lambda_c^+ \Lambda_c^-$  states are not necessarily the same.

NODE=M189R03  
NODE=M189R03

NODE=M189R03;LINKAGE=A

$\psi(4660)$  REFERENCES

NODE=M189

|         |     |                |                                           |                 |
|---------|-----|----------------|-------------------------------------------|-----------------|
| JIA     | 20  | PR D101 091101 | S. Jia <i>et al.</i>                      | (BELLE Collab.) |
| JIA     | 19A | PR D100 111103 | S. Jia <i>et al.</i>                      | (BELLE Collab.) |
| DAI     | 17  | PR D96 116001  | L.-Y. Dai, J. Haidenbauer, U.-G. Meissner | (JULI+)         |
| ZHANG   | 17B | PR D96 054008  | J. Zhang, J. Zhang                        |                 |
| ZHANG   | 17C | EPJ C77 727    | J. Zhang, L. Yuan                         |                 |
| HAN     | 15  | PR D92 012011  | Y.L. Han <i>et al.</i>                    | (BELLE Collab.) |
| WANG    | 15A | PR D91 112007  | X.L. Wang <i>et al.</i>                   | (BELLE Collab.) |
| LEES    | 14F | PR D89 111103  | J.P. Lees <i>et al.</i>                   | (BABAR Collab.) |
| WANG    | 13B | PR D87 051101  | X.L. Wang <i>et al.</i>                   | (BELLE Collab.) |
| PAKHOVA | 09  | PR D80 091101  | G. Pakhlova <i>et al.</i>                 | (BELLE Collab.) |
| LIU     | 08H | PR D78 014032  | Z.Q. Liu, X.S. Qin, C.Z. Yuan             |                 |
| PAKHOVA | 08B | PRL 101 172001 | C. Pakhlova <i>et al.</i>                 | (BELLE Collab.) |
| AUBERT  | 07S | PRL 98 212001  | B. Aubert <i>et al.</i>                   | (BABAR Collab.) |
| WANG    | 07D | PRL 99 142002  | X.L. Wang <i>et al.</i>                   | (BELLE Collab.) |

REFID=60301  
REFID=60037  
REFID=58704  
REFID=58219  
REFID=58463  
REFID=56816  
REFID=56839  
REFID=55938  
REFID=55377  
REFID=53143  
REFID=52296  
REFID=52596  
REFID=51724  
REFID=51959

NODE=M235

$\chi_{c0}(4700)$

$I^G(J^{PC}) = 0^+(0^{++})$

OMITTED FROM SUMMARY TABLE  
was  $X(4700)$

This state shows properties different from a conventional  $q\bar{q}$  state.  
A candidate for an exotic structure. See the review on non- $q\bar{q}$  states.

NODE=M235

Seen by AAIJ 17C in  $B^+ \rightarrow \chi_{c0} K^+$ ,  $\chi_{c0} \rightarrow J/\psi \phi$  using an amplitude analysis of  $B^+ \rightarrow J/\psi \phi K^+$  with a significance (accounting for systematic uncertainties) of 5.6  $\sigma$ .

$\chi_{c0}(4700)$  MASS

NODE=M235M

| VALUE (MeV)               | EVTS | DOCUMENT ID       | TECN     | COMMENT                           |
|---------------------------|------|-------------------|----------|-----------------------------------|
| $4704 \pm 10^{+14}_{-24}$ | 4289 | <sup>1</sup> AAIJ | 17C LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |

NODE=M235M

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of 5.6  $\sigma$ .

NODE=M235M;LINKAGE=A

$\chi_{c0}(4700)$  WIDTH

NODE=M235W

| VALUE (MeV)              | EVTS | DOCUMENT ID       | TECN     | COMMENT                           |
|--------------------------|------|-------------------|----------|-----------------------------------|
| $120 \pm 31^{+42}_{-33}$ | 4289 | <sup>1</sup> AAIJ | 17C LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |

NODE=M235W

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of 5.6  $\sigma$ .

NODE=M235W;LINKAGE=A

$\chi_{c0}(4700)$  DECAY MODES

NODE=M235215;NODE=M235

| Mode                         | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------|--------------------------------|
| $\Gamma_1 \quad J/\psi \phi$ | seen                           |

DESIG=1

$\chi_{c0}(4700)$  BRANCHING RATIOS

NODE=M235220

| $\Gamma(J/\psi \phi)/\Gamma_{\text{total}}$ |      |                   |          |                                   | $\Gamma_1/\Gamma$ |
|---------------------------------------------|------|-------------------|----------|-----------------------------------|-------------------|
| VALUE                                       | EVTS | DOCUMENT ID       | TECN     | COMMENT                           |                   |
| seen                                        | 4289 | <sup>1</sup> AAIJ | 17C LHCB | $B^+ \rightarrow J/\psi \phi K^+$ |                   |

NODE=M235R01  
NODE=M235R01

<sup>1</sup> From an amplitude analysis of the decay  $B^+ \rightarrow J/\psi \phi K^+$  with a significance of 5.6  $\sigma$ .

NODE=M235R01;LINKAGE=A

$\chi_{c0}(4700)$  REFERENCES

NODE=M235

|      |     |                |                       |                   |
|------|-----|----------------|-----------------------|-------------------|
| AAIJ | 17C | PRL 118 022003 | R. Aaij <i>et al.</i> | (LHCb Collab.) JP |
| Also |     | PR D95 012002  | R. Aaij <i>et al.</i> | (LHCb Collab.)    |

REFID=57657  
REFID=57636

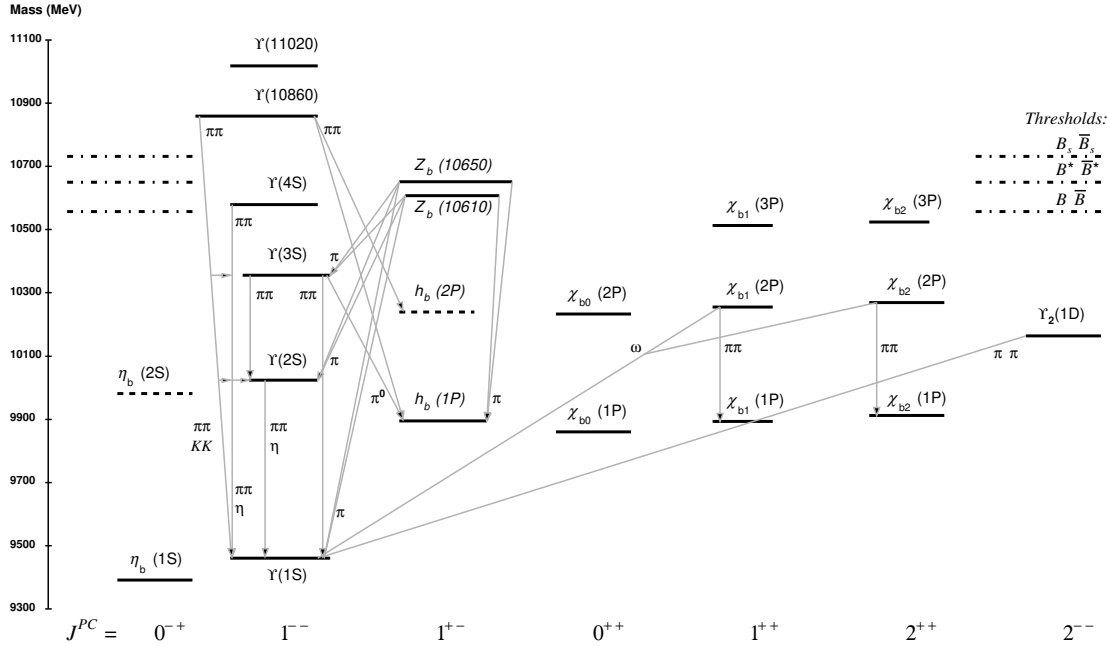


# $b\bar{b}$ MESONS (including possibly non- $q\bar{q}$ states)

NODE=MXXX030

NODE=M849

Updated August 2019.



The level scheme of meson states containing a minimal quark content of  $b\bar{b}$ . The name of a state is determined by its quantum numbers  $I^G J^{PC}$  (see the review “Naming Scheme for Hadrons”). States included in the Summary Tables are shown with solid lines; those requiring confirmation are shown with dotted lines. The arrows indicate the most dominant hadronic transitions. Single photon transitions, including  $\Upsilon(nS) \rightarrow \gamma \eta_b(mS)$ ,  $\Upsilon(nS) \rightarrow \gamma \chi_{bJ}(mP)$ , and  $\chi_{bJ}(nP) \rightarrow \gamma \Upsilon(mS)$ , are omitted for clarity. For orientation, the location of the thresholds related to a pair of ground state open bottom mesons is indicated in the figure.

NODE=M849

## WIDTH DETERMINATIONS OF THE $\Upsilon$ STATES

As is the case for the  $J/\psi(1S)$  and  $\psi(2S)$ , the full widths of the  $b\bar{b}$  states  $\Upsilon(1S)$ ,  $\Upsilon(2S)$ , and  $\Upsilon(3S)$  are not directly measurable, since they are much narrower than the energy resolution of the  $e^+e^-$  storage rings where these states are produced. The common indirect method to determine  $\Gamma$  starts from

$$\Gamma = \Gamma_{\ell\ell}/B_{\ell\ell} , \quad (1)$$

where  $\Gamma_{\ell\ell}$  is one leptonic partial width and  $B_{\ell\ell}$  is the corresponding branching fraction ( $\ell = e, \mu$ , or  $\tau$ ). One then assumes  $e$ - $\mu$ - $\tau$  universality and uses

$$\begin{aligned}\Gamma_{\ell\ell} &= \Gamma_{ee} \\ B_{\ell\ell} &= \text{average of } B_{ee}, B_{\mu\mu}, \text{ and } B_{\tau\tau} .\end{aligned}\quad (2)$$

The electronic partial width  $\Gamma_{ee}$  is also not directly measurable at  $e^+e^-$  storage rings, only in the combination  $\Gamma_{ee}\Gamma_{\text{had}}/\Gamma$ , where  $\Gamma_{\text{had}}$  is the hadronic partial width and

$$\Gamma_{\text{had}} + 3\Gamma_{ee} = \Gamma . \quad (3)$$

This combination is obtained experimentally from the energy-integrated hadronic cross section

$$\begin{aligned}\int_{\text{resonance}} \sigma(e^+e^- \rightarrow \Upsilon \rightarrow \text{hadrons})dE \\ = \frac{6\pi^2}{M^2} \frac{\Gamma_{ee}\Gamma_{\text{had}}}{\Gamma} C_r = \frac{6\pi^2}{M^2} \frac{\Gamma_{ee}^{(0)}\Gamma_{\text{had}}}{\Gamma} C_r^{(0)} ,\end{aligned}\quad (4)$$

where  $M$  is the  $\Upsilon$  mass, and  $C_r$  and  $C_r^{(0)}$  are radiative correction factors.  $C_r$  is used for obtaining  $\Gamma_{ee}$  as defined in Eq. (1), and contains corrections from all orders of QED for describing  $(b\bar{b}) \rightarrow e^+e^-$ . The lowest order QED value  $\Gamma_{ee}^{(0)}$ , relevant for comparison with potential-model calculations, is defined by the lowest order QED graph (Born term) alone, and is about 7% lower than  $\Gamma_{ee}$ .

The Listings give experimental results on  $B_{ee}$ ,  $B_{\mu\mu}$ ,  $B_{\tau\tau}$ , and  $\Gamma_{ee}\Gamma_{\text{had}}/\Gamma$ . The entries of the last quantity have been re-evaluated consistently using the correction procedure of KURA EV 85 [1]. The partial width  $\Gamma_{ee}$  is obtained from the average values for  $\Gamma_{ee}\Gamma_{\text{had}}/\Gamma$  and  $B_{\ell\ell}$  using

$$\Gamma_{ee} = \frac{\Gamma_{ee}\Gamma_{\text{had}}}{\Gamma(1 - 3B_{\ell\ell})} . \quad (5)$$

The total width  $\Gamma$  is then obtained from Eq. (1). We do not list  $\Gamma_{ee}$  and  $\Gamma$  values of individual experiments. The  $\Gamma_{ee}$  values in the Meson Summary Table are also those defined in Eq. (1).

## References

1. E.A. Kuraev, V.S. Fadin, Sov. J. Nucl. Phys. **41**, 466 (1985).

$$\eta_b(1S)$$

$$J^{PC} = 0^{+}(0^{-+})$$

Quantum numbers shown are quark-model predictions. Observed in radiative decay of the  $\Upsilon(3S)$ , therefore  $C = +$ .

NODE=M171

NODE=M171

NODE=M171M

NODE=M171M

### $\eta_b(1S)$ MASS

| VALUE (MeV)                                                                                              | EVTS  | DOCUMENT ID            | TECN      | COMMENT                                                |
|----------------------------------------------------------------------------------------------------------|-------|------------------------|-----------|--------------------------------------------------------|
| <b>9398.7<math>\pm</math>2.0 OUR AVERAGE</b> Error includes scale factor of 1.5. See the ideogram below. |       |                        |           |                                                        |
| 9394.8 $^{+2.7}_{-3.1}$                                                                                  | 29k   | FULSOM                 | 18 BELL   | $\Upsilon(2S) \rightarrow \gamma X$                    |
| 9400.7 $\pm 1.7 \pm 1.6$                                                                                 | 33.1k | TAMPONI                | 15 BELL   | $e^+e^- \rightarrow \gamma\eta + \text{hadrons}$       |
| 9402.4 $\pm 1.5 \pm 1.8$                                                                                 | 34k   | <sup>1</sup> MIZUK     | 12 BELL   | $e^+e^- \rightarrow \gamma\pi^+\pi^- + \text{hadrons}$ |
| 9391.8 $\pm 6.6 \pm 2.0$                                                                                 | 2.3k  | <sup>2</sup> BONVICINI | 10 CLEO   | $\Upsilon(3S) \rightarrow \gamma X$                    |
| 9394.2 $^{+4.8}_{-4.9}$                                                                                  | 13k   | <sup>2</sup> AUBERT    | 09AQ BABR | $\Upsilon(2S) \rightarrow \gamma X$                    |
| 9388.9 $^{+3.1}_{-2.3}$                                                                                  | 19k   | <sup>2</sup> AUBERT    | 08V BABR  | $\Upsilon(3S) \rightarrow \gamma X$                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                            |       |                        |           |                                                        |
| 9393.2 $\pm 3.4 \pm 2.3$                                                                                 | 10    | <sup>2,3</sup> DOBBS   | 12        | $\Upsilon(2S) \rightarrow \gamma \text{ hadrons}$      |
| 9300 $\pm 20 \pm 20$                                                                                     |       | HEISTER                | 02D ALEP  | 181–209 $e^+e^-$                                       |

<sup>1</sup> With floating width. Not independent of the corresponding mass difference measurement.

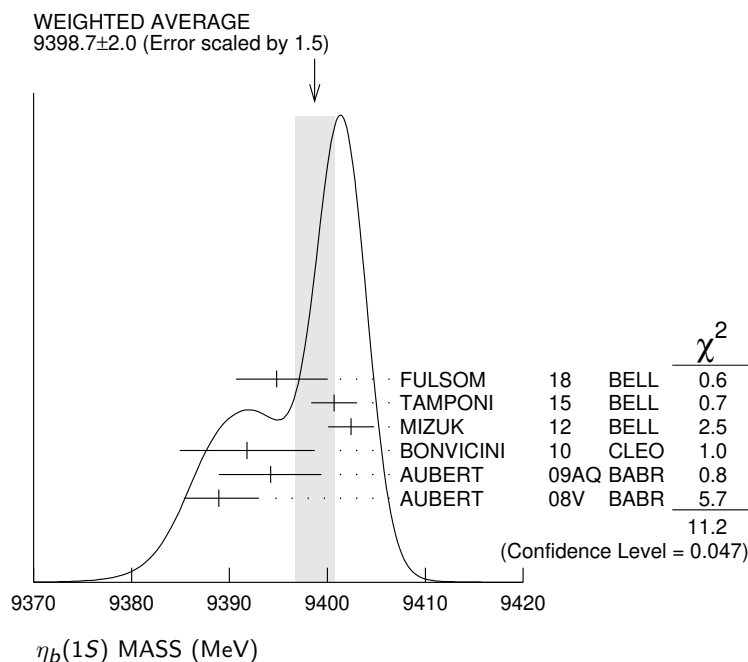
<sup>2</sup> Assuming  $\Gamma_{\eta_b(1S)} = 10$  MeV. Not independent of the corresponding  $\gamma$  energy or mass difference measurements.

<sup>3</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M171M;LINKAGE=MI

NODE=M171M;LINKAGE=AU

NODE=M171M;LINKAGE=DO



### $m_{\Upsilon(1S)} - m_{\eta_b}$

| VALUE (MeV)                                                                                            | EVTS            | DOCUMENT ID            | TECN      | COMMENT                                                |
|--------------------------------------------------------------------------------------------------------|-----------------|------------------------|-----------|--------------------------------------------------------|
| <b>62.3<math>\pm</math>3.2 OUR AVERAGE</b> Error includes scale factor of 1.8. See the ideogram below. |                 |                        |           |                                                        |
| 57.9 $\pm 1.5 \pm 1.8$                                                                                 | 34k             | <sup>1</sup> MIZUK     | 12 BELL   | $e^+e^- \rightarrow \gamma\pi^+\pi^- + \text{hadrons}$ |
| 68.5 $\pm 6.6 \pm 2.0$                                                                                 | 2.3 $\pm 0.5$ k | <sup>2</sup> BONVICINI | 10 CLEO   | $\Upsilon(3S) \rightarrow \gamma X$                    |
| 66.1 $^{+4.8}_{-4.9}$                                                                                  | 13 $\pm 5$ k    | <sup>2</sup> AUBERT    | 09AQ BABR | $\Upsilon(2S) \rightarrow \gamma X$                    |
| 71.4 $^{+2.3}_{-3.1}$                                                                                  | 19 $\pm 3$ k    | <sup>2</sup> AUBERT    | 08V BABR  | $\Upsilon(3S) \rightarrow \gamma X$                    |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                          |                 |                        |           |                                                        |
| 67.1 $\pm 3.4 \pm 2.3$                                                                                 | 10 $^{+5}_{-4}$ | <sup>2,3</sup> DOBBS   | 12        | $\Upsilon(2S) \rightarrow \gamma \text{ hadrons}$      |

NODE=M171M2

NODE=M171M2

<sup>1</sup> With floating width. Not independent of the corresponding mass measurement.

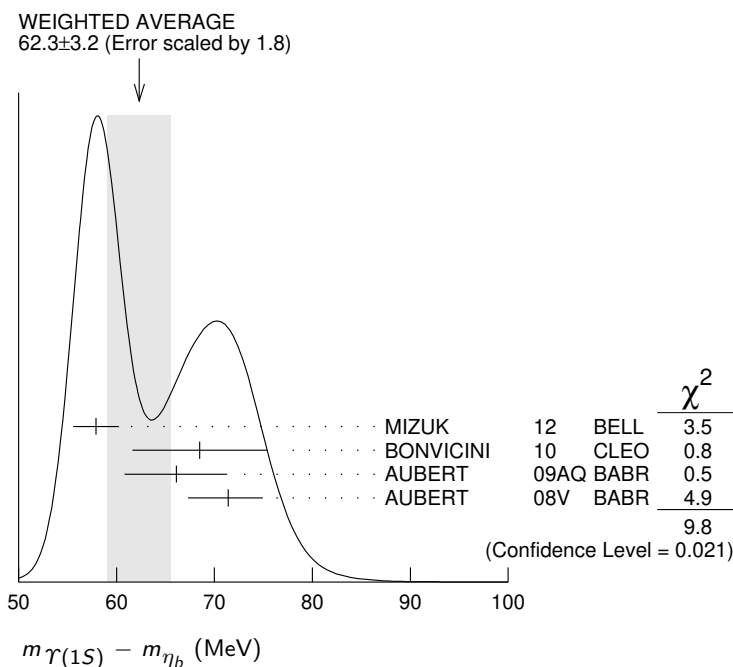
<sup>2</sup> Assuming  $\Gamma_{\eta_b(1S)} = 10$  MeV. Not independent of the corresponding  $\gamma$  energy or mass measurements.

<sup>3</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M171M2;LINKAGE=MI

NODE=M171M2;LINKAGE=AU

NODE=M171M2;LINKAGE=DO



### $\gamma$ ENERGY IN $\Upsilon(3S)$ DECAY

NODE=M171DM

| VALUE (MeV)                                            | EVTS     | DOCUMENT ID            | TECN     | COMMENT                             |
|--------------------------------------------------------|----------|------------------------|----------|-------------------------------------|
| <b>920.6<sup>+2.8</sup><sub>-3.2</sub> OUR AVERAGE</b> |          |                        |          |                                     |
| 918.6±6.0±1.9                                          | 2.3±0.5k | <sup>1</sup> BONVICINI | 10 CLEO  | $\Upsilon(3S) \rightarrow \gamma X$ |
| 921.2 <sup>+2.1</sup> <sub>-2.8</sub> ±2.4             | 19±3k    | <sup>1</sup> AUBERT    | 08v BABR | $\Upsilon(3S) \rightarrow \gamma X$ |

NODE=M171DM

<sup>1</sup> Assuming  $\Gamma_{\eta_b(1S)} = 10$  MeV. Not independent of the corresponding mass or mass difference measurements.

NODE=M171DM;LINKAGE=BO

### $\gamma$ ENERGY IN $\Upsilon(2S)$ DECAY

NODE=M171U2S

| VALUE (MeV)                                    | EVTS  | DOCUMENT ID         | TECN      | COMMENT                             |
|------------------------------------------------|-------|---------------------|-----------|-------------------------------------|
| <b>609.3<sup>+4.6</sup><sub>-4.5</sub>±1.9</b> | 13±5k | <sup>1</sup> AUBERT | 09AQ BABR | $\Upsilon(2S) \rightarrow \gamma X$ |

NODE=M171U2S

<sup>1</sup> Assuming  $\Gamma_{\eta_b(1S)} = 10$  MeV. Not independent of the corresponding mass or mass difference measurements.

NODE=M171U2S;LINKAGE=AU

### $\eta_b(1S)$ WIDTH

NODE=M171W

| VALUE (MeV)                                       | EVTS  | DOCUMENT ID          | TECN    | COMMENT                                                |
|---------------------------------------------------|-------|----------------------|---------|--------------------------------------------------------|
| <b>10<sup>+5</sup><sub>-4</sub> OUR AVERAGE</b>   |       |                      |         |                                                        |
| 8 <sup>+6</sup> <sub>-5</sub> ±5                  | 33.1k | <sup>1</sup> TAMPONI | 15 BELL | $e^+e^- \rightarrow \gamma\eta + \text{hadrons}$       |
| 10.8 <sup>+4.0</sup> <sub>-3.7</sub> +4.5<br>-2.0 | 34k   | <sup>1</sup> MIZUK   | 12 BELL | $e^+e^- \rightarrow \gamma\pi^+\pi^- + \text{hadrons}$ |

NODE=M171W

<sup>1</sup> With floating mass.

NODE=M171W;LINKAGE=MI

**$\eta_b(1S)$  DECAY MODES**

NODE=M171225;NODE=M171

| Mode                      | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|---------------------------|--------------------------------|------------------|
| $\Gamma_1$ hadrons        | seen                           |                  |
| $\Gamma_2$ $3h^+3h^-$     | not seen                       |                  |
| $\Gamma_3$ $2h^+2h^-$     | not seen                       |                  |
| $\Gamma_4$ $4h^+4h^-$     | not seen                       |                  |
| $\Gamma_5$ $\gamma\gamma$ | not seen                       |                  |
| $\Gamma_6$ $\mu^+\mu^-$   | $<9 \times 10^{-3}$            | 90%              |
| $\Gamma_7$ $\tau^+\tau^-$ | $<8\%$                         | 90%              |

DESIG=7

DESIG=1;OUR EST;→ UNCHECKED ←

DESIG=2;OUR EST;→ UNCHECKED ←

DESIG=4;OUR EST;→ UNCHECKED ←

DESIG=3;OUR EST;→ UNCHECKED ←

DESIG=5

DESIG=6

 **$\eta_b(1S) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$** 

NODE=M171230

| $\Gamma(3h^+3h^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | $\Gamma_2\Gamma_5/\Gamma$ |
|----------------------------------------------------------------------|---------------------------|
| VALUE (eV)                                                           | CL%                       |

NODE=M171G1  
NODE=M171G1

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |          |     |      |                  |
|--------|----|----------|-----|------|------------------|
| $<470$ | 95 | ABDALLAH | 06  | DLPH | 161–209 $e^+e^-$ |
| $<132$ | 95 | HEISTER  | 02D | ALEP | 181–209 $e^+e^-$ |

| $\Gamma(2h^+2h^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | $\Gamma_3\Gamma_5/\Gamma$ |
|----------------------------------------------------------------------|---------------------------|
| VALUE (eV)                                                           | CL%                       |

NODE=M171G2  
NODE=M171G2

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |          |     |      |                  |
|--------|----|----------|-----|------|------------------|
| $<190$ | 95 | ABDALLAH | 06  | DLPH | 161–209 $e^+e^-$ |
| $<48$  | 95 | HEISTER  | 02D | ALEP | 181–209 $e^+e^-$ |

| $\Gamma(4h^+4h^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ | $\Gamma_4\Gamma_5/\Gamma$ |
|----------------------------------------------------------------------|---------------------------|
| VALUE (eV)                                                           | CL%                       |

NODE=M171G3  
NODE=M171G3

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |          |    |      |                  |
|--------|----|----------|----|------|------------------|
| $<660$ | 95 | ABDALLAH | 06 | DLPH | 161–209 $e^+e^-$ |
|--------|----|----------|----|------|------------------|

 **$\eta_b(1S)$  BRANCHING RATIOS**

NODE=M171235

| $\Gamma(\text{hadrons})/\Gamma_{\text{total}}$ | $\Gamma_1/\Gamma$ |
|------------------------------------------------|-------------------|
| VALUE                                          | EVTs              |
| seen                                           | 34k               |

NODE=M171R03  
NODE=M171R03

| $\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$ | $\Gamma_6/\Gamma$ |
|--------------------------------------------|-------------------|
| VALUE                                      | CL%               |

NODE=M171R01  
NODE=M171R01

|                     |    |                     |     |      |                                                                |
|---------------------|----|---------------------|-----|------|----------------------------------------------------------------|
| $<9 \times 10^{-3}$ | 90 | <sup>1</sup> AUBERT | 09Z | BABR | $e^+e^- \rightarrow \Upsilon(2S, 3S) \rightarrow \gamma\eta_b$ |
|---------------------|----|---------------------|-----|------|----------------------------------------------------------------|

<sup>1</sup> Obtained using  $B(\Upsilon(2S) \rightarrow \gamma\eta_b) = (4.2^{+1.1}_{-1.0} \pm 0.9) \times 10^{-4}$  and  $B(\Upsilon(3S) \rightarrow \gamma\eta_b) = (4.8 \pm 0.5 \pm 0.6) \times 10^{-4}$ . This limit is equivalent to  $B(\eta_b \rightarrow \mu^+\mu^-) = (-0.25 \pm 0.51 \pm 0.33)\%$  measurement.

NODE=M171R01;LINKAGE=AU

| $\Gamma(\tau^+\tau^-)/\Gamma_{\text{total}}$ |     |             |      |         | $\Gamma_7/\Gamma$                       |
|----------------------------------------------|-----|-------------|------|---------|-----------------------------------------|
| VALUE                                        | CL% | DOCUMENT ID | TECN | COMMENT |                                         |
| $<8 \times 10^{-2}$                          | 90  | AUBERT      | 09P  | BABR    | $e^+e^- \rightarrow \gamma\tau^+\tau^-$ |

NODE=M171R02  
NODE=M171R02 **$\eta_b(1S)$  REFERENCES**

NODE=M171

|           |      |                |                             |                  |
|-----------|------|----------------|-----------------------------|------------------|
| FULSOM    | 18   | PRL 121 232001 | B.G. Fulsom <i>et al.</i>   | (BELLE Collab.)  |
| TAMPONI   | 15   | PRL 115 142001 | U. Tamponi <i>et al.</i>    | (BELLE Collab.)  |
| DOBBS     | 12   | PRL 109 082001 | S. Dobbs <i>et al.</i>      |                  |
| MIZUK     | 12   | PRL 109 232002 | R. Mizuk <i>et al.</i>      | (BELLE Collab.)  |
| BONVICINI | 10   | PR D81 031104  | G. Bonvicini <i>et al.</i>  | (CLEO Collab.)   |
| AUBERT    | 09AQ | PRL 103 161801 | B. Aubert <i>et al.</i>     | (BABAR Collab.)  |
| AUBERT    | 09P  | PRL 103 181801 | B. Aubert <i>et al.</i>     | (BABAR Collab.)  |
| AUBERT    | 09Z  | PRL 103 081803 | B. Aubert <i>et al.</i>     | (BABAR Collab.)  |
| AUBERT    | 08V  | PRL 101 071801 | B. Aubert <i>et al.</i>     | (BABAR Collab.)  |
| ABDALLAH  | 06   | PL B634 340    | J.M. Abdallah <i>et al.</i> | (DELPHI Collab.) |
| HEISTER   | 02D  | PL B530 56     | A. Heister <i>et al.</i>    | (ALEPH Collab.)  |

REFID=59535  
REFID=56996  
REFID=54288  
REFID=54718  
REFID=53231  
REFID=53106  
REFID=53062  
REFID=52930  
REFID=52262  
REFID=51042  
REFID=48577

**$\Upsilon(1S)$** 

$$J^{PC} = 0^{-}(1^{-})$$

NODE=M049

 **$\Upsilon(1S)$  MASS**

NODE=M049M

| VALUE (MeV)                                                                              | DOCUMENT ID                         | TECN     | COMMENT                             |
|------------------------------------------------------------------------------------------|-------------------------------------|----------|-------------------------------------|
| <b>9460.30±0.26 OUR AVERAGE</b>                                                          | Error includes scale factor of 3.3. |          |                                     |
| 9460.51±0.09±0.05                                                                        | <sup>1</sup> ARTAMONOV 00           | MD1      | $e^+e^- \rightarrow \text{hadrons}$ |
| 9459.97±0.11±0.07                                                                        | MACKAY 84                           | REDE     | $e^+e^- \rightarrow \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • •            |                                     |          |                                     |
| 9460.60±0.09±0.05                                                                        | <sup>2,3</sup> BARU                 | 92B REDE | $e^+e^- \rightarrow \text{hadrons}$ |
| 9460.59±0.12                                                                             | BARU 86                             | REDE     | $e^+e^- \rightarrow \text{hadrons}$ |
| 9460.6 ±0.4                                                                              | <sup>3,4</sup> ARTAMONOV 84         | REDE     | $e^+e^- \rightarrow \text{hadrons}$ |
| <sup>1</sup> Reanalysis of BARU 92B and ARTAMONOV 84 using new electron mass (COHEN 87). |                                     |          |                                     |
| <sup>2</sup> Superseding BARU 86.                                                        |                                     |          |                                     |
| <sup>3</sup> Superseded by ARTAMONOV 00.                                                 |                                     |          |                                     |
| <sup>4</sup> Value includes data of ARTAMONOV 82.                                        |                                     |          |                                     |

NODE=M049M

NODE=M049M;LINKAGE=AR  
 NODE=M049M;LINKAGE=A  
 NODE=M049M;LINKAGE=RZ  
 NODE=M049M;LINKAGE=G

 **$\Upsilon(1S)$  WIDTH**

NODE=M049W

| VALUE (keV)                      | DOCUMENT ID                                                     |
|----------------------------------|-----------------------------------------------------------------|
| <b>54.02±1.25 OUR EVALUATION</b> | See the Note on "Width Determinations of the $\Upsilon$ States" |

NODE=M049W  
 → UNCHECKED ←

 **$\Upsilon(1S)$  DECAY MODES**

NODE=M049215;NODE=M049

| Mode                                                                                        | Fraction ( $\Gamma_i/\Gamma$ )    | Scale factor/<br>Confidence level |
|---------------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------|
| $\Gamma_1 \quad \tau^+ \tau^-$                                                              | ( 2.60 ±0.10 ) %                  |                                   |
| $\Gamma_2 \quad e^+ e^-$                                                                    | ( 2.38 ±0.11 ) %                  |                                   |
| $\Gamma_3 \quad \mu^+ \mu^-$                                                                | ( 2.48 ±0.05 ) %                  |                                   |
| <b>Hadronic decays</b>                                                                      |                                   |                                   |
| $\Gamma_4 \quad g g g$                                                                      | (81.7 ±0.7 ) %                    |                                   |
| $\Gamma_5 \quad \gamma g g$                                                                 | ( 2.2 ±0.6 ) %                    |                                   |
| $\Gamma_6 \quad \eta'(958) \text{ anything}$                                                | ( 2.94 ±0.24 ) %                  |                                   |
| $\Gamma_7 \quad J/\psi(1S) \text{ anything}$                                                | ( 5.4 ±0.4 ) × 10 <sup>-4</sup>   | S=1.4                             |
| $\Gamma_8 \quad J/\psi(1S) \eta_c$                                                          | < 2.2                             | × 10 <sup>-6</sup> CL=90%         |
| $\Gamma_9 \quad J/\psi(1S) \chi_{c0}$                                                       | < 3.4                             | × 10 <sup>-6</sup> CL=90%         |
| $\Gamma_{10} \quad J/\psi(1S) \chi_{c1}$                                                    | ( 3.9 ±1.2 ) × 10 <sup>-6</sup>   |                                   |
| $\Gamma_{11} \quad J/\psi(1S) \chi_{c2}$                                                    | < 1.4                             | × 10 <sup>-6</sup> CL=90%         |
| $\Gamma_{12} \quad J/\psi(1S) \eta_c(2S)$                                                   | < 2.2                             | × 10 <sup>-6</sup> CL=90%         |
| $\Gamma_{13} \quad J/\psi(1S) X(3940)$                                                      | < 5.4                             | × 10 <sup>-6</sup> CL=90%         |
| $\Gamma_{14} \quad J/\psi(1S) X(4160)$                                                      | < 5.4                             | × 10 <sup>-6</sup> CL=90%         |
| $\Gamma_{15} \quad X(4350) \text{ anything}, X \rightarrow J/\psi(1S) \phi$                 | < 8.1                             | × 10 <sup>-6</sup> CL=90%         |
| $\Gamma_{16} \quad Z_c(3900)^\pm \text{ anything}, Z_c \rightarrow J/\psi(1S) \pi^\pm$      | < 1.3                             | × 10 <sup>-5</sup> CL=90%         |
| $\Gamma_{17} \quad Z_c(4200)^\pm \text{ anything}, Z_c \rightarrow J/\psi(1S) \pi^\pm$      | < 6.0                             | × 10 <sup>-5</sup> CL=90%         |
| $\Gamma_{18} \quad Z_c(4430)^\pm \text{ anything}, Z_c \rightarrow J/\psi(1S) \pi^\pm$      | < 4.9                             | × 10 <sup>-5</sup> CL=90%         |
| $\Gamma_{19} \quad X_{cs}^\pm \text{ anything}, X \rightarrow J/\psi K^\pm$                 | < 5.7                             | × 10 <sup>-6</sup> CL=90%         |
| $\Gamma_{20} \quad \psi(4260) \text{ anything}, \psi \rightarrow J/\psi(1S) \pi^+ \pi^-$    | < 3.8                             | × 10 <sup>-5</sup> CL=90%         |
| $\Gamma_{21} \quad \psi(4260) \text{ anything}, \psi \rightarrow J/\psi(1S) K^+ K^-$        | < 7.5                             | × 10 <sup>-6</sup> CL=90%         |
| $\Gamma_{22} \quad \chi_{c1}(4140) \text{ anything}, \chi_{c1} \rightarrow J/\psi(1S) \phi$ | < 5.2                             | × 10 <sup>-6</sup> CL=90%         |
| $\Gamma_{23} \quad \chi_{c0} \text{ anything}$                                              | < 4                               | × 10 <sup>-3</sup> CL=90%         |
| $\Gamma_{24} \quad \chi_{c1} \text{ anything}$                                              | ( 1.90 ±0.35 ) × 10 <sup>-4</sup> |                                   |
| $\Gamma_{25} \quad \chi_{c1}(1P) X_{tetra}$                                                 | < 3.78                            | × 10 <sup>-5</sup> CL=90%         |

DESIG=3

DESIG=2

DESIG=1

NODE=M049;CLUMP=A

DESIG=117

DESIG=118

DESIG=73

DESIG=12

DESIG=146

DESIG=147

DESIG=148

DESIG=149

DESIG=150

DESIG=151

DESIG=152

DESIG=167

DESIG=168

DESIG=169

DESIG=170

DESIG=173

DESIG=161

DESIG=165

DESIG=166

DESIG=5

DESIG=6

DESIG=175

|                 |                                                              |                                  |        |           |
|-----------------|--------------------------------------------------------------|----------------------------------|--------|-----------|
| Г <sub>26</sub> | $\chi_{c2}$ anything                                         | $(2.8 \pm 0.8) \times 10^{-4}$   |        | DESIG=7   |
| Г <sub>27</sub> | $\psi(2S)$ anything                                          | $(1.23 \pm 0.20) \times 10^{-4}$ |        | DESIG=8   |
| Г <sub>28</sub> | $\psi(2S)\eta_c$                                             | $< 3.6 \times 10^{-6}$           | CL=90% | DESIG=153 |
| Г <sub>29</sub> | $\psi(2S)\chi_{c0}$                                          | $< 6.5 \times 10^{-6}$           | CL=90% | DESIG=154 |
| Г <sub>30</sub> | $\psi(2S)\chi_{c1}$                                          | $< 4.5 \times 10^{-6}$           | CL=90% | DESIG=155 |
| Г <sub>31</sub> | $\psi(2S)\chi_{c2}$                                          | $< 2.1 \times 10^{-6}$           | CL=90% | DESIG=156 |
| Г <sub>32</sub> | $\psi(2S)\eta_c(2S)$                                         | $< 3.2 \times 10^{-6}$           | CL=90% | DESIG=157 |
| Г <sub>33</sub> | $\psi(2S)X(3940)$                                            | $< 2.9 \times 10^{-6}$           | CL=90% | DESIG=158 |
| Г <sub>34</sub> | $\psi(2S)X(4160)$                                            | $< 2.9 \times 10^{-6}$           | CL=90% | DESIG=159 |
| Г <sub>35</sub> | $\psi(4260)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$ | $< 7.9 \times 10^{-5}$           | CL=90% | DESIG=162 |
| Г <sub>36</sub> | $\psi(4360)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$ | $< 5.2 \times 10^{-5}$           | CL=90% | DESIG=163 |
| Г <sub>37</sub> | $\psi(4660)$ anything, $\psi \rightarrow \psi(2S)\pi^+\pi^-$ | $< 2.2 \times 10^{-5}$           | CL=90% | DESIG=164 |
| Г <sub>38</sub> | $X(4050)^\pm$ anything, $X \rightarrow \psi(2S)\pi^\pm$      | $< 8.8 \times 10^{-5}$           | CL=90% | DESIG=171 |
| Г <sub>39</sub> | $Z_c(4430)^\pm$ anything, $Z_c \rightarrow \psi(2S)\pi^\pm$  | $< 6.7 \times 10^{-5}$           | CL=90% | DESIG=172 |
| Г <sub>40</sub> | $\chi_{c1}(3872)$ anything                                   | $< 2.7 \times 10^{-4}$           | CL=90% | DESIG=194 |
| Г <sub>41</sub> | $Z_c(4200)^+ Z_c(4200)^-$                                    | $< 2.23 \times 10^{-5}$          | CL=90% | DESIG=178 |
| Г <sub>42</sub> | $Z_c(3900)^\pm Z_c(4200)^\mp$                                | $< 8.1 \times 10^{-6}$           | CL=90% | DESIG=179 |
| Г <sub>43</sub> | $Z_c(3900)^+ Z_c(3900)^-$                                    | $< 1.8 \times 10^{-6}$           | CL=90% | DESIG=180 |
| Г <sub>44</sub> | $X(4050)^+ X(4050)^-$                                        | $< 1.58 \times 10^{-5}$          | CL=90% | DESIG=181 |
| Г <sub>45</sub> | $X(4250)^+ X(4250)^-$                                        | $< 2.66 \times 10^{-5}$          | CL=90% | DESIG=182 |
| Г <sub>46</sub> | $X(4050)^\pm X(4250)^\mp$                                    | $< 4.42 \times 10^{-5}$          | CL=90% | DESIG=183 |
| Г <sub>47</sub> | $Z_c(4430)^+ Z_c(4430)^-$                                    | $< 2.03 \times 10^{-5}$          | CL=90% | DESIG=184 |
| Г <sub>48</sub> | $X(4055)^\pm X(4055)^\mp$                                    | $< 2.33 \times 10^{-5}$          | CL=90% | DESIG=186 |
| Г <sub>49</sub> | $X(4055)^\pm Z_c(4430)^\mp$                                  | $< 4.55 \times 10^{-5}$          | CL=90% | DESIG=189 |
| Г <sub>50</sub> | $\rho\pi$                                                    | $< 3.68 \times 10^{-6}$          | CL=90% | DESIG=11  |
| Г <sub>51</sub> | $\omega\pi^0$                                                | $< 3.90 \times 10^{-6}$          | CL=90% | DESIG=131 |
| Г <sub>52</sub> | $\pi^+\pi^-$                                                 | $< 5 \times 10^{-4}$             | CL=90% | DESIG=23  |
| Г <sub>53</sub> | $K^+K^-$                                                     | $< 5 \times 10^{-4}$             | CL=90% | DESIG=24  |
| Г <sub>54</sub> | $p\bar{p}$                                                   | $< 5 \times 10^{-4}$             | CL=90% | DESIG=25  |
| Г <sub>55</sub> | $\pi^+\pi^-\pi^0$                                            | $(2.1 \pm 0.8) \times 10^{-6}$   |        | DESIG=72  |
| Г <sub>56</sub> | $\phi K^+K^-$                                                | $(2.4 \pm 0.5) \times 10^{-6}$   |        | DESIG=136 |
| Г <sub>57</sub> | $\omega\pi^+\pi^-$                                           | $(4.5 \pm 1.0) \times 10^{-6}$   |        | DESIG=137 |
| Г <sub>58</sub> | $K^*(892)^0 K^- \pi^+ + \text{c.c.}$                         | $(4.4 \pm 0.8) \times 10^{-6}$   |        | DESIG=138 |
| Г <sub>59</sub> | $\phi f'_2(1525)$                                            | $< 1.63 \times 10^{-6}$          | CL=90% | DESIG=139 |
| Г <sub>60</sub> | $\omega f_2(1270)$                                           | $< 1.79 \times 10^{-6}$          | CL=90% | DESIG=140 |
| Г <sub>61</sub> | $\rho(770) a_2(1320)$                                        | $< 2.24 \times 10^{-6}$          | CL=90% | DESIG=141 |
| Г <sub>62</sub> | $K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.}$               | $(3.0 \pm 0.8) \times 10^{-6}$   |        | DESIG=142 |
| Г <sub>63</sub> | $K_1(1270)^\pm K^\mp$                                        | $< 2.41 \times 10^{-6}$          | CL=90% | DESIG=143 |
| Г <sub>64</sub> | $K_1(1400)^\pm K^\mp$                                        | $(1.0 \pm 0.4) \times 10^{-6}$   |        | DESIG=144 |
| Г <sub>65</sub> | $b_1(1235)^\pm \pi^\mp$                                      | $< 1.25 \times 10^{-6}$          | CL=90% | DESIG=145 |
| Г <sub>66</sub> | $\pi^+\pi^-\pi^0\pi^0$                                       | $(1.28 \pm 0.30) \times 10^{-5}$ |        | DESIG=132 |
| Г <sub>67</sub> | $K_S^0 K^+ \pi^- + \text{c.c.}$                              | $(1.6 \pm 0.4) \times 10^{-6}$   |        | DESIG=133 |
| Г <sub>68</sub> | $K^*(892)^0 \bar{K}^0 + \text{c.c.}$                         | $(2.9 \pm 0.9) \times 10^{-6}$   |        | DESIG=134 |
| Г <sub>69</sub> | $K^*(892)^- K^+ + \text{c.c.}$                               | $< 1.11 \times 10^{-6}$          | CL=90% | DESIG=135 |
| Г <sub>70</sub> | $f_1(1285)$ anything                                         | $(4.6 \pm 3.1) \times 10^{-3}$   |        | DESIG=174 |
| Г <sub>71</sub> | $D^*(2010)^\pm$ anything                                     | $(2.52 \pm 0.20) \%$             |        | DESIG=30  |
| Г <sub>72</sub> | $\bar{f}_1(1285) X_{tetra}$                                  | $< 6.24 \times 10^{-5}$          | CL=90% | DESIG=176 |
| Г <sub>73</sub> | ${}^2H$ anything                                             | $(2.85 \pm 0.25) \times 10^{-5}$ |        | DESIG=107 |
| Г <sub>74</sub> | Sum of 100 exclusive modes                                   | $(1.200 \pm 0.017) \%$           |        | DESIG=128 |

## Radiative decays

NODE=M049;CLUMP=B

|                  |                                                                       |                                                            |        |           |
|------------------|-----------------------------------------------------------------------|------------------------------------------------------------|--------|-----------|
| Г <sub>75</sub>  | $\gamma\pi^+\pi^-$                                                    | ( 6.3 ±1.8 ) × 10 <sup>-5</sup>                            |        | DESIG=70  |
| Г <sub>76</sub>  | $\gamma\pi^0\pi^0$                                                    | ( 1.7 ±0.7 ) × 10 <sup>-5</sup>                            |        | DESIG=71  |
| Г <sub>77</sub>  | $\gamma\pi\pi$ (S-wave)                                               | ( 4.6 ±0.7 ) × 10 <sup>-5</sup>                            |        | DESIG=190 |
| Г <sub>78</sub>  | $\gamma\pi^0\eta$                                                     | < 2.4 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=111 |
| Г <sub>79</sub>  | $\gamma K^+ K^-$                                                      | [a] ( 1.14 ±0.13 ) × 10 <sup>-5</sup>                      |        | DESIG=102 |
| Г <sub>80</sub>  | $\gamma p\bar{p}$                                                     | [b] < 6 × 10 <sup>-6</sup>                                 | CL=90% | DESIG=103 |
| Г <sub>81</sub>  | $\gamma 2h^+ 2h^-$                                                    | ( 7.0 ±1.5 ) × 10 <sup>-4</sup>                            |        | DESIG=20  |
| Г <sub>82</sub>  | $\gamma 3h^+ 3h^-$                                                    | ( 5.4 ±2.0 ) × 10 <sup>-4</sup>                            |        | DESIG=21  |
| Г <sub>83</sub>  | $\gamma 4h^+ 4h^-$                                                    | ( 7.4 ±3.5 ) × 10 <sup>-4</sup>                            |        | DESIG=22  |
| Г <sub>84</sub>  | $\gamma\pi^+\pi^- K^+ K^-$                                            | ( 2.9 ±0.9 ) × 10 <sup>-4</sup>                            |        | DESIG=14  |
| Г <sub>85</sub>  | $\gamma 2\pi^+ 2\pi^-$                                                | ( 2.5 ±0.9 ) × 10 <sup>-4</sup>                            |        | DESIG=13  |
| Г <sub>86</sub>  | $\gamma 3\pi^+ 3\pi^-$                                                | ( 2.5 ±1.2 ) × 10 <sup>-4</sup>                            |        | DESIG=17  |
| Г <sub>87</sub>  | $\gamma 2\pi^+ 2\pi^- K^+ K^-$                                        | ( 2.4 ±1.2 ) × 10 <sup>-4</sup>                            |        | DESIG=18  |
| Г <sub>88</sub>  | $\gamma\pi^+\pi^- p\bar{p}$                                           | ( 1.5 ±0.6 ) × 10 <sup>-4</sup>                            |        | DESIG=15  |
| Г <sub>89</sub>  | $\gamma 2\pi^+ 2\pi^- p\bar{p}$                                       | ( 4 ±6 ) × 10 <sup>-5</sup>                                |        | DESIG=19  |
| Г <sub>90</sub>  | $\gamma 2K^+ 2K^-$                                                    | ( 2.0 ±2.0 ) × 10 <sup>-5</sup>                            |        | DESIG=16  |
| Г <sub>91</sub>  | $\gamma\eta'(958)$                                                    | < 1.9 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=55  |
| Г <sub>92</sub>  | $\gamma\eta$                                                          | < 1.0 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=54  |
| Г <sub>93</sub>  | $\gamma f_0(980)$                                                     | < 3 × 10 <sup>-5</sup>                                     | CL=90% | DESIG=105 |
| Г <sub>94</sub>  | $\gamma f'_2(1525)$                                                   | ( 2.9 ±0.6 ) × 10 <sup>-5</sup>                            |        | DESIG=52  |
| Г <sub>95</sub>  | $\gamma f_2(1270)$                                                    | ( 1.01 ±0.06 ) × 10 <sup>-4</sup>                          |        | DESIG=51  |
| Г <sub>96</sub>  | $\gamma\eta(1405)$                                                    | < 8.2 × 10 <sup>-5</sup>                                   | CL=90% | DESIG=65  |
| Г <sub>97</sub>  | $\gamma f_0(1500)$                                                    | < 1.5 × 10 <sup>-5</sup>                                   | CL=90% | DESIG=108 |
| Г <sub>98</sub>  | $\gamma f_0(1500) \rightarrow \gamma K^+ K^-$                         | ( 1.0 ±0.4 ) × 10 <sup>-5</sup>                            |        | DESIG=192 |
| Г <sub>99</sub>  | $\gamma f_0(1710)$                                                    | < 2.6 × 10 <sup>-4</sup>                                   | CL=90% | DESIG=53  |
| Г <sub>100</sub> | $\gamma f_0(1710) \rightarrow \gamma K^+ K^-$                         | ( 1.01 ±0.32 ) × 10 <sup>-5</sup>                          |        | DESIG=112 |
| Г <sub>101</sub> | $\gamma f_0(1710) \rightarrow \gamma\pi^+\pi^-$                       | ( 5.3 ±2.0 ) × 10 <sup>-6</sup>                            |        | DESIG=191 |
| Г <sub>102</sub> | $\gamma f_0(1710) \rightarrow \gamma\pi^0\pi^0$                       | < 1.4 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=109 |
| Г <sub>103</sub> | $\gamma f_0(1710) \rightarrow \gamma\eta\eta$                         | < 1.8 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=110 |
| Г <sub>104</sub> | $\gamma f_4(2050)$                                                    | < 5.3 × 10 <sup>-5</sup>                                   | CL=90% | DESIG=104 |
| Г <sub>105</sub> | $\gamma f_0(2200) \rightarrow \gamma K^+ K^-$                         | < 2 × 10 <sup>-4</sup>                                     | CL=90% | DESIG=69  |
| Г <sub>106</sub> | $\gamma f_J(2220) \rightarrow \gamma K^+ K^-$                         | < 8 × 10 <sup>-7</sup>                                     | CL=90% | DESIG=60  |
| Г <sub>107</sub> | $\gamma f_J(2220) \rightarrow \gamma\pi^+\pi^-$                       | < 6 × 10 <sup>-7</sup>                                     | CL=90% | DESIG=61  |
| Г <sub>108</sub> | $\gamma f_J(2220) \rightarrow \gamma p\bar{p}$                        | < 1.1 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=62  |
| Г <sub>109</sub> | $\gamma\eta(2225) \rightarrow \gamma\phi\phi$                         | < 3 × 10 <sup>-3</sup>                                     | CL=90% | DESIG=68  |
| Г <sub>110</sub> | $\gamma\eta_c(1S)$                                                    | < 2.9 × 10 <sup>-5</sup>                                   | CL=90% | DESIG=119 |
| Г <sub>111</sub> | $\gamma\eta_c(2S)$                                                    | < 4 × 10 <sup>-4</sup>                                     | CL=90% | DESIG=193 |
| Г <sub>112</sub> | $\gamma\chi_{c0}$                                                     | < 6.6 × 10 <sup>-5</sup>                                   | CL=90% | DESIG=120 |
| Г <sub>113</sub> | $\gamma\chi_{c1}$                                                     | ( 4.7 <sup>+2.4</sup> <sub>-1.9</sub> ) × 10 <sup>-5</sup> |        | DESIG=121 |
| Г <sub>114</sub> | $\gamma\chi_{c2}$                                                     | < 7.6 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=122 |
| Г <sub>115</sub> | $\gamma\chi_{c1}(3872)$                                               | < 5 × 10 <sup>-5</sup>                                     | CL=90% | DESIG=195 |
| Г <sub>116</sub> | $\gamma\chi_{c1}(3872), \chi_{c1} \rightarrow \pi^+\pi^-\pi^0 J/\psi$ | < 2.8 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=124 |
| Г <sub>117</sub> | $\gamma X(3915) \rightarrow \omega J/\psi$                            | < 3.0 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=125 |
| Г <sub>118</sub> | $\gamma\chi_{c1}(4140) \rightarrow \phi J/\psi$                       | < 2.2 × 10 <sup>-6</sup>                                   | CL=90% | DESIG=126 |
| Г <sub>119</sub> | $\gamma X$                                                            | [c] < 4.5 × 10 <sup>-6</sup>                               | CL=90% | DESIG=66  |
| Г <sub>120</sub> | $\gamma X\bar{X} (m_X < 3.1 \text{ GeV})$                             | [d] < 1 × 10 <sup>-3</sup>                                 | CL=90% | DESIG=67  |
| Г <sub>121</sub> | $\gamma X\bar{X} (m_X < 4.5 \text{ GeV})$                             | [e] < 2.4 × 10 <sup>-4</sup>                               | CL=90% | DESIG=127 |
| Г <sub>122</sub> | $\gamma X \rightarrow \gamma + \geq 4 \text{ prongs}$                 | [f] < 1.78 × 10 <sup>-4</sup>                              | CL=95% | DESIG=113 |
| Г <sub>123</sub> | $\gamma a_1^0 \rightarrow \gamma\mu^+\mu^-$                           | [g] < 9 × 10 <sup>-6</sup>                                 | CL=90% | DESIG=114 |
| Г <sub>124</sub> | $\gamma a_1^0 \rightarrow \gamma\tau^+\tau^-$                         | [a] < 1.30 × 10 <sup>-4</sup>                              | CL=90% | DESIG=115 |
| Г <sub>125</sub> | $\gamma a_1^0 \rightarrow \gamma g g$                                 | [h] < 1 %                                                  | CL=90% | DESIG=129 |
| Г <sub>126</sub> | $\gamma a_1^0 \rightarrow \gamma s\bar{s}$                            | [h] < 1 × 10 <sup>-3</sup>                                 | CL=90% | DESIG=130 |

## Lepton Family number (LF) violating modes

NODE=M049;CLUMP=C

|                  |                   |    |                          |        |
|------------------|-------------------|----|--------------------------|--------|
| Г <sub>127</sub> | $\mu^\pm\tau^\mp$ | LF | < 6.0 × 10 <sup>-6</sup> | CL=95% |
|------------------|-------------------|----|--------------------------|--------|

DESIG=116



## Other decays

 $\Gamma_{128}$  invisible  $< 3.0 \times 10^{-4}$  CL=90%

 NODE=M049;CLUMP=D  
 DESIG=106
[a]  $2m_\tau < M(\tau^+\tau^-) < 9.2$  GeV

LINKAGE=E49

[b]  $2 \text{ GeV} < m_{K^+K^-} < 3$  GeV

LINKAGE=G49

[c]  $X = \text{scalar with } m < 8.0$  GeV

LINKAGE=A49

[d]  $X\bar{X} = \text{vectors with } m < 3.1$  GeV

LINKAGE=B49

[e]  $X$  and  $\bar{X} = \text{zero spin with } m < 4.5$  GeV

LINKAGE=F49

[f]  $1.5 \text{ GeV} < m_X < 5.0$  GeV

LINKAGE=C49

[g]  $201 \text{ MeV} < M(\mu^+\mu^-) < 3565$  MeV

LINKAGE=D49

[h]  $0.5 \text{ GeV} < m_X < 9.0$  GeV, where  $m_X$  is the invariant mass of the hadronic final state.

LINKAGE=I49

 $\Upsilon(1S) \Gamma(i) \Gamma(e^+e^-) / \Gamma(\text{total})$ 

NODE=M049218

 $\Gamma(e^+e^-) \times \Gamma(\mu^+\mu^-) / \Gamma_{\text{total}}$  $\Gamma_2 \Gamma_3 / \Gamma$ 

| VALUE (eV)          | DOCUMENT ID | TECN | COMMENT                              |
|---------------------|-------------|------|--------------------------------------|
| <b>31.2±1.6±1.7</b> | KOBEL       | 92   | CBAL $e^+e^- \rightarrow \mu^+\mu^-$ |

 NODE=M049G1  
 NODE=M049G1
 $\Gamma(\text{hadrons}) \times \Gamma(e^+e^-) / \Gamma_{\text{total}}$  $\Gamma_0 \Gamma_2 / \Gamma$ 

| VALUE (keV)                    | DOCUMENT ID             | TECN | COMMENT                                      |
|--------------------------------|-------------------------|------|----------------------------------------------|
| <b>1.240±0.016 OUR AVERAGE</b> |                         |      |                                              |
| 1.252±0.004±0.019              | <sup>1</sup> ROSNER     | 06   | CLEO $9.5 e^+e^- \rightarrow \text{hadrons}$ |
| 1.187±0.023±0.031              | <sup>1</sup> BARU       | 92B  | MD1 $e^+e^- \rightarrow \text{hadrons}$      |
| 1.23 ±0.02 ±0.05               | <sup>1</sup> JAKUBOWSKI | 88   | CBAL $e^+e^- \rightarrow \text{hadrons}$     |
| 1.37 ±0.06 ±0.09               | <sup>2</sup> GILES      | 84B  | CLEO $e^+e^- \rightarrow \text{hadrons}$     |
| 1.23 ±0.08 ±0.04               | <sup>2</sup> ALBRECHT   | 82   | DASP $e^+e^- \rightarrow \text{hadrons}$     |
| 1.13 ±0.07 ±0.11               | <sup>2</sup> NICZYPORUK | 82   | LENA $e^+e^- \rightarrow \text{hadrons}$     |
| 1.09 ±0.25                     | <sup>2</sup> BOCK       | 80   | CNTR $e^+e^- \rightarrow \text{hadrons}$     |
| 1.35 ±0.14                     | <sup>3</sup> BERGER     | 79   | PLUT $e^+e^- \rightarrow \text{hadrons}$     |

 NODE=M049G2  
 NODE=M049G2
<sup>1</sup> Radiative corrections evaluated following KURAEV 85.<sup>2</sup> Radiative corrections reevaluated by BUCHMUELLER 88 following KURAEV 85.<sup>3</sup> Radiative corrections reevaluated by ALEXANDER 89 using  $B(\mu\mu) = 0.026$ .
 NODE=M049G2;LINKAGE=B  
 NODE=M049G2;LINKAGE=R  
 NODE=M049G2;LINKAGE=P
 $\Upsilon(1S)$  PARTIAL WIDTHS

NODE=M049220

 $\Gamma(e^+e^-)$  $\Gamma_2$ 

| VALUE (keV)                       | DOCUMENT ID |
|-----------------------------------|-------------|
| <b>1.340±0.018 OUR EVALUATION</b> |             |

 NODE=M049W2  
 NODE=M049W2  
 → UNCHECKED ←
 $\Upsilon(1S)$  BRANCHING RATIOS

NODE=M049225

 $\Gamma(\tau^+\tau^-) / \Gamma_{\text{total}}$  $\Gamma_1 / \Gamma$ 

| VALUE (units $10^{-2}$ )                    | EVTS | DOCUMENT ID           | TECN | COMMENT                                                         |
|---------------------------------------------|------|-----------------------|------|-----------------------------------------------------------------|
| <b>2.60±0.10 OUR AVERAGE</b>                |      |                       |      |                                                                 |
| 2.53±0.13±0.05                              | 60k  | <sup>1</sup> BESSON   | 07   | CLEO $e^+e^- \rightarrow \Upsilon(1S) \rightarrow \tau^+\tau^-$ |
| 2.61±0.12 <sup>+0.09</sup> <sub>-0.13</sub> | 25k  | CINABRO               | 94B  | CLE2 $e^+e^- \rightarrow \tau^+\tau^-$                          |
| 2.7 ±0.4 ±0.2                               |      | <sup>2</sup> ALBRECHT | 85C  | ARG $\Upsilon(2S) \rightarrow \pi^+\pi^-\tau^+\tau^-$           |
| 3.4 ±0.4 ±0.4                               |      | GILES                 | 83   | CLEO $e^+e^- \rightarrow \tau^+\tau^-$                          |

 NODE=M049R3  
 NODE=M049R3

<sup>1</sup> BESSON 07 reports  $[\Gamma(\Upsilon(1S) \rightarrow \tau^+\tau^-) / \Gamma_{\text{total}}] / [B(\Upsilon(1S) \rightarrow \mu^+\mu^-)] = 1.02 \pm 0.02 \pm 0.05$  which we multiply by our best value  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M049R3;LINKAGE=BE

<sup>2</sup> Using  $B(\Upsilon(1S) \rightarrow ee) = B(\Upsilon(1S) \rightarrow \mu\mu) = 0.0256$ ; not used for width evaluations.

NODE=M049R3;LINKAGE=A

 $\Gamma(e^+e^-) / \Gamma_{\text{total}}$  $\Gamma_2 / \Gamma$ 

| VALUE (units $10^{-2}$ )     | EVTS | DOCUMENT ID | TECN | COMMENT                                          |
|------------------------------|------|-------------|------|--------------------------------------------------|
| <b>2.38±0.11 OUR AVERAGE</b> |      |             |      |                                                  |
| 2.29±0.08±0.11               |      | ALEXANDER   | 98   | CLE2 $\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$ |
| 2.42±0.14±0.14               | 307  | ALBRECHT    | 87   | ARG $\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$  |
| 2.8 ±0.3 ±0.2                | 826  | BESSON      | 84   | CLEO $\Upsilon(2S) \rightarrow \pi^+\pi^-e^+e^-$ |
| 5.1 ±3.0                     |      | BERGER      | 80C  | PLUT $e^+e^- \rightarrow e^+e^-$                 |

 NODE=M049R2  
 NODE=M049R2

$\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$ 
 $\Gamma_3/\Gamma$ 

| VALUE                                     | EVTs | DOCUMENT ID        | TECN | COMMENT                                              |
|-------------------------------------------|------|--------------------|------|------------------------------------------------------|
| <b>0.0248±0.0005 OUR AVERAGE</b>          |      |                    |      |                                                      |
| 0.0249±0.0002±0.0007                      | 345k | ADAMS              | 05   | CLEO $e^+e^- \rightarrow \mu^+\mu^-$                 |
| 0.0249±0.0008±0.0013                      |      | ALEXANDER          | 98   | CLE2 $\Upsilon(2S) \rightarrow \pi^+\pi^-\mu^+\mu^-$ |
| 0.0212±0.0020±0.0010                      |      | <sup>1</sup> BARU  | 92   | MD1 $e^+e^- \rightarrow \mu^+\mu^-$                  |
| 0.0231±0.0012±0.0010                      |      | <sup>1</sup> KOBEL | 92   | CBAL $e^+e^- \rightarrow \mu^+\mu^-$                 |
| 0.0252±0.0007±0.0007                      |      | CHEN               | 89B  | CLEO $e^+e^- \rightarrow \mu^+\mu^-$                 |
| 0.0261±0.0009±0.0011                      |      | KAARSBERG          | 89   | CSB2 $e^+e^- \rightarrow \mu^+\mu^-$                 |
| 0.0230±0.0025±0.0013                      | 86   | ALBRECHT           | 87   | ARG $\Upsilon(2S) \rightarrow \pi^+\pi^-\mu^+\mu^-$  |
| 0.029 ±0.003 ±0.002                       | 864  | BESSON             | 84   | CLEO $\Upsilon(2S) \rightarrow \pi^+\pi^-\mu^+\mu^-$ |
| 0.027 ±0.003 ±0.003                       |      | ANDREWS            | 83   | CLEO $e^+e^- \rightarrow \mu^+\mu^-$                 |
| 0.032 ±0.013 ±0.003                       |      | ALBRECHT           | 82   | DASP $e^+e^- \rightarrow \mu^+\mu^-$                 |
| 0.038 ±0.015 ±0.002                       |      | NICZYPORUK         | 82   | LENA $e^+e^- \rightarrow \mu^+\mu^-$                 |
| 0.014 <sup>+0.034</sup> <sub>-0.014</sub> |      | BOCK               | 80   | CNTR $e^+e^- \rightarrow \mu^+\mu^-$                 |
| 0.022 ±0.020                              |      | BERGER             | 79   | PLUT $e^+e^- \rightarrow \mu^+\mu^-$                 |

<sup>1</sup> Taking into account interference between the resonance and continuum.

NODE=M049R1  
NODE=M049R1

NODE=M049R1;LINKAGE=G

 $\Gamma(\tau^+\tau^-)/\Gamma(\mu^+\mu^-)$ 
 $\Gamma_1/\Gamma_3$ 

| VALUE                          | EVTs | DOCUMENT ID                  | TECN | COMMENT                                           |
|--------------------------------|------|------------------------------|------|---------------------------------------------------|
| <b>1.008±0.023 OUR AVERAGE</b> |      |                              |      |                                                   |
| 1.005±0.013±0.022              | 0.7M | <sup>1</sup> DEL-AMO-SA..10c | BABR | $\Upsilon(3S) \rightarrow \pi^+\pi^-\Upsilon(1S)$ |
| 1.02 ±0.02 ±0.05               | 60k  | BESSON                       | 07   | CLEO $e^+e^- \rightarrow \Upsilon(1S)$            |

<sup>1</sup> Allows any number of extra photons with total energy < 500 MeV.

NODE=M049R3  
NODE=M049R43

NODE=M049R43;LINKAGE=DE

 $\Gamma(ggg)/\Gamma_{\text{total}}$ 
 $\Gamma_4/\Gamma$ 

| VALUE (units 10 <sup>-2</sup> ) | EVTs | DOCUMENT ID         | TECN | COMMENT                                        |
|---------------------------------|------|---------------------|------|------------------------------------------------|
| <b>81.7±0.7</b>                 | 20M  | <sup>1</sup> BESSON | 06A  | CLEO $\Upsilon(1S) \rightarrow \text{hadrons}$ |

<sup>1</sup> Calculated using the value  $\Gamma(\gamma gg)/\Gamma(ggg) = (2.70 \pm 0.01 \pm 0.13 \pm 0.24)\%$  from BESSON 06A and PDG 08 values of  $B(\mu^+\mu^-) = (2.48 \pm 0.05)\%$  and  $R_{\text{hadrons}} = 3.51$ . The statistical error is negligible and the systematic error is partially correlated with that of  $\Gamma(\gamma gg)/\Gamma_{\text{total}}$  measurement of BESSON 06A.

NODE=M049R35  
NODE=M049R35

NODE=M049R35;LINKAGE=BE

 $\Gamma(\gamma gg)/\Gamma_{\text{total}}$ 
 $\Gamma_5/\Gamma$ 

| VALUE (units 10 <sup>-2</sup> ) | EVTs | DOCUMENT ID         | TECN | COMMENT                                                 |
|---------------------------------|------|---------------------|------|---------------------------------------------------------|
| <b>2.20±0.60</b>                | 400k | <sup>1</sup> BESSON | 06A  | CLEO $\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$ |

<sup>1</sup> Calculated using BESSON 06A values of  $\Gamma(\gamma gg)/\Gamma(ggg) = (2.70 \pm 0.01 \pm 0.13 \pm 0.24)\%$  and  $\Gamma(ggg)/\Gamma_{\text{total}}$ . The statistical error is negligible and the systematic error is partially correlated with that of  $\Gamma(ggg)/\Gamma_{\text{total}}$  measurement of BESSON 06A.

NODE=M049R36  
NODE=M049R36

NODE=M049R36;LINKAGE=BE

 $\Gamma(\gamma gg)/\Gamma(ggg)$ 
 $\Gamma_5/\Gamma_4$ 

| VALUE (units 10 <sup>-2</sup> ) | EVTs | DOCUMENT ID | TECN | COMMENT                                                   |
|---------------------------------|------|-------------|------|-----------------------------------------------------------|
| <b>2.70±0.01±0.27</b>           | 20M  | BESSON      | 06A  | CLEO $\Upsilon(1S) \rightarrow (\gamma +) \text{hadrons}$ |

NODE=M049R37  
NODE=M049R37

 $\Gamma(\eta'(958) \text{ anything})/\Gamma_{\text{total}}$ 
 $\Gamma_6/\Gamma$ 

| VALUE                            | DOCUMENT ID | TECN | COMMENT                                                |
|----------------------------------|-------------|------|--------------------------------------------------------|
| <b>0.0294±0.0024 OUR AVERAGE</b> |             |      |                                                        |
| 0.030 ±0.002 ±0.002              | AQUINES     | 06A  | CLE3 $\Upsilon(1S) \rightarrow \eta' \text{ anything}$ |
| 0.028 ±0.004 ±0.002              | ARTUSO      | 03   | CLE2 $\Upsilon(1S) \rightarrow \eta' \text{ anything}$ |

NODE=M049R73  
NODE=M049R73

 $\Gamma(J/\psi(1S) \text{ anything})/\Gamma_{\text{total}}$ 
 $\Gamma_7/\Gamma$ 

| VALUE (units 10 <sup>-4</sup> )                                 | CL% | EVTs                | DOCUMENT ID | TECN | COMMENT                           |
|-----------------------------------------------------------------|-----|---------------------|-------------|------|-----------------------------------|
| <b>5.4 ±0.4 OUR FIT</b> Error includes scale factor of 1.4.     |     |                     |             |      |                                   |
| <b>5.4 ±0.4 OUR AVERAGE</b> Error includes scale factor of 1.5. |     |                     |             |      |                                   |
| 5.25±0.13±0.25                                                  | 3k  | SHEN                | 16          | BELL | $e^+e^- \rightarrow J/\psi X$     |
| 6.4 ±0.4 ±0.6                                                   | 730 | BRIERE              | 04          | CLEO | $e^+e^- \rightarrow J/\psi X$     |
| 11 ±4 ±2                                                        |     | <sup>1</sup> FULTON | 89          | CLEO | $e^+e^- \rightarrow \mu^+\mu^- X$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |            |     |      |                                             |
|------|----|------------|-----|------|---------------------------------------------|
| <6.8 | 90 | ALBRECHT   | 92J | ARG  | $e^+e^- \rightarrow e^+e^- X, \mu^+\mu^- X$ |
| <17  | 90 | MASCHMANN  | 90  | CBAL | $e^+e^- \rightarrow \text{hadrons}$         |
| <200 | 90 | NICZYPORUK | 83  | LENA |                                             |

<sup>1</sup> Using  $B((J/\psi) \rightarrow \mu^+\mu^-) = (6.9 \pm 0.9)\%$ .

NODE=M049R12  
NODE=M049R12

NODE=M049R12;LINKAGE=K

|                                                                                                        |      |             |      |         |                                                |                              |
|--------------------------------------------------------------------------------------------------------|------|-------------|------|---------|------------------------------------------------|------------------------------|
| $\Gamma(J/\psi(1S)\eta_c)/\Gamma_{\text{total}}$                                                       |      |             |      |         | $\Gamma_8/\Gamma$                              | NODE=M049R85<br>NODE=M049R85 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<2.2 \times 10^{-6}$                                                                                  | 90   | YANG        | 14   | BELL    | $e^+e^- \rightarrow J/\psi X$                  |                              |
| $\Gamma(J/\psi(1S)\chi_{c0})/\Gamma_{\text{total}}$                                                    |      |             |      |         | $\Gamma_9/\Gamma$                              | NODE=M049R86<br>NODE=M049R86 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<3.4 \times 10^{-6}$                                                                                  | 90   | YANG        | 14   | BELL    | $e^+e^- \rightarrow J/\psi X$                  |                              |
| $\Gamma(J/\psi(1S)\chi_{c1})/\Gamma_{\text{total}}$                                                    |      |             |      |         | $\Gamma_{10}/\Gamma$                           | NODE=M049R87<br>NODE=M049R87 |
| VALUE (units $10^{-6}$ )                                                                               | EVTS | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $3.90 \pm 1.21 \pm 0.23$                                                                               | 20   | YANG        | 14   | BELL    | $e^+e^- \rightarrow J/\psi X$                  |                              |
| $\Gamma(J/\psi(1S)\chi_{c2})/\Gamma_{\text{total}}$                                                    |      |             |      |         | $\Gamma_{11}/\Gamma$                           | NODE=M049R88<br>NODE=M049R88 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<1.4 \times 10^{-6}$                                                                                  | 90   | YANG        | 14   | BELL    | $e^+e^- \rightarrow J/\psi X$                  |                              |
| $\Gamma(J/\psi(1S)\eta_c(2S))/\Gamma_{\text{total}}$                                                   |      |             |      |         | $\Gamma_{12}/\Gamma$                           | NODE=M049R89<br>NODE=M049R89 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<2.2 \times 10^{-6}$                                                                                  | 90   | YANG        | 14   | BELL    | $e^+e^- \rightarrow J/\psi X$                  |                              |
| $\Gamma(J/\psi(1S)X(3940))/\Gamma_{\text{total}}$                                                      |      |             |      |         | $\Gamma_{13}/\Gamma$                           | NODE=M049R90<br>NODE=M049R90 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<5.4 \times 10^{-6}$                                                                                  | 90   | YANG        | 14   | BELL    | $e^+e^- \rightarrow J/\psi X$                  |                              |
| $\Gamma(J/\psi(1S)X(4160))/\Gamma_{\text{total}}$                                                      |      |             |      |         | $\Gamma_{14}/\Gamma$                           | NODE=M049R91<br>NODE=M049R91 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<5.4 \times 10^{-6}$                                                                                  | 90   | YANG        | 14   | BELL    | $e^+e^- \rightarrow J/\psi X$                  |                              |
| $\Gamma(X(4350) \text{ anything}, X \rightarrow J/\psi(1S)\phi)/\Gamma_{\text{total}}$                 |      |             |      |         | $\Gamma_{15}/\Gamma$                           | NODE=M049P05<br>NODE=M049P05 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<8.1 \times 10^{-6}$                                                                                  | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$    |                              |
| $\Gamma(Z_c(3900)^\pm \text{ anything}, Z_c \rightarrow J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$      |      |             |      |         | $\Gamma_{16}/\Gamma$                           | NODE=M049P06<br>NODE=M049P06 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<1.3 \times 10^{-5}$                                                                                  | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$    |                              |
| $\Gamma(Z_c(4200)^\pm \text{ anything}, Z_c \rightarrow J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$      |      |             |      |         | $\Gamma_{17}/\Gamma$                           | NODE=M049P07<br>NODE=M049P07 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<6.0 \times 10^{-5}$                                                                                  | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$    |                              |
| $\Gamma(Z_c(4430)^\pm \text{ anything}, Z_c \rightarrow J/\psi(1S)\pi^\pm)/\Gamma_{\text{total}}$      |      |             |      |         | $\Gamma_{18}/\Gamma$                           | NODE=M049P08<br>NODE=M049P08 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<4.9 \times 10^{-5}$                                                                                  | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$    |                              |
| $\Gamma(X_{cs}^\pm \text{ anything}, X \rightarrow J/\psi K^\pm)/\Gamma_{\text{total}}$                |      |             |      |         | $\Gamma_{19}/\Gamma$                           | NODE=M049P11<br>NODE=M049P11 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<5.7 \times 10^{-6}$                                                                                  | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi K^- X$        |                              |
| $\Gamma(\psi(4260) \text{ anything}, \psi \rightarrow J/\psi(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$     |      |             |      |         | $\Gamma_{20}/\Gamma$                           | NODE=M049R99<br>NODE=M049R99 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<3.8 \times 10^{-5}$                                                                                  | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi \pi^+\pi^- X$ |                              |
| $\Gamma(\psi(4260) \text{ anything}, \psi \rightarrow J/\psi(1S)K^+K^-)/\Gamma_{\text{total}}$         |      |             |      |         | $\Gamma_{21}/\Gamma$                           | NODE=M049P03<br>NODE=M049P03 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<7.5 \times 10^{-6}$                                                                                  | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$    |                              |
| $\Gamma(\chi_{c1}(4140) \text{ anything}, \chi_{c1} \rightarrow J/\psi(1S)\phi)/\Gamma_{\text{total}}$ |      |             |      |         | $\Gamma_{22}/\Gamma$                           | NODE=M049P04<br>NODE=M049P04 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<5.2 \times 10^{-6}$                                                                                  | 90   | SHEN        | 16   | BELL    | $\Upsilon(1S) \rightarrow J/\psi K^+ K^- X$    |                              |
| $\Gamma(\chi_{c0} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$                               |      |             |      |         | $\Gamma_{23}/\Gamma_7$                         | NODE=M049R25<br>NODE=M049R25 |
| VALUE                                                                                                  | CL%  | DOCUMENT ID | TECN | COMMENT |                                                |                              |
| $<7.4$                                                                                                 | 90   | BRIERE      | 04   | CLEO    | $e^+e^- \rightarrow J/\psi X$                  |                              |

$\Gamma(\chi_{c1} \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ NODE=M049P13  
NODE=M049P13VALUE (units  $10^{-4}$ ) EVTS

DOCUMENT ID

TECN

COMMENT

**1.90±0.35 OUR FIT****1.90±0.43±0.14**

215

JIA

17

BELL

 $\Upsilon(1S) \rightarrow \gamma J/\psi(1S)$  $\Gamma(\chi_{c1} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$  $\Gamma_{24}/\Gamma_7$ NODE=M049R26  
NODE=M049R26

VALUE EVTS

DOCUMENT ID

TECN

COMMENT

**0.35±0.07 OUR FIT****0.35±0.08±0.06**

52 ± 12

BRIERE

04

CLEO

 $e^+e^- \rightarrow J/\psi X$  $\Gamma(\chi_{c1}(1P)\chi_{tetra})/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ NODE=M049P15  
NODE=M049P15

VALUE CL%

DOCUMENT ID

TECN

COMMENT

**<37.8 × 10<sup>-6</sup>**

90

<sup>1</sup> JIA

17A

BELL

 $e^+e^- \rightarrow \text{hadrons}$ 

<sup>1</sup> For a tetraquark state  $\chi_{tetra}$ , with mass in the range 1.16–2.46 GeV and width in the range 0–0.3 GeV. Measured 90% CL limits as a function of  $\chi_{tetra}$  mass and width range from  $4.4 \times 10^{-6}$  to  $37.8 \times 10^{-6}$ .

NODE=M049P15;LINKAGE=A

 $\Gamma(\chi_{c2} \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$  $\Gamma_{26}/\Gamma_7$ NODE=M049R27  
NODE=M049R27

VALUE EVTS

DOCUMENT ID

TECN

COMMENT

**0.52±0.12±0.09**

47 ± 11

BRIERE

04

CLEO

 $e^+e^- \rightarrow J/\psi X$  $\Gamma(\psi(2S) \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ NODE=M049P12  
NODE=M049P12VALUE (units  $10^{-4}$ ) EVTS

DOCUMENT ID

TECN

COMMENT

**1.23±0.17±0.11**

215

SHEN

16

BELL

 $e^+e^- \rightarrow \psi(2S) X$  $\Gamma(\psi(2S) \text{ anything})/\Gamma(J/\psi(1S) \text{ anything})$  $\Gamma_{27}/\Gamma_7$ NODE=M049R28  
NODE=M049R28

VALUE EVTS

DOCUMENT ID

TECN

COMMENT

**0.41±0.11±0.08**

42 ± 11

BRIERE

04

CLEO

 $e^+e^- \rightarrow J/\psi \pi^+ \pi^- X$  $\Gamma(\psi(2S)\eta_c)/\Gamma_{\text{total}}$  $\Gamma_{28}/\Gamma$ NODE=M049R92  
NODE=M049R92

VALUE CL%

DOCUMENT ID

TECN

COMMENT

**<3.6 × 10<sup>-6</sup>**

90

YANG

14

BELL

 $e^+e^- \rightarrow \psi(2S) X$  $\Gamma(\psi(2S)\chi_{c0})/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ NODE=M049R93  
NODE=M049R93

VALUE CL%

DOCUMENT ID

TECN

COMMENT

**<6.5 × 10<sup>-6</sup>**

90

YANG

14

BELL

 $e^+e^- \rightarrow \psi(2S) X$  $\Gamma(\psi(2S)\chi_{c1})/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ NODE=M049R94  
NODE=M049R94

VALUE CL%

DOCUMENT ID

TECN

COMMENT

**<4.5 × 10<sup>-6</sup>**

90

YANG

14

BELL

 $e^+e^- \rightarrow \psi(2S) X$  $\Gamma(\psi(2S)\chi_{c2})/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ NODE=M049R95  
NODE=M049R95

VALUE CL%

DOCUMENT ID

TECN

COMMENT

**<2.1 × 10<sup>-6</sup>**

90

YANG

14

BELL

 $e^+e^- \rightarrow \psi(2S) X$  $\Gamma(\psi(2S)\eta_c(2S))/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ NODE=M049R96  
NODE=M049R96

VALUE CL%

DOCUMENT ID

TECN

COMMENT

**<3.2 × 10<sup>-6</sup>**

90

YANG

14

BELL

 $e^+e^- \rightarrow \psi(2S) X$  $\Gamma(\psi(2S)X(3940))/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ NODE=M049R97  
NODE=M049R97

VALUE CL%

DOCUMENT ID

TECN

COMMENT

**<2.9 × 10<sup>-6</sup>**

90

YANG

14

BELL

 $e^+e^- \rightarrow \psi(2S) X$  $\Gamma(\psi(2S)X(4160))/\Gamma_{\text{total}}$  $\Gamma_{34}/\Gamma$ NODE=M049R98  
NODE=M049R98

VALUE CL%

DOCUMENT ID

TECN

COMMENT

**<2.9 × 10<sup>-6</sup>**

90

YANG

14

BELL

 $e^+e^- \rightarrow \psi(2S) X$  $\Gamma(\psi(4260) \text{ anything}, \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ NODE=M049P00  
NODE=M049P00

VALUE CL%

DOCUMENT ID

TECN

COMMENT

**<7.9 × 10<sup>-5</sup>**

90

SHEN

16

BELL

 $\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^- X$  $\Gamma(\psi(4360) \text{ anything}, \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ NODE=M049P01  
NODE=M049P01

VALUE CL%

DOCUMENT ID

TECN

COMMENT

**<5.2 × 10<sup>-5</sup>**

90

SHEN

16

BELL

 $\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^- X$

$\Gamma(\psi(4660) \text{ anything}, \psi \rightarrow \psi(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$   $\Gamma_{37}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                                              |
|-----------------------|-----|-------------|------|------------------------------------------------------|
| $<2.2 \times 10^{-5}$ | 90  | SHEN        | 16   | BELL $\Upsilon(1S) \rightarrow \psi(2S)\pi^+\pi^- X$ |

NODE=M049P02  
NODE=M049P02

 $\Gamma(X(4050)^\pm \text{ anything}, X \rightarrow \psi(2S)\pi^\pm)/\Gamma_{\text{total}}$   $\Gamma_{38}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                                           |
|-----------------------|-----|-------------|------|---------------------------------------------------|
| $<8.8 \times 10^{-5}$ | 90  | SHEN        | 16   | BELL $\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$ |

NODE=M049P09  
NODE=M049P09

 $\Gamma(Z_c(4430)^\pm \text{ anything}, Z_c \rightarrow \psi(2S)\pi^\pm)/\Gamma_{\text{total}}$   $\Gamma_{39}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                                           |
|-----------------------|-----|-------------|------|---------------------------------------------------|
| $<6.7 \times 10^{-5}$ | 90  | SHEN        | 16   | BELL $\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$ |

NODE=M049P10  
NODE=M049P10

 $\Gamma(\chi_{c1}(3872) \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{40}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID       | TECN | COMMENT                                              |
|-----------------------|-----|-------------------|------|------------------------------------------------------|
| $<2.8 \times 10^{-4}$ | 90  | <sup>1</sup> SHEN | 16   | BELL $\Upsilon(1S) \rightarrow J/\psi \pi^+ \pi^- X$ |

NODE=M049P31  
NODE=M049P31

<sup>1</sup> SHEN 16 reports  $[\Gamma(\Upsilon(1S) \rightarrow \chi_{c1}(3872) \text{ anything})/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S))] < 9.5 \times 10^{-6}$  which we divide by our best value  $B(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) = 3.4 \times 10^{-2}$ .

NODE=M049P31;LINKAGE=A

 $\Gamma(Z_c(4200)^+ Z_c(4200)^-)/\Gamma_{\text{total}}$   $\Gamma_{41}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID      | TECN | COMMENT                                          |
|------------------------|-----|------------------|------|--------------------------------------------------|
| $<22.3 \times 10^{-6}$ | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$ |

NODE=M049P17  
NODE=M049P17

<sup>1</sup> Assuming  $B(Z_c(4200)^\pm \rightarrow J/\psi \pi^\pm) = 1$ .

NODE=M049P17;LINKAGE=A

 $\Gamma(Z_c(3900)^\pm Z_c(4200)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{42}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID      | TECN | COMMENT                                          |
|-----------------------|-----|------------------|------|--------------------------------------------------|
| $<8.1 \times 10^{-6}$ | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$ |

NODE=M049P18  
NODE=M049P18

<sup>1</sup> Assuming  $B(Z_c(4200)^\pm \rightarrow J/\psi \pi^\pm) = 1 = B(Z_c(3900)^\pm \rightarrow J/\psi \pi^\pm)$ .

NODE=M049P18;LINKAGE=A

 $\Gamma(Z_c(3900)^+ Z_c(3900)^-)/\Gamma_{\text{total}}$   $\Gamma_{43}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID      | TECN | COMMENT                                          |
|-----------------------|-----|------------------|------|--------------------------------------------------|
| $<1.8 \times 10^{-6}$ | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$ |

NODE=M049P19  
NODE=M049P19

<sup>1</sup> Assuming  $B(Z_c(3900)^\pm \rightarrow J/\psi \pi^\pm) = 1$

NODE=M049P19;LINKAGE=A

 $\Gamma(X(4050)^+ X(4050)^-)/\Gamma_{\text{total}}$   $\Gamma_{44}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID      | TECN | COMMENT                                                |
|------------------------|-----|------------------|------|--------------------------------------------------------|
| $<15.8 \times 10^{-6}$ | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow \chi_{c1}(1P)\pi^\pm X$ |

NODE=M049P20  
NODE=M049P20

<sup>1</sup> Assuming  $B(X(4050)^\pm \rightarrow \chi_{c1}(1P)\pi^\pm) = 1$

NODE=M049P20;LINKAGE=A

 $\Gamma(X(4250)^+ X(4250)^-)/\Gamma_{\text{total}}$   $\Gamma_{45}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID      | TECN | COMMENT                                                |
|------------------------|-----|------------------|------|--------------------------------------------------------|
| $<26.6 \times 10^{-6}$ | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow \chi_{c1}(1P)\pi^\pm X$ |

NODE=M049P21  
NODE=M049P21

<sup>1</sup> Assuming  $B(X(4250)^\pm \rightarrow \chi_{c1}(1P)\pi^\pm) = 1$

NODE=M049P21;LINKAGE=A

 $\Gamma(X(4050)^\pm X(4250)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{46}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID      | TECN | COMMENT                                                |
|------------------------|-----|------------------|------|--------------------------------------------------------|
| $<44.2 \times 10^{-6}$ | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow \chi_{c1}(1P)\pi^\pm X$ |

NODE=M049P22  
NODE=M049P22

<sup>1</sup> Assuming  $B(X(4050)^\pm \rightarrow \chi_{c1}(1P)\pi^\pm) = 1 = B(X(4250)^\pm \rightarrow \chi_{c1}(1P)\pi^\pm)$

NODE=M049P22;LINKAGE=A

 $\Gamma(Z_c(4430)^+ Z_c(4430)^-)/\Gamma_{\text{total}}$   $\Gamma_{47}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID      | TECN | COMMENT                                           |
|------------------------|-----|------------------|------|---------------------------------------------------|
| $<20.3 \times 10^{-6}$ | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(2S) \rightarrow \psi(2S)\pi^\pm X$ |

NODE=M049P23  
NODE=M049P23

<sup>1</sup> Assuming  $B(Z_c(4430)^\pm \rightarrow \psi(2S)\pi^\pm) = 1$

NODE=M049P23;LINKAGE=A

 $\Gamma(X(4055)^\pm X(4055)^\mp)/\Gamma_{\text{total}}$   $\Gamma_{48}/\Gamma$ 

| VALUE                  | CL% | DOCUMENT ID      | TECN | COMMENT                                           |
|------------------------|-----|------------------|------|---------------------------------------------------|
| $<23.3 \times 10^{-6}$ | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$ |

NODE=M049P25  
NODE=M049P25

<sup>1</sup> Assuming  $B(X(4055)^\pm \rightarrow \psi(2S)\pi^\pm) = 1$

NODE=M049P25;LINKAGE=A

$\Gamma(X(4055)^\pm Z_c(4430)^\mp)/\Gamma_{\text{total}}$  $\Gamma_{49}/\Gamma$ 

| VALUE                                                                                                                 | CL% | DOCUMENT ID      | TECN | COMMENT                                           |
|-----------------------------------------------------------------------------------------------------------------------|-----|------------------|------|---------------------------------------------------|
| $<45.5 \times 10^{-6}$                                                                                                | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow \psi(2S)\pi^\pm X$ |
| <sup>1</sup> Assuming $B(X(4055)^\pm \rightarrow \psi(2S)\pi^\pm) = 1 = B(Z_c(4430)^\pm \rightarrow \psi(2S)\pi^\pm)$ |     |                  |      |                                                   |

NODE=M049P26  
 NODE=M049P26

NODE=M049P26;LINKAGE=A

 $\Gamma(\rho\pi)/\Gamma_{\text{total}}$  $\Gamma_{50}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                      | CL% | DOCUMENT ID | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|-----|-------------|------|-------------------------------------------------|
| $<3.68$                                                                       | 90  | SHEN        | 13   | BELL $\Upsilon(1S) \rightarrow \pi^+\pi^-\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                                 |
| $<1 \times 10^3$                                                              | 90  | BLINOV      | 90   | MD1 $\Upsilon(1S) \rightarrow \rho^0\pi^0$      |
| $<2 \times 10^2$                                                              | 90  | FULTON      | 90B  | $\Upsilon(1S) \rightarrow \rho^0\pi^0$          |
| $<2.1 \times 10^3$                                                            | 90  | NICZYPORUK  | 83   | LENA $\Upsilon(1S) \rightarrow \rho^0\pi^0$     |

NODE=M049R11  
 NODE=M049R11

 $\Gamma(\omega\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{51}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                              |
|--------------------------|-----|-------------|------|------------------------------------------------------|
| $<3.90$                  | 90  | SHEN        | 13   | BELL $\Upsilon(1S) \rightarrow \pi^+\pi^-\pi^0\pi^0$ |

NODE=M049R05  
 NODE=M049R05

 $\Gamma(\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{52}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                   |
|--------------------------|-----|-------------|------|-------------------------------------------|
| $<5$                     | 90  | BARU        | 92   | MD1 $\Upsilon(1S) \rightarrow \pi^+\pi^-$ |

NODE=M049R57  
 NODE=M049R57

 $\Gamma(K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{53}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                               |
|--------------------------|-----|-------------|------|---------------------------------------|
| $<5$                     | 90  | BARU        | 92   | MD1 $\Upsilon(1S) \rightarrow K^+K^-$ |

NODE=M049R58  
 NODE=M049R58

 $\Gamma(p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{54}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID       | TECN | COMMENT                                 |
|--------------------------|-----|-------------------|------|-----------------------------------------|
| $<5$                     | 90  | <sup>1</sup> BARU | 96   | MD1 $\Upsilon(1S) \rightarrow p\bar{p}$ |

NODE=M049R59  
 NODE=M049R59

<sup>1</sup> Supersedes BARU 92 in this node.

NODE=M049R59;LINKAGE=A

 $\Gamma(\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{55}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                      | CL%        | EVTS | DOCUMENT ID   | TECN | COMMENT                                         |
|-------------------------------------------------------------------------------|------------|------|---------------|------|-------------------------------------------------|
| $2.14 \pm 0.72 \pm 0.34$                                                      | $26 \pm 9$ |      | SHEN          | 13   | BELL $\Upsilon(1S) \rightarrow \pi^+\pi^-\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |            |      |               |      |                                                 |
| $<18.4$                                                                       | 90         |      | ANASTASSOV 99 | CLE2 | $e^+e^- \rightarrow \text{hadrons}$             |

NODE=M049R72  
 NODE=M049R72

 $\Gamma(\phi K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{56}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                   |
|--------------------------|------|-------------|------|-------------------------------------------|
| $2.36 \pm 0.37 \pm 0.29$ | 56   | SHEN        | 12A  | BELL $\Upsilon(1S) \rightarrow 2(K^+K^-)$ |

NODE=M049R75  
 NODE=M049R75

 $\Gamma(\omega\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{57}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                            |
|--------------------------|------|-------------|------|----------------------------------------------------|
| $4.46 \pm 0.67 \pm 0.72$ | 64   | SHEN        | 12A  | BELL $\Upsilon(1S) \rightarrow 2(\pi^+\pi^-)\pi^0$ |

NODE=M049R76  
 NODE=M049R76

 $\Gamma(K^*(892)^0 K^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                          |
|--------------------------|------|-------------|------|--------------------------------------------------|
| $4.42 \pm 0.50 \pm 0.58$ | 173  | SHEN        | 12A  | BELL $\Upsilon(1S) \rightarrow K^+K^-\pi^+\pi^-$ |

NODE=M049R77  
 NODE=M049R77

 $\Gamma(\phi f'_2(1525))/\Gamma_{\text{total}}$  $\Gamma_{59}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                   |
|--------------------------|-----|-------------|------|-------------------------------------------|
| $<1.63$                  | 90  | SHEN        | 12A  | BELL $\Upsilon(1S) \rightarrow 2(K^+K^-)$ |

NODE=M049R78  
 NODE=M049R78

 $\Gamma(\omega f_2(1270))/\Gamma_{\text{total}}$  $\Gamma_{60}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                            |
|--------------------------|-----|-------------|------|----------------------------------------------------|
| $<1.79$                  | 90  | SHEN        | 12A  | BELL $\Upsilon(1S) \rightarrow 2(\pi^+\pi^-)\pi^0$ |

NODE=M049R79  
 NODE=M049R79

 $\Gamma(\rho(770) a_2(1320))/\Gamma_{\text{total}}$  $\Gamma_{61}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                            |
|--------------------------|-----|-------------|------|----------------------------------------------------|
| $<2.24$                  | 90  | SHEN        | 12A  | BELL $\Upsilon(1S) \rightarrow 2(\pi^+\pi^-)\pi^0$ |

NODE=M049R80  
 NODE=M049R80

$\Gamma(K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{62}/\Gamma$ 

| VALUE (units $10^{-6}$ )                   | EVTS | DOCUMENT ID | TECN | COMMENT                                             |
|--------------------------------------------|------|-------------|------|-----------------------------------------------------|
| <b><math>3.02 \pm 0.68 \pm 0.34</math></b> | 42   | SHEN        | 12A  | BELL $\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$ |

NODE=M049R81  
NODE=M049R81

 $\Gamma(K_1(1270)^\pm K^\mp)/\Gamma_{\text{total}}$   $\Gamma_{63}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN | COMMENT                                             |
|------------------------------|-----|-------------|------|-----------------------------------------------------|
| <b><math>&lt;2.41</math></b> | 90  | SHEN        | 12A  | BELL $\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$ |

NODE=M049R82  
NODE=M049R82

 $\Gamma(K_1(1400)^\pm K^\mp)/\Gamma_{\text{total}}$   $\Gamma_{64}/\Gamma$ 

| VALUE (units $10^{-6}$ )                   | EVTS | DOCUMENT ID | TECN | COMMENT                                             |
|--------------------------------------------|------|-------------|------|-----------------------------------------------------|
| <b><math>1.02 \pm 0.35 \pm 0.22</math></b> | 24   | SHEN        | 12A  | BELL $\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$ |

NODE=M049R83  
NODE=M049R83

 $\Gamma(b_1(1235)^\pm \pi^\mp)/\Gamma_{\text{total}}$   $\Gamma_{65}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN | COMMENT                                              |
|------------------------------|-----|-------------|------|------------------------------------------------------|
| <b><math>&lt;1.25</math></b> | 90  | SHEN        | 12A  | BELL $\Upsilon(1S) \rightarrow 2(\pi^+ \pi^-) \pi^0$ |

NODE=M049R84  
NODE=M049R84

 $\Gamma(\pi^+ \pi^- \pi^0 \pi^0)/\Gamma_{\text{total}}$   $\Gamma_{66}/\Gamma$ 

| VALUE (units $10^{-6}$ )                 | EVTS         | DOCUMENT ID | TECN | COMMENT                                                 |
|------------------------------------------|--------------|-------------|------|---------------------------------------------------------|
| <b><math>12.8 \pm 2.0 \pm 2.3</math></b> | $143 \pm 22$ | SHEN        | 13   | BELL $\Upsilon(1S) \rightarrow \pi^+ \pi^- \pi^0 \pi^0$ |

NODE=M049R06  
NODE=M049R06

 $\Gamma(K_S^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{67}/\Gamma$ 

| VALUE (units $10^{-6}$ )                   | CL%        | EVTS | DOCUMENT ID | TECN | COMMENT                                         |
|--------------------------------------------|------------|------|-------------|------|-------------------------------------------------|
| <b><math>1.59 \pm 0.33 \pm 0.18</math></b> | $37 \pm 8$ |      | SHEN        | 13   | BELL $\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$ |

NODE=M049R07  
NODE=M049R07

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |                    |     |                                            |
|--------|----|--------------------|-----|--------------------------------------------|
| $<3.4$ | 90 | <sup>1</sup> DOBBS | 12A | $\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$ |
|--------|----|--------------------|-----|--------------------------------------------|

<sup>1</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M049R07;LINKAGE=DO

 $\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{68}/\Gamma$ 

| VALUE (units $10^{-6}$ )                   | EVTS       | DOCUMENT ID | TECN | COMMENT                                         |
|--------------------------------------------|------------|-------------|------|-------------------------------------------------|
| <b><math>2.92 \pm 0.85 \pm 0.37</math></b> | $16 \pm 5$ | SHEN        | 13   | BELL $\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$ |

NODE=M049R08  
NODE=M049R08

 $\Gamma(K^*(892)^- K^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{69}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN | COMMENT                                         |
|------------------------------|-----|-------------|------|-------------------------------------------------|
| <b><math>&lt;1.11</math></b> | 90  | SHEN        | 13   | BELL $\Upsilon(1S) \rightarrow K_S^0 K^- \pi^+$ |

NODE=M049R09  
NODE=M049R09

 $\Gamma(f_1(1285) \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{70}/\Gamma$ 

| VALUE (units $10^{-3}$ )                | EVTS | DOCUMENT ID | TECN | COMMENT                                   |
|-----------------------------------------|------|-------------|------|-------------------------------------------|
| <b><math>4.6 \pm 2.8 \pm 1.3</math></b> | 3.1k | JIA         | 17A  | BELL $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M049P14  
NODE=M049P14

 $\Gamma(D^*(2010)^\pm \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{71}/\Gamma$ 

| <i>VALUE (units 10<sup>-3</sup>)</i> | <i>CL%</i> | <i>EVTS</i> | <i>DOCUMENT ID</i>  | <i>TECN</i> | <i>COMMENT</i>                                           |
|--------------------------------------|------------|-------------|---------------------|-------------|----------------------------------------------------------|
| <b>25.2±1.3±1.5</b>                  |            | ≈ 2k        | <sup>1</sup> AUBERT | 10c         | BABR $\Upsilon(2S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$ |

NODE=M049R32  
NODE=M049R32

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                       |     |                                         |
|-------|----|-----------------------|-----|-----------------------------------------|
| $<19$ | 90 | <sup>2</sup> ALBRECHT | 92J | ARG $e^+ e^- \rightarrow D^0 \pi^\pm X$ |
|-------|----|-----------------------|-----|-----------------------------------------|

<sup>1</sup> For  $x_p > 0.1$ .

<sup>2</sup> For  $x_p > 0.2$ .

NODE=M049R32;LINKAGE=AU

NODE=M049R32;LINKAGE=B

 $\Gamma(f_1(1285) X_{\text{tetra}})/\Gamma_{\text{total}}$   $\Gamma_{72}/\Gamma$ 

| VALUE                                       | CL% | DOCUMENT ID      | TECN | COMMENT                                   |
|---------------------------------------------|-----|------------------|------|-------------------------------------------|
| <b><math>&lt;62.4 \times 10^{-6}</math></b> | 90  | <sup>1</sup> JIA | 17A  | BELL $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M049P16  
NODE=M049P16

<sup>1</sup> For a tetraquark state  $X_{\text{tetra}}$ , with mass in the range 1.16–2.46 GeV and width in the range 0–0.3 GeV. Measured 90% CL limits as a function of  $X_{\text{tetra}}$  mass and width range from  $4.6 \times 10^{-6}$  to  $62.4 \times 10^{-6}$ .

NODE=M049P16;LINKAGE=A

 $\Gamma(\bar{2}H \text{ anything})/\Gamma_{\text{total}}$   $\Gamma_{73}/\Gamma$ 

| VALUE (units $10^{-5}$ )                      | EVTS | DOCUMENT ID | TECN | COMMENT                               |
|-----------------------------------------------|------|-------------|------|---------------------------------------|
| <b><math>2.85 \pm 0.25</math> OUR AVERAGE</b> |      |             |      |                                       |
| $2.81 \pm 0.49^{+0.20}_{-0.24}$               |      | LEES        | 14G  | BABR $e^+ e^- \rightarrow \bar{2}H X$ |
| $2.86 \pm 0.19 \pm 0.21$                      | 455  | ASNER       | 07   | CLEO $e^+ e^- \rightarrow \bar{2}H X$ |

NODE=M049R33  
NODE=M049R33

OCCUR=2

$\Gamma(\text{Sum of 100 exclusive modes})/\Gamma_{\text{total}}$  $\Gamma_{74}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | DOCUMENT ID   | TECN | COMMENT                                   |
|--------------------------|---------------|------|-------------------------------------------|
| <b>1.200±0.017</b>       | 1,2 DOBBS 12A |      | $\Upsilon(1S) \rightarrow \text{hadrons}$ |

NODE=M049R02  
 NODE=M049R02

<sup>1</sup> DOBBS 12A presents individual exclusive branching fractions or upper limits for 100 modes of four to ten pions, kaons, or protons.

NODE=M049R02;LINKAGE=DO

<sup>2</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M049R02;LINKAGE=NC

 $\Gamma(ggg, \gamma g g \rightarrow \bar{d} \text{ anything})/\Gamma(ggg, \gamma g g \rightarrow \text{anything})$ 

NODE=M049R34  
 NODE=M049R34

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                            |
|--------------------------|------|-------------|------|------------------------------------|
| <b>3.36±0.23±0.25</b>    | 455  | ASNER       | 07   | CLEO $e^+e^- \rightarrow \bar{d}X$ |

 $\Gamma(\gamma\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{75}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | DOCUMENT ID                | TECN | COMMENT                             |
|--------------------------|----------------------------|------|-------------------------------------|
| <b>6.3±1.2±1.3</b>       | <sup>1</sup> ANASTASSOV 99 | CLE2 | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M049R70  
 NODE=M049R70

<sup>1</sup> For  $m_{\pi\pi} > 1 \text{ GeV}$ .

NODE=M049R70;LINKAGE=A

 $\Gamma(\gamma\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{76}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | DOCUMENT ID                | TECN | COMMENT                             |
|--------------------------|----------------------------|------|-------------------------------------|
| <b>1.7±0.6±0.3</b>       | <sup>1</sup> ANASTASSOV 99 | CLE2 | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M049R71  
 NODE=M049R71

<sup>1</sup> For  $m_{\pi\pi} > 1 \text{ GeV}$ .

NODE=M049R71;LINKAGE=A

 $\Gamma(\gamma\pi\pi(\text{S-wave}))/\Gamma_{\text{total}}$  $\Gamma_{77}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | DOCUMENT ID | TECN | COMMENT                                     |
|--------------------------|-------------|------|---------------------------------------------|
| <b>4.63±0.56±0.48</b>    | LEES 18A    | BABR | $\Upsilon(1S) \rightarrow \gamma\pi^+\pi^-$ |

NODE=M049P27  
 NODE=M049P27

 $\Gamma(\gamma\pi^0\eta)/\Gamma_{\text{total}}$  $\Gamma_{78}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID             | TECN | COMMENT                           |
|--------------------------|-----|-------------------------|------|-----------------------------------|
| <b>&lt;2.4</b>           | 90  | <sup>1</sup> BESSON 07A | CLEO | $e^+e^- \rightarrow \Upsilon(1S)$ |

NODE=M049R47  
 NODE=M049R47

<sup>1</sup> BESSON 07A obtained this limit for  $0.7 < m_{\pi^0\eta} < 3 \text{ GeV}$ .

NODE=M049R47;LINKAGE=BE

 $\Gamma(\gamma K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{79}/\Gamma$ 

( $2 < m_{K^+K^-} < 3 \text{ GeV}$ )

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|--------------------------|-----|-------------|------|------------------------------------------|
| <b>1.14±0.08±0.10</b>    | 90  | ATHAR 06    | CLE3 | $\Upsilon(1S) \rightarrow \gamma K^+K^-$ |

NODE=M049R24  
 NODE=M049R24  
 NODE=M049R24

 $\Gamma(\gamma p\bar{p})/\Gamma_{\text{total}}$  $\Gamma_{80}/\Gamma$ 

( $2 < m_{p\bar{p}} < 3 \text{ GeV}$ )

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|--------------------------|-----|-------------|------|--------------------------------------------|
| <b>&lt;0.6</b>           | 90  | ATHAR 06    | CLE3 | $\Upsilon(1S) \rightarrow \gamma p\bar{p}$ |

NODE=M049R29  
 NODE=M049R29  
 NODE=M049R29

 $\Gamma(\gamma 2h^+2h^-)/\Gamma_{\text{total}}$  $\Gamma_{81}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS    | DOCUMENT ID | TECN | COMMENT                             |
|--------------------------|---------|-------------|------|-------------------------------------|
| <b>7.0±1.1±1.0</b>       | 80 ± 12 | FULTON 90B  | CLEO | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M049R20  
 NODE=M049R20

 $\Gamma(\gamma 3h^+3h^-)/\Gamma_{\text{total}}$  $\Gamma_{82}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS    | DOCUMENT ID | TECN | COMMENT                             |
|--------------------------|---------|-------------|------|-------------------------------------|
| <b>5.4±1.5±1.3</b>       | 39 ± 11 | FULTON 90B  | CLEO | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M049R21  
 NODE=M049R21

 $\Gamma(\gamma 4h^+4h^-)/\Gamma_{\text{total}}$  $\Gamma_{83}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS    | DOCUMENT ID | TECN | COMMENT                             |
|--------------------------|---------|-------------|------|-------------------------------------|
| <b>7.4±2.5±2.5</b>       | 36 ± 12 | FULTON 90B  | CLEO | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M049R22  
 NODE=M049R22

 $\Gamma(\gamma\pi^+\pi^-K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{84}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS   | DOCUMENT ID | TECN | COMMENT                             |
|--------------------------|--------|-------------|------|-------------------------------------|
| <b>2.9±0.7±0.6</b>       | 29 ± 8 | FULTON 90B  | CLEO | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M049R14  
 NODE=M049R14

 $\Gamma(\gamma 2\pi^+2\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{85}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS   | DOCUMENT ID | TECN | COMMENT                             |
|--------------------------|--------|-------------|------|-------------------------------------|
| <b>2.5±0.7±0.5</b>       | 26 ± 7 | FULTON 90B  | CLEO | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M049R13  
 NODE=M049R13



$\Gamma(\gamma 3\pi^+ 3\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{86}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | EVTs       | DOCUMENT ID | TECN     | COMMENT                              |
|-----------------------------------------|------------|-------------|----------|--------------------------------------|
| <b><math>2.5 \pm 0.9 \pm 0.8</math></b> | $17 \pm 5$ | FULTON      | 90B CLEO | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M049R17  
 NODE=M049R17

 $\Gamma(\gamma 2\pi^+ 2\pi^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{87}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | EVTs       | DOCUMENT ID | TECN     | COMMENT                              |
|-----------------------------------------|------------|-------------|----------|--------------------------------------|
| <b><math>2.4 \pm 0.9 \pm 0.8</math></b> | $18 \pm 7$ | FULTON      | 90B CLEO | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M049R18  
 NODE=M049R18

 $\Gamma(\gamma \pi^+ \pi^- \rho \bar{\rho})/\Gamma_{\text{total}}$  $\Gamma_{88}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | EVTs       | DOCUMENT ID | TECN     | COMMENT                              |
|-----------------------------------------|------------|-------------|----------|--------------------------------------|
| <b><math>1.5 \pm 0.5 \pm 0.3</math></b> | $22 \pm 6$ | FULTON      | 90B CLEO | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M049R15  
 NODE=M049R15

 $\Gamma(\gamma 2\pi^+ 2\pi^- \rho \bar{\rho})/\Gamma_{\text{total}}$  $\Gamma_{89}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | EVTs      | DOCUMENT ID | TECN     | COMMENT                              |
|-----------------------------------------|-----------|-------------|----------|--------------------------------------|
| <b><math>0.4 \pm 0.4 \pm 0.4</math></b> | $7 \pm 6$ | FULTON      | 90B CLEO | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M049R19  
 NODE=M049R19

 $\Gamma(\gamma 2K^+ 2K^-)/\Gamma_{\text{total}}$  $\Gamma_{90}/\Gamma$ 

| VALUE (units $10^{-4}$ )        | EVTs      | DOCUMENT ID | TECN     | COMMENT                              |
|---------------------------------|-----------|-------------|----------|--------------------------------------|
| <b><math>0.2 \pm 0.2</math></b> | $2 \pm 2$ | FULTON      | 90B CLEO | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M049R16  
 NODE=M049R16

 $\Gamma(\gamma \eta'(958))/\Gamma_{\text{total}}$  $\Gamma_{91}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                      | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                  |
|-------------------------------------------------------------------------------|-----|-------------|----------|------------------------------------------------------------------------------------------|
| <b><math>&lt; 1.9</math></b>                                                  | 90  | ATHAR       | 07A CLEO | $\Upsilon(1S) \rightarrow \gamma \eta' \rightarrow \gamma \pi^+ \pi^- \eta, \gamma \rho$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                                                                                          |
| $< 16$                                                                        | 90  | RICHICHI    | 01B CLE2 | $\Upsilon(1S) \rightarrow \gamma \eta' \rightarrow \gamma \eta \pi^+ \pi^-$              |

NODE=M049R55  
 NODE=M049R55

 $\Gamma(\gamma \eta)/\Gamma_{\text{total}}$  $\Gamma_{92}/\Gamma$ 

| VALUE (units $10^{-6}$ )                                                      | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                          |
|-------------------------------------------------------------------------------|-----|-------------|----------|------------------------------------------------------------------------------------------------------------------|
| <b><math>&lt; 1.0</math></b>                                                  | 90  | ATHAR       | 07A CLEO | $\Upsilon(1S) \rightarrow \gamma \eta \rightarrow \gamma \gamma \gamma, \gamma \pi^+ \pi^- \pi^0, \gamma 3\pi^0$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |          |                                                                                                                  |
| $< 21$                                                                        | 90  | MASEK       | 02 CLEO  | $\Upsilon(1S) \rightarrow \gamma \eta$                                                                           |

NODE=M049R54  
 NODE=M049R54

 $\Gamma(\gamma f_0(980))/\Gamma_{\text{total}}$  $\Gamma_{93}/\Gamma$ 

| VALUE (units $10^{-5}$ )   | CL% | DOCUMENT ID        | TECN    | COMMENT                                       |
|----------------------------|-----|--------------------|---------|-----------------------------------------------|
| <b><math>&lt; 3</math></b> | 90  | <sup>1</sup> ATHAR | 06 CLE3 | $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ |

<sup>1</sup> Assuming  $B(f_0(980) \rightarrow \pi \pi) = 1$ .

NODE=M049R31  
 NODE=M049R31

NODE=M049R31;LINKAGE=AT

 $\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$  $\Gamma_{94}/\Gamma$ 

| VALUE (units $10^{-5}$ )                    | CL% | EVTs | DOCUMENT ID         | TECN     | COMMENT                                   |
|---------------------------------------------|-----|------|---------------------|----------|-------------------------------------------|
| <b><math>2.9 \pm 0.6</math> OUR AVERAGE</b> |     |      |                     |          |                                           |
| $2.13 \pm 0.28 \pm 0.72$                    |     |      | <sup>1</sup> LEES   | 18A BABR | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |
| $4.1 \pm 1.4 \pm 0.1$                       |     | 17   | <sup>2</sup> BESSON | 11 CLEO  | $\Upsilon(1S) \rightarrow K_S^0 K_S^0$    |
| $3.7^{+0.9}_{-0.7} \pm 0.8$                 |     |      | ATHAR               | 06 CLE3  | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |    |                       |          |                                           |
|----------|----|-----------------------|----------|-------------------------------------------|
| $< 14$   | 90 | <sup>3</sup> FULTON   | 90B CLEO | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |
| $< 19.4$ | 90 | <sup>3</sup> ALBRECHT | 89 ARG   | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |

<sup>1</sup> Using  $B(f'_2(1525) \rightarrow K \bar{K}) = 0.887 \pm 0.022$  and  $B(K^0 \bar{K}^0) = 1/2 B(K \bar{K})$ .

<sup>2</sup> BESSON 11 reports  $(4.0 \pm 1.3 \pm 0.6) \times 10^{-5}$  from a measurement of  $[\Gamma(\Upsilon(1S) \rightarrow \gamma f'_2(1525))/\Gamma_{\text{total}}] \times [B(f'_2(1525) \rightarrow K \bar{K})]$  assuming  $B(f'_2(1525) \rightarrow K \bar{K}) = (88.8 \pm 3.1) \times 10^{-2}$ , which we rescale to our best value  $B(f'_2(1525) \rightarrow K \bar{K}) = (87.6 \pm 2.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. The result also assumes  $B(K_S^0 \rightarrow \pi^+ \pi^-) = (69.20 \pm 0.05)\%$  and  $B(f'_2(1525) \rightarrow K \bar{K}) = 4 B(f'_2(1525) \rightarrow K_S^0 K_S^0)$ .

<sup>3</sup> Assuming  $B(f'_2(1525) \rightarrow K \bar{K}) = 0.71$ .

NODE=M049R52  
 NODE=M049R52

NODE=M049R52;LINKAGE=A  
 NODE=M049R52;LINKAGE=BE

NODE=M049R52;LINKAGE=D

$\Gamma(\gamma f_2(1270))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )                       | CL% | DOCUMENT ID             | TECN     | COMMENT                                       |
|------------------------------------------------|-----|-------------------------|----------|-----------------------------------------------|
| <b>10.1 ± 0.6 OUR AVERAGE</b>                  |     |                         |          |                                               |
| 10.15 ± 0.59 <sup>+0.54</sup> <sub>-0.43</sub> |     | <sup>1</sup> LEES       | 18A BABR | $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ |
| 10.5 ± 1.6 <sup>+1.9</sup> <sub>-1.8</sub>     |     | <sup>2</sup> BESSON     | 07A CLE3 | $\Upsilon(1S) \rightarrow \gamma \pi^0 \pi^0$ |
| 10.2 ± 0.8 ± 0.7                               |     | ATHAR                   | 06 CLE3  | $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ |
| 8.1 ± 2.3 <sup>+2.9</sup> <sub>-2.7</sub>      |     | <sup>3</sup> ANASTASSOV | 99 CLE2  | $e^+ e^- \rightarrow \text{hadrons}$          |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|     |    |                       |          |                                               |
|-----|----|-----------------------|----------|-----------------------------------------------|
| <21 | 90 | <sup>3</sup> FULTON   | 90B CLEO | $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ |
| <13 | 90 | <sup>3</sup> ALBRECHT | 89 ARG   | $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ |
| <81 | 90 | SCHMITT               | 88 CBAL  | $\Upsilon(1S) \rightarrow \gamma X$           |

<sup>1</sup> Using  $B(f_2(1270) \rightarrow \pi^0 \pi^0) = 1/3 B(f_2(1270) \rightarrow \pi \pi)$  and  $B(f_2(1270) \rightarrow \pi \pi) = (84.2^{+2.9}_{-0.9})\%$ .

<sup>2</sup> Using  $B(f_2(1270) \rightarrow \pi^0 \pi^0) = B(f_2(1270) \rightarrow \pi \pi)/3$  and  $B(f_2(1270) \rightarrow \pi \pi) = (84.7^{+2.5}_{-1.2})\%$ .

<sup>3</sup> Using  $B(f_2(1270) \rightarrow \pi \pi) = 0.84$ .

NODE=M049R51  
NODE=M049R51

NODE=M049R51;LINKAGE=A

NODE=M049R51;LINKAGE=BE

NODE=M049R51;LINKAGE=C

 $\Gamma(\gamma \eta(1405))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID         | TECN     | COMMENT                                               |
|--------------------------|-----|---------------------|----------|-------------------------------------------------------|
| <b>&lt;8.2</b>           | 90  | <sup>1</sup> FULTON | 90B CLEO | $\Upsilon(1S) \rightarrow \gamma K^\pm \pi^\mp K_S^0$ |

<sup>1</sup> Includes unknown branching ratio of  $\eta(1405) \rightarrow K^\pm \pi^\mp K_S^0$ .

NODE=M049R23  
NODE=M049R23

NODE=M049R23;LINKAGE=J

 $\Gamma(\gamma f_0(1500))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID         | TECN     | COMMENT                                                           |
|--------------------------|-----|---------------------|----------|-------------------------------------------------------------------|
| <b>&lt;1.5</b>           | 90  | <sup>1</sup> BESSON | 07A CLEO | $e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma \pi^0 \pi^0$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                                                                                                                               |    |                     |          |                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---------------------|----------|-----------------------------------------------------------------|
| <6.1                                                                                                                                                          | 90 | <sup>2</sup> BESSON | 07A CLEO | $e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma \eta \eta$ |
| <sup>1</sup> Using $B(f_0(1500) \rightarrow \pi^0 \pi^0) = B(f_0(1500) \rightarrow \pi \pi)/3$ and $B(f_0(1500) \rightarrow \pi \pi) = (0.349 \pm 0.023)\%$ . |    |                     |          |                                                                 |

<sup>2</sup> Calculated by us using  $B(f_0(1500) \rightarrow \eta \eta) = (5.1 \pm 0.9)\%$ .

NODE=M049R44  
NODE=M049R44

OCCUR=2

NODE=M049R44;LINKAGE=BE

NODE=M049R44;LINKAGE=BS

 $\Gamma(\gamma f_0(1500) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )  | DOCUMENT ID       | TECN     | COMMENT                                                       |
|---------------------------|-------------------|----------|---------------------------------------------------------------|
| <b>1.04 ± 0.14 ± 0.33</b> | <sup>1</sup> LEES | 18A BABR | $e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma K^+ K^-$ |

<sup>1</sup> LEES 18A quotes  $B(\Upsilon(1S) \rightarrow \gamma f_0(1500) \rightarrow \gamma K \bar{K}) = (2.08 \pm 0.27 \pm 0.65) \times 10^{-5}$  assuming  $B(K^0 \bar{K}^0) = 1/2 B(K \bar{K})$ .

NODE=M049P29  
NODE=M049P29

NODE=M049P29;LINKAGE=A

 $\Gamma(\gamma f_0(1710))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID           | TECN   | COMMENT                                   |
|--------------------------|-----|-----------------------|--------|-------------------------------------------|
| <b>&lt; 2.6</b>          | 90  | <sup>1</sup> ALBRECHT | 89 ARG | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                       |          |                                               |
|-------|----|-----------------------|----------|-----------------------------------------------|
| < 6.3 | 90 | <sup>1</sup> FULTON   | 90B CLEO | $\Upsilon(1S) \rightarrow \gamma K^+ K^-$     |
| <19   | 90 | <sup>1</sup> FULTON   | 90B CLEO | $\Upsilon(1S) \rightarrow \gamma K_S^0 K_S^0$ |
| < 8   | 90 | <sup>2</sup> ALBRECHT | 89 ARG   | $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ |
| <24   | 90 | <sup>3</sup> SCHMITT  | 88 CBAL  | $\Upsilon(1S) \rightarrow \gamma X$           |

<sup>1</sup> Assuming  $B(f_0(1710) \rightarrow K \bar{K}) = 0.38$ .

<sup>2</sup> Assuming  $B(f_0(1710) \rightarrow \pi \pi) = 0.04$ .

<sup>3</sup> Assuming  $B(f_0(1710) \rightarrow \eta \eta) = 0.18$ .

NODE=M049R53  
NODE=M049R53

OCCUR=2

OCCUR=2

NODE=M049R53;LINKAGE=E

NODE=M049R53;LINKAGE=F

NODE=M049R53;LINKAGE=A

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )  | CL% | DOCUMENT ID       | TECN     | COMMENT                                                       |
|---------------------------|-----|-------------------|----------|---------------------------------------------------------------|
| <b>1.01 ± 0.26 ± 0.18</b> |     | <sup>1</sup> LEES | 18A BABR | $e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma K^+ K^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                                                                                                                                                                                     |    |       |         |                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-------|---------|---------------------------------------------------------------|
| <0.7                                                                                                                                                                                                | 90 | ATHAR | 06 CLEO | $e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma K^+ K^-$ |
| <sup>1</sup> LEES 18A quotes $B(\Upsilon(1S) \rightarrow \gamma f_0(1710) \rightarrow \gamma K \bar{K}) = (2.02 \pm 0.51 \pm 0.35) \times 10^{-5}$ assuming $B(K^0 \bar{K}^0) = 1/2 B(K \bar{K})$ . |    |       |         |                                                               |

NODE=M049R50  
NODE=M049R50

NODE=M049R50;LINKAGE=A

$\Gamma(\gamma f_0(1710) \rightarrow \gamma \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{101}/\Gamma$ VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

**0.53 ± 0.17 ± 0.11**<sup>1</sup>

LEES

18A

BABR

 $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ 

<sup>1</sup> LEES 18A quotes  $B(\Upsilon(1S) \rightarrow \gamma f_0(1710) \rightarrow \gamma \pi \pi) = (0.79 \pm 0.26 \pm 0.17) \times 10^{-5}$  assuming  $B(\pi^0 \pi^0) = 1/3 B(\pi \pi)$ .

NODE=M049P28  
NODE=M049P28

NODE=M049P28;LINKAGE=A

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma \pi^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{102}/\Gamma$ VALUE (units  $10^{-6}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**<1.4**

90

BESSON

07A

CLEO

 $e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma \pi^0 \pi^0$ 

NODE=M049R45  
NODE=M049R45

 $\Gamma(\gamma f_0(1710) \rightarrow \gamma \eta \eta)/\Gamma_{\text{total}}$  $\Gamma_{103}/\Gamma$ VALUE (units  $10^{-6}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**<1.8**

90

BESSON

07A

CLEO

 $e^+ e^- \rightarrow \Upsilon(1S) \rightarrow \gamma \eta \eta$ 

NODE=M049R46  
NODE=M049R46

 $\Gamma(\gamma f_4(2050))/\Gamma_{\text{total}}$  $\Gamma_{104}/\Gamma$ VALUE (units  $10^{-5}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**<5.3**

90

<sup>1</sup>

ATHAR

06

CLE3

 $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ 

<sup>1</sup> Assuming  $B(f_4(2050) \rightarrow \pi \pi) = 0.17$ .

NODE=M049R30  
NODE=M049R30

NODE=M049R30;LINKAGE=AT

 $\Gamma(\gamma f_0(2200) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{105}/\Gamma$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<0.0002**

90

BARU

89

MD1

 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ 

NODE=M049R63  
NODE=M049R63

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{106}/\Gamma$ VALUE (units  $10^{-7}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**< 8**

90

ATHAR

06

CLE3

 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt; 160

90

MASEK

02

CLEO

 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ 

&lt; 150

90

FULTON

90B

CLEO

 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ 

&lt; 290

90

ALBRECHT

89

ARG

 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ 

&lt;2000

90

BARU

89

MD1

 $\Upsilon(1S) \rightarrow \gamma K^+ K^-$ 

NODE=M049R56  
NODE=M049R56

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma \pi^+ \pi^-)/\Gamma_{\text{total}}$  $\Gamma_{107}/\Gamma$ VALUE (units  $10^{-7}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**< 6**

90

ATHAR

06

CLE3

 $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt;120

90

MASEK

02

CLEO

 $\Upsilon(1S) \rightarrow \gamma \pi^+ \pi^-$ 

NODE=M049R41  
NODE=M049R41

 $\Gamma(\gamma f_J(2220) \rightarrow \gamma p \bar{p})/\Gamma_{\text{total}}$  $\Gamma_{108}/\Gamma$ VALUE (units  $10^{-7}$ )

CL%

DOCUMENT ID

TECN

COMMENT

**< 11**

90

ATHAR

06

CLE3

 $\Upsilon(1S) \rightarrow \gamma p \bar{p}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

&lt;160

90

MASEK

02

CLEO

 $\Upsilon(1S) \rightarrow \gamma p \bar{p}$ 

NODE=M049R42  
NODE=M049R42

 $\Gamma(\gamma \eta(2225) \rightarrow \gamma \phi \phi)/\Gamma_{\text{total}}$  $\Gamma_{109}/\Gamma$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<0.003**

90

BARU

89

MD1

 $\Upsilon(1S) \rightarrow \gamma K^+ K^- K^+ K^-$ 

NODE=M049R62  
NODE=M049R62

 $\Gamma(\gamma \eta_c(1S))/\Gamma_{\text{total}}$  $\Gamma_{110}/\Gamma$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<2.9 × 10<sup>-5</sup> (CL = 90%)** [ $<5.7 \times 10^{-5}$  (CL = 90%) OUR 2020 BEST LIMIT]**<2.9 × 10<sup>-5</sup>**

90

<sup>1</sup>

KATRENKO

20

BELL

 $e^+ e^- \rightarrow \gamma + \text{hadrons}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

<5.7 × 10<sup>-5</sup>

90

SHEN

10A

BELL

 $\Upsilon(1S) \rightarrow \gamma X$ 

<sup>1</sup> Using  $\Upsilon(2S) \rightarrow \Upsilon(1S) \pi^+ \pi^-$  decays.

NODE=M049R38  
NODE=M049R38

NODE=M049R38;LINKAGE=A

 $\Gamma(\gamma \eta_c(2S))/\Gamma_{\text{total}}$  $\Gamma_{111}/\Gamma$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<4 × 10<sup>-4</sup>**

90

<sup>1</sup>

KATRENKO

20

BELL

 $e^+ e^- \rightarrow \gamma + \text{hadrons}$ 

<sup>1</sup> Using  $\Upsilon(2S) \rightarrow \Upsilon(1S) \pi^+ \pi^-$  decays.

NODE=M049P30  
NODE=M049P30

NODE=M049P30;LINKAGE=A

$\Gamma(\gamma\chi_{c0})/\Gamma_{\text{total}}$  $\Gamma_{112}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID                                             | TECN | COMMENT                                                 |
|-------------------------------------------------------------------------------|-----|---------------------------------------------------------|------|---------------------------------------------------------|
| $<6.6 \times 10^{-5}$ (CL = 90%)                                              |     | [ $<6.5 \times 10^{-4}$ (CL = 90%) OUR 2020 BEST LIMIT] |      |                                                         |
| $<6.6 \times 10^{-5}$                                                         | 90  | <sup>1</sup> KATRENKO                                   | 20   | BELL $\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                                                         |      |                                                         |
| $<6.5 \times 10^{-4}$                                                         | 90  | SHEN                                                    | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$                |
| <sup>1</sup> Using $\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-$ decays.  |     |                                                         |      |                                                         |

NODE=M049R39  
 NODE=M049R39

NODE=M049R39;LINKAGE=A

 $\Gamma(\gamma\chi_{c1})/\Gamma_{\text{total}}$  $\Gamma_{113}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                      | CL% | EVTS | DOCUMENT ID           | TECN | COMMENT                                                 |
|-------------------------------------------------------------------------------|-----|------|-----------------------|------|---------------------------------------------------------|
| $4.7^{+2.4+0.4}_{-1.8-0.5}$                                                   |     | 5    | <sup>1</sup> KATRENKO | 20   | BELL $\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |      |                       |      |                                                         |
| <2.3                                                                          | 90  |      | SHEN                  | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$                |
| <sup>1</sup> Using $\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-$ decays.  |     |      |                       |      |                                                         |

NODE=M049R40  
 NODE=M049R40

NODE=M049R40;LINKAGE=A

 $\Gamma(\gamma\chi_{c2})/\Gamma_{\text{total}}$  $\Gamma_{114}/\Gamma$ 

| VALUE                                                                         | CL% | DOCUMENT ID                                             | TECN | COMMENT                                                 |
|-------------------------------------------------------------------------------|-----|---------------------------------------------------------|------|---------------------------------------------------------|
| $<7.6 \times 10^{-6}$ (CL = 90%)                                              |     | [ $<7.6 \times 10^{-6}$ (CL = 90%) OUR 2020 BEST LIMIT] |      |                                                         |
| $<7.6 \times 10^{-6}$                                                         | 90  | SHEN                                                    | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$                |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                                                         |      |                                                         |
| $<3.3 \times 10^{-5}$                                                         | 90  | <sup>1</sup> KATRENKO                                   | 20   | BELL $\Upsilon(1S) \rightarrow \gamma + \text{hadrons}$ |
| <sup>1</sup> Using $\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-$ decays.  |     |                                                         |      |                                                         |

NODE=M049R48  
 NODE=M049R48

NODE=M049R48;LINKAGE=A

 $\Gamma(\gamma\chi_{c1}(3872))/\Gamma_{\text{total}}$  $\Gamma_{115}/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                                             | CL% | DOCUMENT ID       | TECN | COMMENT                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------------|------|------------------------------------------|
| $<5 \times 10^{-5}$                                                                                                                                                                                                                                                                                               | 90  | <sup>1</sup> SHEN | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |
| <sup>1</sup> SHEN 10A reports $[\Gamma(\Upsilon(1S) \rightarrow \gamma\chi_{c1}(3872))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \pi^+\pi^- J/\psi(1S))] < 1.6 \times 10^{-6}$ which we divide by our best value $B(\chi_{c1}(3872) \rightarrow \pi^+\pi^- J/\psi(1S)) = 3.4 \times 10^{-2}$ . |     |                   |      |                                          |

NODE=M049P32  
 NODE=M049P32

NODE=M049P32;LINKAGE=A

 $\Gamma(\gamma\chi_{c1}(3872), \chi_{c1} \rightarrow \pi^+\pi^-\pi^0 J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{116}/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID                                             | TECN | COMMENT                                  |
|----------------------------------|-----|---------------------------------------------------------|------|------------------------------------------|
| $<2.8 \times 10^{-6}$ (CL = 90%) |     | [ $<2.8 \times 10^{-6}$ (CL = 90%) OUR 2020 BEST LIMIT] |      |                                          |
| $<2.8 \times 10^{-6}$            | 90  | SHEN                                                    | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R68  
 NODE=M049R68

 $\Gamma(\gamma X(3915) \rightarrow \omega J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{117}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|--------------------------|-----|-------------|------|------------------------------------------|
| $<3.0$                   | 90  | SHEN        | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R69  
 NODE=M049R69

 $\Gamma(\gamma\chi_{c1}(4140) \rightarrow \phi J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{118}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|--------------------------|-----|-------------|------|------------------------------------------|
| $<2.2$                   | 90  | SHEN        | 10A  | BELL $\Upsilon(1S) \rightarrow \gamma X$ |

NODE=M049R74  
 NODE=M049R74

 $\Gamma(\gamma X)/\Gamma_{\text{total}}$  $\Gamma_{119}/\Gamma$ 

| (X = scalar with $m < 8.0$ GeV)                                               |     |                              |      |                                      |
|-------------------------------------------------------------------------------|-----|------------------------------|------|--------------------------------------|
| VALUE (units $10^{-6}$ )                                                      | CL% | DOCUMENT ID                  | TECN | COMMENT                              |
| $< 4.5$                                                                       | 90  | <sup>1</sup> DEL-AMO-SA..11J | BABR | $e^+e^- \rightarrow \gamma + X$      |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                              |      |                                      |
| <30                                                                           | 90  | <sup>2</sup> BALEST          | 95   | CLEO $e^+e^- \rightarrow \gamma + X$ |
| <sup>1</sup> For a noninteracting scalar X with mass $m < 8.0$ GeV.           |     |                              |      |                                      |
| <sup>2</sup> For a noninteracting pseudoscalar X with mass $< 7.2$ GeV.       |     |                              |      |                                      |

NODE=M049R60  
 NODE=M049R60  
 NODE=M049R60

NODE=M049R60;LINKAGE=DA  
 NODE=M049R60;LINKAGE=A

 $\Gamma(\gamma X \bar{X}(m_X < 3.1 \text{ GeV}))/\Gamma_{\text{total}}$  $\Gamma_{120}/\Gamma$ 

| (X $\bar{X}$ = vectors with $m < 3.1$ GeV)                        |     |                     |      |                                              |
|-------------------------------------------------------------------|-----|---------------------|------|----------------------------------------------|
| VALUE (units $10^{-3}$ )                                          | CL% | DOCUMENT ID         | TECN | COMMENT                                      |
| $<1$                                                              | 90  | <sup>1</sup> BALEST | 95   | CLEO $e^+e^- \rightarrow \gamma + X \bar{X}$ |
| <sup>1</sup> For a noninteracting vector X with mass $< 3.1$ GeV. |     |                     |      |                                              |

NODE=M049R61  
 NODE=M049R61  
 NODE=M049R61

NODE=M049R61;LINKAGE=A

$\Gamma(\gamma X \bar{X} (m_X < 4.5 \text{ GeV}))/\Gamma_{\text{total}}$  $X$  and  $\bar{X}$  = zero spin with  $m < 4.5 \text{ GeV}$  $\Gamma_{121}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID                  | TECN | COMMENT                                 |
|--------------------------|-----|------------------------------|------|-----------------------------------------|
| <b>&lt;24</b>            | 90  | <sup>1</sup> DEL-AMO-SA..11J | BABR | $e^+e^- \rightarrow \gamma + X \bar{X}$ |

<sup>1</sup> For a noninteracting scalar  $X$  with mass  $m < 4.5 \text{ GeV}$ .

NODE=M049R01

NODE=M049R01  
NODE=M049R01

NODE=M049R01;LINKAGE=DA

 $\Gamma(\gamma X \rightarrow \gamma + \geq 4 \text{ prongs})/\Gamma_{\text{total}}$  $(1.5 \text{ GeV} < m_X < 5.0 \text{ GeV})$  $\Gamma_{122}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                       |
|--------------------------|-----|-------------|----------|-------------------------------|
| <b>&lt;1.78</b>          | 95  | ROSNER      | 07A CLEO | $e^+e^- \rightarrow \gamma X$ |

NODE=M049R64

NODE=M049R64  
NODE=M049R64 $\Gamma(\gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-)/\Gamma_{\text{total}}$  $(201 < M(\mu^+ \mu^-) < 3565 \text{ MeV})$  $\Gamma_{123}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID       | TECN    | COMMENT                                                          |
|--------------------------|-----|-------------------|---------|------------------------------------------------------------------|
| <b>&lt;9</b>             | 90  | <sup>1</sup> LOVE | 08 CLEO | $e^+e^- \rightarrow \gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                   |          |                                                                  |
|------|----|-------------------|----------|------------------------------------------------------------------|
| <9.7 | 90 | <sup>2</sup> LEES | 13C BABR | $e^+e^- \rightarrow \gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-$ |
|------|----|-------------------|----------|------------------------------------------------------------------|

<sup>1</sup> For a narrow scalar or pseudoscalar  $a_1^0$  with  $201 < M(\mu^+ \mu^-) < 3565 \text{ MeV}$ , excluding  $J/\psi$ . Measured 90% CL limits as a function of  $M(\mu^+ \mu^-)$  range from  $1-9 \times 10^{-6}$ .<sup>2</sup> For a narrow scalar or pseudoscalar  $a_1^0$  with mass in the range 212–9200 MeV, excluding  $J/\psi$  and  $\psi(2S)$ . Measured 90% CL limits as a function of  $m_{a_1^0}$  range from  $0.28-9.7 \times 10^{-6}$ .

NODE=M049R65

NODE=M049R65  
NODE=M049R65

NODE=M049R65;LINKAGE=LO

NODE=M049R65;LINKAGE=LE

 $\Gamma(\gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-)/\Gamma_{\text{total}}$  $(2m_\tau < M(\tau^+ \tau^-) < 9.2 \text{ GeV})$  $\Gamma_{124}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID       | TECN     | COMMENT                                                     |
|--------------------------|-----|-------------------|----------|-------------------------------------------------------------|
| <b>&lt;130</b>           | 90  | <sup>1</sup> LEES | 13R BABR | $\Upsilon(2S) \rightarrow \gamma \tau^+ \tau^- \pi^+ \pi^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                   |         |                                                                    |
|------|----|-------------------|---------|--------------------------------------------------------------------|
| < 50 | 90 | <sup>2</sup> LOVE | 08 CLEO | $e^+e^- \rightarrow \gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-$ |
|------|----|-------------------|---------|--------------------------------------------------------------------|

<sup>1</sup> For a narrow scalar  $a_1^0$  with  $2m_\tau < M(a_1^0) < 9.2 \text{ GeV}$ , which result in a 90% CL upper limits of  $0.9 \times 10^{-5}$  at  $M(a_1^0) = 2m_\tau$ ,  $\approx 1.5 \times 10^{-5}$  at  $M(a_1^0) = 7.5 \text{ GeV}$ , and  $13 \times 10^{-5}$  at  $M(a_1^0) = 9.2 \text{ GeV}$ .<sup>2</sup> For a narrow scalar or pseudoscalar  $a_1^0$  with  $2m_\tau < M(a_1^0) < 7.5 \text{ GeV}$ , which result in a 90% CL limits ranging from  $1 \times 10^{-5}$  at  $M(a_1^0)=2m_\tau$  to  $5 \times 10^{-5}$  at  $M(a_1^0)=7.5 \text{ GeV}$ .

NODE=M049R66

NODE=M049R66  
NODE=M049R66

NODE=M049R66;LINKAGE=A

NODE=M049R66;LINKAGE=LO

 $\Gamma(\gamma a_1^0 \rightarrow \gamma g g)/\Gamma_{\text{total}}$  $(0.5 \text{ GeV} < m < 9.0 \text{ GeV})$  $\Gamma_{125}/\Gamma$ 

| VALUE                                    | CL% | DOCUMENT ID       | TECN     | COMMENT                             |
|------------------------------------------|-----|-------------------|----------|-------------------------------------|
| <b>&lt;1 <math>\times 10^{-2}</math></b> | 90  | <sup>1</sup> LEES | 13L BABR | $\Upsilon(1S) \rightarrow \gamma X$ |

<sup>1</sup> For a narrow,  $CP$ -odd pseudoscalar  $a_1^0$  searched for in 26 hadronic decay modes with invariant mass  $0.5 \text{ GeV} < m_X < 9.0 \text{ GeV}$ . Measured 90% CL limit as a function of  $m_X$  range from  $10^{-6}$  to  $10^{-2}$ .

NODE=M049R03

NODE=M049R03  
NODE=M049R03

NODE=M049R03;LINKAGE=A

 $\Gamma(\gamma a_1^0 \rightarrow \gamma s \bar{s})/\Gamma_{\text{total}}$  $(0.5 \text{ GeV} < m < 9.0 \text{ GeV})$  $\Gamma_{126}/\Gamma$ 

| VALUE                                    | CL% | DOCUMENT ID       | TECN     | COMMENT                             |
|------------------------------------------|-----|-------------------|----------|-------------------------------------|
| <b>&lt;1 <math>\times 10^{-3}</math></b> | 90  | <sup>1</sup> LEES | 13L BABR | $\Upsilon(1S) \rightarrow \gamma X$ |

<sup>1</sup> For a narrow,  $CP$ -odd pseudoscalar  $a_1^0$  searched for in 14 hadronic decay modes with invariant mass  $1.5 \text{ GeV} < m_X < 9.0 \text{ GeV}$ . Measured 90% CL limit as a function of  $m_X$  range from  $10^{-5}$  to  $10^{-3}$ .

NODE=M049R04

NODE=M049R04  
NODE=M049R04

NODE=M049R04;LINKAGE=A

LEPTON FAMILY NUMBER ( $LF$ ) VIOLATING MODES

NODE=M049230

 $\Gamma(\mu^\pm \tau^\mp)/\Gamma_{\text{total}}$  $\Gamma_{127}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                               |
|--------------------------|-----|-------------|----------|---------------------------------------|
| <b>&lt;6.0</b>           | 95  | LOVE        | 08A CLEO | $e^+e^- \rightarrow \mu^\pm \tau^\mp$ |

NODE=M049R67

NODE=M049R67

## OTHER DECAYS

 $\Gamma(\text{invisible})/\Gamma_{\text{total}}$  $\Gamma_{128}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | DOCUMENT ID | TECN      | COMMENT                                             |
|-------------------------------------------------------------------------------|-----|-------------|-----------|-----------------------------------------------------|
| <b>&lt; 3.0</b>                                                               | 90  | AUBERT      | 09AX BABR | $\Upsilon(3S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |           |                                                     |
| <39                                                                           | 90  | RUBIN       | 07 CLEO   | $\Upsilon(2S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$ |
| <25                                                                           | 90  | TAJIMA      | 07 BELL   | $\Upsilon(3S) \rightarrow \pi^+ \pi^- \Upsilon(1S)$ |

NODE=M049235

NODE=M049R10  
NODE=M049R10 $\Upsilon(1S)$  REFERENCES

NODE=M049

|                                                             |      |                         |                                  |                              |
|-------------------------------------------------------------|------|-------------------------|----------------------------------|------------------------------|
| KATRENKO                                                    | 20   | PRL 124 122001          | P. Katrenko <i>et al.</i>        | (BELLE Collab.)              |
| JIA                                                         | 18   | PR D97 112004           | S. Jia <i>et al.</i>             | (BELLE Collab.)              |
| LEES                                                        | 18A  | PR D97 112006           | J.P. Lees <i>et al.</i>          | (BABAR Collab.)              |
| JIA                                                         | 17   | PR D95 012001           | S. Jia <i>et al.</i>             | (BELLE Collab.)              |
| JIA                                                         | 17A  | PR D96 112002           | S. Jia <i>et al.</i>             | (BELLE Collab.)              |
| SHEN                                                        | 16   | PR D93 112013           | C.P. Shen <i>et al.</i>          | (BELLE Collab.)              |
| LEES                                                        | 14G  | PR D89 111102           | J.P. Lees <i>et al.</i>          | (BABAR Collab.)              |
| YANG                                                        | 14   | PR D90 112008           | S.D. Yang <i>et al.</i>          | (BELLE Collab.)              |
| LEES                                                        | 13C  | PR D87 031102           | J.P. Lees <i>et al.</i>          | (BABAR Collab.)              |
| LEES                                                        | 13L  | PR D88 031701           | J.P. Lees <i>et al.</i>          | (BABAR Collab.)              |
| LEES                                                        | 13R  | PR D88 071102           | J.P. Lees <i>et al.</i>          | (BABAR Collab.)              |
| SHEN                                                        | 13   | PR D88 011102           | C.P. Shen <i>et al.</i>          | (BELLE Collab.)              |
| DOBBS                                                       | 12A  | PR D86 052003           | S. Dobbs <i>et al.</i>           |                              |
| SHEN                                                        | 12A  | PR D86 031102           | C.P. Shen <i>et al.</i>          | (BELLE Collab.)              |
| BESSION                                                     | 11   | PR D83 037101           | D. Besson <i>et al.</i>          | (CLEO Collab.)               |
| DEL-AMO-SA...                                               | 11J  | PRL 107 021804          | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)              |
| AUBERT                                                      | 10C  | PR D81 011102           | B. Aubert <i>et al.</i>          | (BABAR Collab.)              |
| DEL-AMO-SA...                                               | 10C  | PRL 104 191801          | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.)              |
| SHEN                                                        | 10A  | PR D82 051504           | C.P. Shen <i>et al.</i>          | (BELLE Collab.)              |
| AUBERT                                                      | 09AX | PRL 103 251801          | B. Aubert <i>et al.</i>          | (BABAR Collab.)              |
| LOVE                                                        | 08   | PRL 101 151802          | W. Love <i>et al.</i>            | (CLEO Collab.)               |
| LOVE                                                        | 08A  | PRL 101 201601          | W. Love <i>et al.</i>            | (CLEO Collab.)               |
| PDG                                                         | 08   | PL B667 1               | C. Amsler <i>et al.</i>          | (PDG Collab.)                |
| ASNER                                                       | 07   | PR D75 012009           | D.M. Asner <i>et al.</i>         | (CLEO Collab.)               |
| ATHAR                                                       | 07A  | PR D76 072003           | S.B. Athar <i>et al.</i>         | (CLEO Collab.)               |
| BESSION                                                     | 07   | PRL 98 052002           | D. Besson <i>et al.</i>          | (CLEO Collab.)               |
| BESSION                                                     | 07A  | PR D75 072001           | D. Besson <i>et al.</i>          | (CLEO Collab.)               |
| ROSNER                                                      | 07A  | PR D76 117102           | J.L. Rosner <i>et al.</i>        | (CLEO Collab.)               |
| RUBIN                                                       | 07   | PR D75 031104           | P. Rubin <i>et al.</i>           | (CLEO Collab.)               |
| TAJIMA                                                      | 07   | PRL 98 132001           | O. Tajima <i>et al.</i>          | (BELLE Collab.)              |
| AQUINES                                                     | 06A  | PR D74 092006           | O. Aquines <i>et al.</i>         | (CLEO Collab.)               |
| ATHAR                                                       | 06   | PR D73 032001           | S.B. Athar <i>et al.</i>         | (CLEO Collab.)               |
| BESSION                                                     | 06A  | PR D74 012003           | D. Besson <i>et al.</i>          | (CLEO Collab.)               |
| ROSNER                                                      | 06   | PRL 96 092003           | J.L. Rosner <i>et al.</i>        | (CLEO Collab.)               |
| ADAMS                                                       | 05   | PRL 94 012001           | G.S. Adams <i>et al.</i>         | (CLEO Collab.)               |
| BRIERE                                                      | 04   | PR D70 072001           | R.A. Briere <i>et al.</i>        | (CLEO Collab.)               |
| ARTUSO                                                      | 03   | PR D67 052003           | M. Artuso <i>et al.</i>          | (CLEO Collab.)               |
| MASEK                                                       | 02   | PR D65 072002           | G. Masek <i>et al.</i>           | (CLEO Collab.)               |
| RICHICHI                                                    | 01B  | PRL 87 141801           | S.J. Richichi <i>et al.</i>      | (CLEO Collab.)               |
| ARTAMONOV                                                   | 00   | PL B474 427             | A.S. Artamonov <i>et al.</i>     |                              |
| ANASTASSOV                                                  | 99   | PRL 82 286              | A. Anastassov <i>et al.</i>      | (CLEO Collab.)               |
| ALEXANDER                                                   | 98   | PR D58 052004           | J.P. Alexander <i>et al.</i>     | (CLEO Collab.)               |
| BARU                                                        | 96   | PRPL 267 71             | S.E. Baru <i>et al.</i>          | (NOVO)                       |
| BALEST                                                      | 95   | PR D51 2053             | R. Balest <i>et al.</i>          | (CLEO Collab.)               |
| CINABRO                                                     | 94B  | PL B340 129             | D. Cinabro <i>et al.</i>         | (CLEO Collab.)               |
| ALBRECHT                                                    | 92J  | ZPHY C55 25             | H. Albrecht <i>et al.</i>        | (ARGUS Collab.)              |
| BARU                                                        | 92   | ZPHY C54 229            | S.E. Baru <i>et al.</i>          | (NOVO)                       |
| BARU                                                        | 92B  | ZPHY C56 547            | S.E. Baru <i>et al.</i>          | (NOVO)                       |
| KOBEL                                                       | 92   | ZPHY C53 193            | M. Kobel <i>et al.</i>           | (Crystal Ball Collab.)       |
| BLINOV                                                      | 90   | PL B245 311             | A.E. Blinov <i>et al.</i>        | (NOVO)                       |
| FULTON                                                      | 90B  | PR D41 1401             | R. Fulton <i>et al.</i>          | (CLEO Collab.)               |
| MASCHMANN                                                   | 90   | ZPHY C46 555            | W.S. Maschmann <i>et al.</i>     | (Crystal Ball Collab.)       |
| ALBRECHT                                                    | 89   | ZPHY C42 349            | H. Albrecht <i>et al.</i>        | (ARGUS Collab.)              |
| ALEXANDER                                                   | 89   | NP B320 45              | J.P. Alexander <i>et al.</i>     | (LBL, MICH, SLAC)            |
| BARU                                                        | 89   | ZPHY C42 505            | S.E. Baru <i>et al.</i>          | (NOVO)                       |
| CHEN                                                        | 89B  | PR D39 3528             | W.Y. Chen <i>et al.</i>          | (CLEO Collab.)               |
| FULTON                                                      | 89   | PL B224 445             | R. Fulton <i>et al.</i>          | (CLEO Collab.)               |
| KAARSBERG                                                   | 89   | PRL 62 2077             | T.M. Kaarsberg <i>et al.</i>     | (CUSB Collab.)               |
| BUCHMUEL...                                                 | 88   | HE $e^+e^-$ Physics 412 | W. Buchmueller, S. Cooper        | (HANN, DESY, MIT)            |
| Editors: A. Ali and P. Soeding, World Scientific, Singapore |      |                         |                                  |                              |
| JAKUBOWSKI                                                  | 88   | ZPHY C40 49             | Z. Jakubowski <i>et al.</i>      | (Crystal Ball Collab.) IGJPC |
| SCHMITT                                                     | 88   | ZPHY C40 199            | P. Schmitt <i>et al.</i>         | (Crystal Ball Collab.)       |
| ALBRECHT                                                    | 87   | ZPHY C35 283            | H. Albrecht <i>et al.</i>        | (ARGUS Collab.)              |
| COHEN                                                       | 87   | RMP 59 1121             | E.R. Cohen, B.N. Taylor          | (RISC, NBS)                  |
| BARU                                                        | 86   | ZPHY C30 551            | S.E. Baru <i>et al.</i>          | (NOVO)                       |
| ALBRECHT                                                    | 85C  | PL 154B 452             | H. Albrecht <i>et al.</i>        | (ARGUS Collab.)              |
| KURAEV                                                      | 85   | SJNP 41 466             | E.A. Kuraev, V.S. Fadin          | (NOVO)                       |
| Translated from YAF 41 733.                                 |      |                         |                                  |                              |
| ARTAMONOV                                                   | 84   | PL 137B 272             | A.S. Artamonov <i>et al.</i>     | (NOVO)                       |
| BESSION                                                     | 84   | PR D30 1433             | D. Besson <i>et al.</i>          | (CLEO Collab.)               |
| GILES                                                       | 84B  | PR D29 1285             | R. Giles <i>et al.</i>           | (CLEO Collab.)               |
| MACKAY                                                      | 84   | PR D29 2483             | W.W. MacKay <i>et al.</i>        | (CUSB Collab.)               |
| ANDREWS                                                     | 83   | PRL 50 807              | D.E. Andrews <i>et al.</i>       | (CLEO Collab.)               |
| GILES                                                       | 83   | PRL 50 877              | R. Giles <i>et al.</i>           | (HARV, OSU, ROCH, RUTG+)     |
| NICZYPORUK                                                  | 83   | ZPHY C17 197            | B. Niczyporuk <i>et al.</i>      | (LENA Collab.)               |
| ALBRECHT                                                    | 82   | PL 116B 383             | H. Albrecht <i>et al.</i>        | (DESY, DORT, HEIDH+)         |
| ARTAMONOV                                                   | 82   | PL 118B 225             | A.S. Artamonov <i>et al.</i>     | (NOVO)                       |
| NICZYPORUK                                                  | 82   | ZPHY C15 299            | B. Niczyporuk <i>et al.</i>      | (LENA Collab.)               |
| BERGER                                                      | 80C  | PL 93B 497              | C. Berger <i>et al.</i>          | (PLUTO Collab.)              |
| BOCK                                                        | 80   | ZPHY C6 125             | P. Bock <i>et al.</i>            | (HEIDP, MPIM, DESY, HAMB)    |
| BERGER                                                      | 79   | ZPHY C1 343             | C. Berger <i>et al.</i>          | (PLUTO Collab.)              |

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REFID=22271

REFID=22272

REFID=22263

REFID=22264

REFID=22259

$\chi_{b0}(1P)$ 

$$J^G(J^{PC}) = 0^+(0^{++})$$

$J$  needs confirmation.

Observed in radiative decay of the  $\Upsilon(2S)$ , therefore  $C = +$ . Branching ratio requires E1 transition, M1 is strongly disfavored, therefore  $P = +$ .

NODE=M076

NODE=M076

 $\chi_{b0}(1P)$  MASS

VALUE (MeV)

DOCUMENT ID

**9859.44 ± 0.42 ± 0.31 OUR EVALUATION** From average  $\gamma$  energy below, using  $\Upsilon(2S)$   
mass = 10023.26 ± 0.31 MeV

NODE=M076M

NODE=M076M

→ UNCHECKED ←

 $m_{\chi_{b1}(1P)} - m_{\chi_{b0}(1P)}$ 

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

**32.49 ± 0.93**

LEES

14M

BABR

 $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ 

NODE=M076M2

NODE=M076M2

 $\gamma$  ENERGY IN  $\Upsilon(2S)$  DECAY

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

**162.5 ± 0.4 OUR AVERAGE**

162.56 ± 0.19 ± 0.42

162.0 ± 0.8 ± 1.2

162.1 ± 0.5 ± 1.4

163.8 ± 1.6 ± 2.7

158.0 ± 7 ± 1

• • • We do not use the following data for averages, fits, limits, etc. • • •

149.4 ± 0.7 ± 5.0

KLOPFEN...

83

CUSB

 $\Upsilon(2S) \rightarrow \gamma X$ 

NODE=M076DM

NODE=M076DM

 $\chi_{b0}(1P)$  DECAY MODES

| Mode                                              | Fraction ( $\Gamma_i/\Gamma$ )   | Confidence level |
|---------------------------------------------------|----------------------------------|------------------|
| $\Gamma_1 \quad \gamma \Upsilon(1S)$              | ( 1.94 ± 0.27 ) %                |                  |
| $\Gamma_2 \quad D^0 X$                            | < 10.4 %                         | 90%              |
| $\Gamma_3 \quad \pi^+ \pi^- K^+ K^- \pi^0$        | < 1.6 × 10 <sup>-4</sup>         | 90%              |
| $\Gamma_4 \quad 2\pi^+ \pi^- K^- K_S^0$           | < 5 × 10 <sup>-5</sup>           | 90%              |
| $\Gamma_5 \quad 2\pi^+ \pi^- K^- K_S^0 2\pi^0$    | < 5 × 10 <sup>-4</sup>           | 90%              |
| $\Gamma_6 \quad 2\pi^+ 2\pi^- 2\pi^0$             | < 2.1 × 10 <sup>-4</sup>         | 90%              |
| $\Gamma_7 \quad 2\pi^+ 2\pi^- K^+ K^-$            | ( 1.1 ± 0.6 ) × 10 <sup>-4</sup> |                  |
| $\Gamma_8 \quad 2\pi^+ 2\pi^- K^+ K^- \pi^0$      | < 2.7 × 10 <sup>-4</sup>         | 90%              |
| $\Gamma_9 \quad 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$     | < 5 × 10 <sup>-4</sup>           | 90%              |
| $\Gamma_{10} \quad 3\pi^+ 2\pi^- K^- K_S^0 \pi^0$ | < 1.6 × 10 <sup>-4</sup>         | 90%              |
| $\Gamma_{11} \quad 3\pi^+ 3\pi^-$                 | < 8 × 10 <sup>-5</sup>           | 90%              |
| $\Gamma_{12} \quad 3\pi^+ 3\pi^- 2\pi^0$          | < 6 × 10 <sup>-4</sup>           | 90%              |
| $\Gamma_{13} \quad 3\pi^+ 3\pi^- K^+ K^-$         | ( 2.4 ± 1.2 ) × 10 <sup>-4</sup> |                  |
| $\Gamma_{14} \quad 3\pi^+ 3\pi^- K^+ K^- \pi^0$   | < 1.0 × 10 <sup>-3</sup>         | 90%              |
| $\Gamma_{15} \quad 4\pi^+ 4\pi^-$                 | < 8 × 10 <sup>-5</sup>           | 90%              |
| $\Gamma_{16} \quad 4\pi^+ 4\pi^- 2\pi^0$          | < 2.1 × 10 <sup>-3</sup>         | 90%              |
| $\Gamma_{17} \quad J/\psi J/\psi$                 | < 7 × 10 <sup>-5</sup>           | 90%              |
| $\Gamma_{18} \quad J/\psi \psi(2S)$               | < 1.2 × 10 <sup>-4</sup>         | 90%              |
| $\Gamma_{19} \quad \psi(2S) \psi(2S)$             | < 3.1 × 10 <sup>-5</sup>         | 90%              |
| $\Gamma_{20} \quad J/\psi(1S) \text{ anything}$   | < 2.3 × 10 <sup>-3</sup>         | 90%              |

NODE=M076215;NODE=M076

DESIG=1

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=6

DESIG=7

DESIG=8

DESIG=9

DESIG=10

DESIG=11

DESIG=12

DESIG=13

DESIG=14

DESIG=15

DESIG=16

DESIG=17

DESIG=18

DESIG=19

DESIG=20

 $\chi_{b0}(1P)$  BRANCHING RATIOS $\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

VALUE (%)

CL% EVTS

DOCUMENT ID

TECN

COMMENT

**1.94 ± 0.27 OUR AVERAGE**

2.07 ± 0.24 ± 0.21

1.76 ± 0.30 ± 0.18

87

1,2 LEES

14M

BABR

 $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ 

3,4 KORNICER

11

CLEO

 $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$ 

NODE=M076220

NODE=M076R1

NODE=M076R1

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                   |     |      |                                                     |
|-------|----|-------------------|-----|------|-----------------------------------------------------|
| < 4.6 | 90 | <sup>5</sup> LEES | 11J | BABR | $\Upsilon(2S) \rightarrow X\gamma$                  |
| < 6   | 90 | WALK              | 86  | CBAL | $\Upsilon(2S) \rightarrow \gamma\gamma\ell^+\ell^-$ |
| <11   | 90 | PAUSS             | 83  | CUSB | $\Upsilon(2S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

<sup>1</sup> LEES 14M quotes  $\Gamma(\chi_{b0}(1P) \rightarrow \gamma\Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P))/\Gamma_{\text{total}}$   
 $= (7.75 \pm 0.91) \times 10^{-4}$  combining the results from samples of  $\Upsilon(2S) \rightarrow \gamma\gamma\mu^+\mu^-$   
 with and without converted photons. Assumes  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ .

<sup>2</sup> LEES 14M reports  $[\Gamma(\chi_{b0}(1P) \rightarrow \gamma\Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P))]$   
 $= (7.75 \pm 0.91) \times 10^{-4}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P)) =$   
 $(3.8 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is  
 the systematic error from using our best value.

<sup>3</sup> Assuming  $B(\Upsilon(1S) \rightarrow \ell^+\ell^-) = (2.48 \pm 0.05)\%$ .

<sup>4</sup> KORNICER 11 reports  $[\Gamma(\chi_{b0}(1P) \rightarrow \gamma\Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P))]$   
 $= (6.59 \pm 0.96 \pm 0.60) \times 10^{-4}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P)) =$   
 $(3.8 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is  
 the systematic error from using our best value.

<sup>5</sup> LEES 11J quotes a central value of  $\Gamma(\chi_{b0}(1P) \rightarrow \gamma\Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(2S) \rightarrow$   
 $\gamma\chi_{b0}(1P))/\Gamma_{\text{total}} = (8.3 \pm 5.6^{+3.7}_{-2.6}) \times 10^{-4}$ .

NODE=M076R1;LINKAGE=A

NODE=M076R1;LINKAGE=B

NODE=M076R1;LINKAGE=KA

NODE=M076R1;LINKAGE=KR

NODE=M076R1;LINKAGE=LE

**$\Gamma(D^0X)/\Gamma_{\text{total}}$**   **$\Gamma_2/\Gamma$**

| VALUE                             | CL% | DOCUMENT ID | TECN    | COMMENT                                |
|-----------------------------------|-----|-------------|---------|----------------------------------------|
| <b>&lt;10.4 × 10<sup>-2</sup></b> | 90  | 6,7 BRIERE  | 08 CLEO | $\Upsilon(2S) \rightarrow \gamma D^0X$ |

<sup>6</sup> For  $p_{D^0} > 2.5$  GeV/c.

<sup>7</sup> The authors also present their result as  $(5.6 \pm 3.6 \pm 0.5) \times 10^{-2}$ .

NODE=M076R01

NODE=M076R01

NODE=M076R01;LINKAGE=BR

NODE=M076R01;LINKAGE=RI

**$\Gamma(\pi^+\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}$**   **$\Gamma_3/\Gamma$**

| VALUE (units 10 <sup>-4</sup> ) | CL% | DOCUMENT ID        | TECN     | COMMENT                                                |
|---------------------------------|-----|--------------------|----------|--------------------------------------------------------|
| <b>&lt;1.6</b>                  | 90  | <sup>8</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma\pi^+\pi^-K^+K^-\pi^0$ |

<sup>8</sup> ASNER 08A reports  $[\Gamma(\chi_{b0}(1P) \rightarrow \pi^+\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow$   
 $\gamma\chi_{b0}(1P))]$  <  $6 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P)) =$   
 $3.8 \times 10^{-2}$ .

NODE=M076R02

NODE=M076R02

NODE=M076R02;LINKAGE=AS

**$\Gamma(2\pi^+\pi^-K^-K_S^0)/\Gamma_{\text{total}}$**   **$\Gamma_4/\Gamma$**

| VALUE (units 10 <sup>-4</sup> ) | CL% | DOCUMENT ID        | TECN     | COMMENT                                               |
|---------------------------------|-----|--------------------|----------|-------------------------------------------------------|
| <b>&lt;0.5</b>                  | 90  | <sup>9</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+\pi^-K^-K_S^0$ |

<sup>9</sup> ASNER 08A reports  $[\Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+\pi^-K^-K_S^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow$   
 $\gamma\chi_{b0}(1P))]$  <  $2 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P)) =$   
 $3.8 \times 10^{-2}$ .

NODE=M076R03

NODE=M076R03

NODE=M076R03;LINKAGE=AS

**$\Gamma(2\pi^+\pi^-K^-K_S^0 2\pi^0)/\Gamma_{\text{total}}$**   **$\Gamma_5/\Gamma$**

| VALUE (units 10 <sup>-4</sup> ) | CL% | DOCUMENT ID         | TECN     | COMMENT                                                |
|---------------------------------|-----|---------------------|----------|--------------------------------------------------------|
| <b>&lt;5</b>                    | 90  | <sup>10</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+\pi^-K^-2\pi^0$ |

<sup>10</sup> ASNER 08A reports  $[\Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+\pi^-K^-K_S^0 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow$   
 $\gamma\chi_{b0}(1P))]$  <  $18 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P)) =$   
 $3.8 \times 10^{-2}$ .

NODE=M076R04

NODE=M076R04

NODE=M076R04;LINKAGE=AS

**$\Gamma(2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}}$**   **$\Gamma_6/\Gamma$**

| VALUE (units 10 <sup>-4</sup> ) | CL% | DOCUMENT ID         | TECN     | COMMENT                                              |
|---------------------------------|-----|---------------------|----------|------------------------------------------------------|
| <b>&lt;2.1</b>                  | 90  | <sup>11</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-2\pi^0$ |

<sup>11</sup> ASNER 08A reports  $[\Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P))]$   
 <  $8 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b0}(1P)) = 3.8 \times 10^{-2}$ .

NODE=M076R05

NODE=M076R05

NODE=M076R05;LINKAGE=AS

**$\Gamma(2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}}$**   **$\Gamma_7/\Gamma$**

| VALUE (units 10 <sup>-4</sup> ) | EVTS | DOCUMENT ID         | TECN     | COMMENT                                              |
|---------------------------------|------|---------------------|----------|------------------------------------------------------|
| <b>1.1 ± 0.6 ± 0.1</b>          | 7    | <sup>12</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-$ |

<sup>12</sup> ASNER 08A reports  $[\Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow$   
 $\gamma\chi_{b0}(1P))]$  =  $(4 \pm 2 \pm 1) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow$   
 $\gamma\chi_{b0}(1P)) = (3.8 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our  
 second error is the systematic error from using our best value.

NODE=M076R06

NODE=M076R06

NODE=M076R06;LINKAGE=AS



$\Gamma(2\pi^+ 2\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|-----|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;2.7</b>           | 90  | 13 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^- \pi^0$<br>13 ASNER 08A reports $[\Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+ 2\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ < $10 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}$ . |

NODE=M076R07  
 NODE=M076R07

NODE=M076R07;LINKAGE=AS

 $\Gamma(2\pi^+ 2\pi^- K^+ K^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------|-----|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;5</b>             | 90  | 14 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$<br>14 ASNER 08A reports $[\Gamma(\chi_{b0}(1P) \rightarrow 2\pi^+ 2\pi^- K^+ K^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ < $20 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}$ . |

NODE=M076R08  
 NODE=M076R08

NODE=M076R08;LINKAGE=AS

 $\Gamma(3\pi^+ 2\pi^- K^- K_S^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------|-----|-------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;1.6</b>           | 90  | 15 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 2\pi^- K^- K_S^0 \pi^0$<br>15 ASNER 08A reports $[\Gamma(\chi_{b0}(1P) \rightarrow 3\pi^+ 2\pi^- K^- K_S^0 \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ < $6 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}$ . |

NODE=M076R09  
 NODE=M076R09

NODE=M076R09;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                      |
|--------------------------|-----|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;0.8</b>           | 90  | 16 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^-$<br>16 ASNER 08A reports $[\Gamma(\chi_{b0}(1P) \rightarrow 3\pi^+ 3\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ < $3 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}$ . |

NODE=M076R10  
 NODE=M076R10

NODE=M076R10;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------|-----|-------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;6</b>             | 90  | 17 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- 2\pi^0$<br>17 ASNER 08A reports $[\Gamma(\chi_{b0}(1P) \rightarrow 3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ < $22 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}$ . |

NODE=M076R11  
 NODE=M076R11

NODE=M076R11;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------|-----|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b><math>2.4 \pm 1.2 \pm 0.2</math></b> | 9   | 18 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^-$<br>18 ASNER 08A reports $[\Gamma(\chi_{b0}(1P) \rightarrow 3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ = $(9 \pm 4 \pm 2) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = (3.8 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |

NODE=M076R12  
 NODE=M076R12

NODE=M076R12;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|-----|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;10</b>            | 90  | 19 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$<br>19 ASNER 08A reports $[\Gamma(\chi_{b0}(1P) \rightarrow 3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ < $37 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}$ . |

NODE=M076R13  
 NODE=M076R13

NODE=M076R13;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                      |
|--------------------------|-----|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;0.8</b>           | 90  | 20 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^-$<br>20 ASNER 08A reports $[\Gamma(\chi_{b0}(1P) \rightarrow 4\pi^+ 4\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ < $3 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}$ . |

NODE=M076R14  
 NODE=M076R14

NODE=M076R14;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------|-----|-------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;21</b>            | 90  | 21 ASNER    | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^- 2\pi^0$<br>21 ASNER 08A reports $[\Gamma(\chi_{b0}(1P) \rightarrow 4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ < $77 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}$ . |

NODE=M076R15  
 NODE=M076R15

NODE=M076R15;LINKAGE=AS

$\Gamma(J/\psi J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                         | CL% | DOCUMENT ID | TECN    | COMMENT                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------|---------|------------------------------------------|
| <b>&lt;7</b>                                                                                                                                                                                                                                                                                     | 90  | 22 SHEN     | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| 22 SHEN 12 reports $< 7.1 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b0}(1P) \rightarrow J/\psi J/\psi)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ assuming $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = (3.8 \pm 0.4) \times 10^{-2}$ . |     |             |         |                                          |

NODE=M076R16  
 NODE=M076R16

NODE=M076R16;LINKAGE=SH

 $\Gamma(J/\psi \psi(2S))/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                          | CL% | DOCUMENT ID | TECN    | COMMENT                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------|---------|------------------------------------------|
| <b>&lt;12</b>                                                                                                                                                                                                                                                                                     | 90  | 23 SHEN     | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| 23 SHEN 12 reports $< 12 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b0}(1P) \rightarrow J/\psi \psi(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ assuming $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = (3.8 \pm 0.4) \times 10^{-2}$ . |     |             |         |                                          |

NODE=M076R17  
 NODE=M076R17

NODE=M076R17;LINKAGE=SH

 $\Gamma(\psi(2S) \psi(2S))/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                             | CL% | DOCUMENT ID | TECN    | COMMENT                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------|---------|------------------------------------------|
| <b>&lt;3.1</b>                                                                                                                                                                                                                                                                                       | 90  | 24 SHEN     | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| 24 SHEN 12 reports $< 3.1 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b0}(1P) \rightarrow \psi(2S) \psi(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$ assuming $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = (3.8 \pm 0.4) \times 10^{-2}$ . |     |             |         |                                          |

NODE=M076R18  
 NODE=M076R18

NODE=M076R18;LINKAGE=SH

 $\Gamma(J/\psi(1S) \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{20}/\Gamma$ 

| VALUE                                      | CL% | DOCUMENT ID | TECN     | COMMENT                              |
|--------------------------------------------|-----|-------------|----------|--------------------------------------|
| <b>&lt;2.3 <math>\times 10^{-3}</math></b> | 90  | JIA         | 17A BELL | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M076R00  
 NODE=M076R00

 $\chi_{b0}(1P)$  CROSS-PARTICLE BRANCHING RATIOS

NODE=M076230

$$\Gamma(\chi_{b0}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_1/\Gamma \times \Gamma_{61}^{\Upsilon(2S)}/\Gamma \Upsilon(2S)$$

| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                            | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------|----------|-------------------------------------|
| <b>&lt;1.7 <math>\times 10^{-3}</math></b>                                                                                                                                                                                                                                                                                                                                                                                       | 90  | 25 LEES     | 11J BABR | $\Upsilon(2S) \rightarrow X \gamma$ |
| 25 LEES 11J quotes a central value of $\Gamma(\chi_{b0}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))/\Gamma_{\text{total}} = (8.3 \pm 5.6^{+3.7}_{-2.6}) \times 10^{-4}$ and derives a 90% CL upper limit of $\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}} < 4.6\%$ using $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = (3.8 \pm 0.4)\%$ . |     |             |          |                                     |

NODE=M076B02  
 NODE=M076B02

NODE=M076B02;LINKAGE=LE

 $B(\chi_{b0}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$ 

NODE=M076B01  
 NODE=M076B01

| VALUE (units $10^{-5}$ )                                                                            | EVTS | DOCUMENT ID | TECN     | COMMENT                                              |
|-----------------------------------------------------------------------------------------------------|------|-------------|----------|------------------------------------------------------|
| <b>1.67<math>\pm</math>0.28 OUR AVERAGE</b>                                                         |      |             |          |                                                      |
| 2.9 $^{+1.7}_{-1.4}$ $^{+0.1}_{-0.8}$                                                               |      | 26 LEES     | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |
| 1.63 $\pm$ 0.24 $\pm$ 0.15                                                                          | 87   | KORNICER    | 11 CLEO  | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$    |
| 26 From a sample of $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ with one converted photon. |      |             |          |                                                      |

NODE=M076B01;LINKAGE=A

$$[B(\chi_{b0}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))] / [B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$$

NODE=M076A01  
 NODE=M076A01

| VALUE (%)                                                                                           | DOCUMENT ID | TECN     | COMMENT                                              |
|-----------------------------------------------------------------------------------------------------|-------------|----------|------------------------------------------------------|
| <b>3.28<math>\pm</math>0.37</b>                                                                     | 27 LEES     | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |
| 27 From a sample of $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ without converted photons. |             |          |                                                      |

NODE=M076A01;LINKAGE=A

 $\chi_{b0}(1P)$  REFERENCES

NODE=M076

|            |     |               |                               |                          |
|------------|-----|---------------|-------------------------------|--------------------------|
| JIA        | 17A | PR D96 112002 | S. Jia <i>et al.</i>          | (BELLE Collab.)          |
| LEES       | 14M | PR D90 112010 | J.P. Lees <i>et al.</i>       | (BABAR Collab.)          |
| SHEN       | 12  | PR D85 071102 | C.P. Shen <i>et al.</i>       | (BELLE Collab.)          |
| KORNICER   | 11  | PR D83 054003 | M. Kornicer <i>et al.</i>     | (CLEO Collab.)           |
| LEES       | 11J | PR D84 072002 | J.P. Lees <i>et al.</i>       | (BABAR Collab.)          |
| ASNER      | 08A | PR D78 091103 | D.M. Asner <i>et al.</i>      | (CLEO Collab.)           |
| BRIERE     | 08  | PR D78 092007 | R.A. Briere <i>et al.</i>     | (CLEO Collab.)           |
| ARTUSO     | 05  | PRL 94 032001 | M. Artuso <i>et al.</i>       | (CLEO Collab.)           |
| EDWARDS    | 99  | PR D59 032003 | K.W. Edwards <i>et al.</i>    | (CLEO Collab.)           |
| WALK       | 86  | PR D34 2611   | W.S. Walk <i>et al.</i>       | (Crystal Ball Collab.)   |
| ALBRECHT   | 85E | PL 160B 331   | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)          |
| NERNST     | 85  | PRL 54 2195   | R. Nernst <i>et al.</i>       | (Crystal Ball Collab.)   |
| HAAS       | 84  | PRL 52 799    | J. Haas <i>et al.</i>         | (CLEO Collab.)           |
| KLOPFEN... | 83  | PRL 51 160    | C. Klopfenstein <i>et al.</i> | (CUSB Collab.)           |
| PAUSS      | 83  | PL 130B 439   | F. Pauss <i>et al.</i>        | (MPIM, COLU, CORN, LSU+) |

REFID=58318  
 REFID=56343  
 REFID=54313  
 REFID=16769  
 REFID=53936  
 REFID=52574  
 REFID=52577  
 REFID=50454  
 REFID=46612  
 REFID=22290  
 REFID=22288  
 REFID=22289  
 REFID=22287  
 REFID=22285  
 REFID=22286

$\chi_{b1}(1P)$ 

$$J^G(J^{PC}) = 0^+(1^{++})$$

$J$  needs confirmation.

Observed in radiative decay of the  $\Upsilon(2S)$ , therefore  $C = +$ . Branching ratio requires E1 transition, M1 is strongly disfavored, therefore  $P = +$ .  $J = 1$  from SKWARNICKI 87.

NODE=M077

NODE=M077

 **$\chi_{b1}(1P)$  MASS**

NODE=M077M

VALUE (MeV)

DOCUMENT ID

**9892.78 ± 0.26 ± 0.31 OUR EVALUATION** From average  $\gamma$  energy below, using  $\Upsilon(2S)$  mass = 10023.26 ± 0.31 MeV

NODE=M077M

→ UNCHECKED ←

 **$\gamma$  ENERGY IN  $\Upsilon(2S)$  DECAY**

NODE=M077DM

NODE=M077DM

VALUE (MeV)

DOCUMENT ID

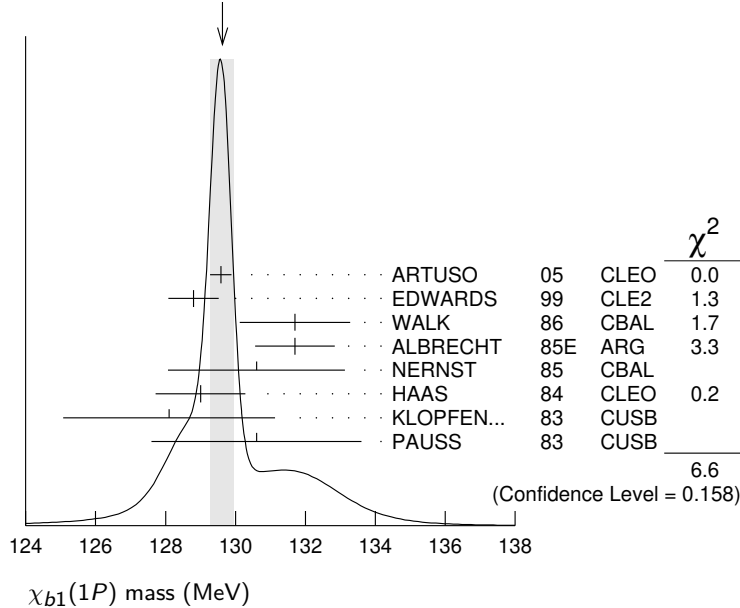
TECN

COMMENT

**129.63 ± 0.33 OUR AVERAGE** Error includes scale factor of 1.3. See the ideogram below.

|                      |            |     |      |                                                        |
|----------------------|------------|-----|------|--------------------------------------------------------|
| 129.58 ± 0.09 ± 0.29 | ARTUSO     | 05  | CLEO | $\Upsilon(2S) \rightarrow \gamma X$                    |
| 128.8 ± 0.4 ± 0.6    | EDWARDS    | 99  | CLE2 | $\Upsilon(2S) \rightarrow \gamma \chi(1P)$             |
| 131.7 ± 0.9 ± 1.3    | WALK       | 86  | CBAL | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| 131.7 ± 0.3 ± 1.1    | ALBRECHT   | 85E | ARG  | $\Upsilon(2S) \rightarrow \text{conv.} \gamma X$       |
| 130.6 ± 0.8 ± 2.4    | NERNST     | 85  | CBAL | $\Upsilon(2S) \rightarrow \gamma X$                    |
| 129 ± 0.8 ± 1        | HAAS       | 84  | CLEO | $\Upsilon(2S) \rightarrow \text{conv.} \gamma X$       |
| 128.1 ± 0.4 ± 3.0    | KLOPFEN... | 83  | CUSB | $\Upsilon(2S) \rightarrow \gamma X$                    |
| 130.6 ± 3.0          | PAUSS      | 83  | CUSB | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

WEIGHTED AVERAGE  
129.63 ± 0.33 (Error scaled by 1.3)

 **$\chi_{b1}(1P)$  DECAY MODES**

NODE=M077215;NODE=M077

| Mode                                              | Fraction ( $\Gamma_i/\Gamma$ )  | Confidence level |
|---------------------------------------------------|---------------------------------|------------------|
| $\Gamma_1 \quad \gamma \Upsilon(1S)$              | (35.2 ± 2.0) %                  | DESIG=1          |
| $\Gamma_2 \quad D^0 X$                            | (12.6 ± 2.2) %                  | DESIG=2          |
| $\Gamma_3 \quad \pi^+ \pi^- K^+ K^- \pi^0$        | ( 2.0 ± 0.6) × 10 <sup>-4</sup> | DESIG=3          |
| $\Gamma_4 \quad 2\pi^+ \pi^- K^- K_S^0$           | ( 1.3 ± 0.5) × 10 <sup>-4</sup> | DESIG=4          |
| $\Gamma_5 \quad 2\pi^+ \pi^- K^- K_S^0 2\pi^0$    | < 6 × 10 <sup>-4</sup>          | 90% DESIG=5      |
| $\Gamma_6 \quad 2\pi^+ 2\pi^- 2\pi^0$             | ( 8.0 ± 2.5) × 10 <sup>-4</sup> | DESIG=6          |
| $\Gamma_7 \quad 2\pi^+ 2\pi^- K^+ K^-$            | ( 1.5 ± 0.5) × 10 <sup>-4</sup> | DESIG=7          |
| $\Gamma_8 \quad 2\pi^+ 2\pi^- K^+ K^- \pi^0$      | ( 3.5 ± 1.2) × 10 <sup>-4</sup> | DESIG=8          |
| $\Gamma_9 \quad 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$     | ( 8.6 ± 3.2) × 10 <sup>-4</sup> | DESIG=9          |
| $\Gamma_{10} \quad 3\pi^+ 2\pi^- K^- K_S^0 \pi^0$ | ( 9.3 ± 3.3) × 10 <sup>-4</sup> | DESIG=10         |
| $\Gamma_{11} \quad 3\pi^+ 3\pi^-$                 | ( 1.9 ± 0.6) × 10 <sup>-4</sup> | DESIG=11         |

|               |                               |                                |     |          |
|---------------|-------------------------------|--------------------------------|-----|----------|
| $\Gamma_{12}$ | $3\pi^+ 3\pi^- 2\pi^0$        | $(1.7 \pm 0.5) \times 10^{-3}$ |     | DESIG=12 |
| $\Gamma_{13}$ | $3\pi^+ 3\pi^- K^+ K^-$       | $(2.6 \pm 0.8) \times 10^{-4}$ |     | DESIG=13 |
| $\Gamma_{14}$ | $3\pi^+ 3\pi^- K^+ K^- \pi^0$ | $(7.5 \pm 2.6) \times 10^{-4}$ |     | DESIG=14 |
| $\Gamma_{15}$ | $4\pi^+ 4\pi^-$               | $(2.6 \pm 0.9) \times 10^{-4}$ |     | DESIG=15 |
| $\Gamma_{16}$ | $4\pi^+ 4\pi^- 2\pi^0$        | $(1.4 \pm 0.6) \times 10^{-3}$ |     | DESIG=16 |
| $\Gamma_{17}$ | $\omega$ anything             | $(4.9 \pm 1.4) \%$             |     | DESIG=21 |
| $\Gamma_{18}$ | $\omega X_{tetra}$            | $< 4.44 \times 10^{-4}$        | 90% | DESIG=22 |
| $\Gamma_{19}$ | $J/\psi J/\psi$               | $< 2.7 \times 10^{-5}$         | 90% | DESIG=17 |
| $\Gamma_{20}$ | $J/\psi \psi(2S)$             | $< 1.7 \times 10^{-5}$         | 90% | DESIG=18 |
| $\Gamma_{21}$ | $\psi(2S) \psi(2S)$           | $< 6 \times 10^{-5}$           | 90% | DESIG=19 |
| $\Gamma_{22}$ | $J/\psi(1S)$ anything         | $< 1.1 \times 10^{-3}$         | 90% | DESIG=20 |
| $\Gamma_{23}$ | $J/\psi(1S) X_{tetra}$        | $< 2.27 \times 10^{-4}$        | 90% | DESIG=23 |

### $\chi_{b1}(1P)$ BRANCHING RATIOS

NODE=M077220

$\Gamma(\gamma \Upsilon(1S))/\Gamma_{total}$   $\Gamma_1/\Gamma$

| VALUE                                            | EVTS | DOCUMENT ID             | TECN     | COMMENT                                                |
|--------------------------------------------------|------|-------------------------|----------|--------------------------------------------------------|
| <b>0.352±0.020 OUR AVERAGE</b>                   |      |                         |          |                                                        |
| 0.356 <sup>+0.016</sup> <sub>-0.022</sub> ±0.019 | 964k | <sup>1</sup> FULSOM     | 18 BELL  | $\Upsilon(2S) \rightarrow \gamma X$                    |
| 0.364 ±0.017 ±0.019                              |      | <sup>2,3,4</sup> LEES   | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$   |
| 0.331 ±0.018 ±0.017                              | 3222 | <sup>4,5</sup> KORNICER | 11 CLEO  | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$      |
| 0.350 ±0.023 ±0.018                              | 13k  | <sup>6</sup> LEES       | 11J BABR | $\Upsilon(2S) \rightarrow X \gamma$                    |
| 0.34 ±0.07 ±0.02                                 | 53   | <sup>4,7,8</sup> WALK   | 86 CBAL  | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| 0.47 ±0.18                                       |      | KLOPFEN...              | 83 CUSB  | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

NODE=M077R1  
NODE=M077R1

OCCUR=4

<sup>1</sup> FULSOM 18 reports  $[\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (2.45 \pm 0.02 \pm 0.11 \pm 0.15) \times 10^{-2}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R1;LINKAGE=J

<sup>2</sup> LEES 14M quotes  $\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{total} \times \Gamma(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))/\Gamma_{total} = (2.51 \pm 0.12) \%$  combining the results from samples of  $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$  with and without converted photons.

NODE=M077R1;LINKAGE=B

<sup>3</sup> LEES 14M reports  $[\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (2.51 \pm 0.12) \times 10^{-2}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R1;LINKAGE=D

<sup>4</sup> Assuming  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\%$ .

<sup>5</sup> KORNICER 11 reports  $[\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (22.8 \pm 0.4 \pm 1.2) \times 10^{-3}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R1;LINKAGE=KA  
NODE=M077R1;LINKAGE=KR

<sup>6</sup> LEES 11J reports  $[\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (24.1 \pm 0.6 \pm 1.5) \times 10^{-3}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R1;LINKAGE=LE

<sup>7</sup> WALK 86 quotes  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) \times B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-) = (5.8 \pm 0.9 \pm 0.7) \%$ .

NODE=M077R1;LINKAGE=A

<sup>8</sup> WALK 86 reports  $[\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{total}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (23.4 \pm 3.63 \pm 2.82) \times 10^{-3}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R1;LINKAGE=C

$\Gamma(D^0 X)/\Gamma_{total}$   $\Gamma_2/\Gamma$

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID         | TECN    | COMMENT                                 |
|--------------------------|------|---------------------|---------|-----------------------------------------|
| <b>12.6±1.9±1.1</b>      | 2310 | <sup>1</sup> BRIERE | 08 CLEO | $\Upsilon(2S) \rightarrow \gamma D^0 X$ |

<sup>1</sup> For  $p_{D^0} > 2.5$  GeV/c.

NODE=M077R01  
NODE=M077R01

NODE=M077R01;LINKAGE=BR

$\Gamma(\pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{total}$   $\Gamma_3/\Gamma$

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                     |
|--------------------------|------|--------------------|----------|-------------------------------------------------------------|
| <b>2.0±0.6±0.1</b>       | 18   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^- \pi^0$ |

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow \pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{total}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))] = (14 \pm 3 \pm 3) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R02  
NODE=M077R02

NODE=M077R02;LINKAGE=AS

$\Gamma(2\pi^+\pi^-K^-K_S^0)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                               |
|--------------------------|------|--------------------|----------|-------------------------------------------------------|
| <b>1.3±0.5±0.1</b>       | 11   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+\pi^-K^-K_S^0$ |

NODE=M077R03  
 NODE=M077R03

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 2\pi^+\pi^-K^-K_S^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P))] = (9 \pm 3 \pm 2) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R03;LINKAGE=AS

 $\Gamma(2\pi^+\pi^-K^-K_S^02\pi^0)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                                                |
|--------------------------|-----|--------------------|----------|--------------------------------------------------------|
| <b>&lt;6</b>             | 90  | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+\pi^-K^-2\pi^0$ |

NODE=M077R04  
 NODE=M077R04

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 2\pi^+\pi^-K^-K_S^02\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P))] < 42 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P)) = 6.9 \times 10^{-2}$ .

NODE=M077R04;LINKAGE=AS

 $\Gamma(2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                              |
|--------------------------|------|--------------------|----------|------------------------------------------------------|
| <b>8.0±2.4±0.4</b>       | 46   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-2\pi^0$ |

NODE=M077R05  
 NODE=M077R05

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P))] = (55 \pm 9 \pm 14) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R05;LINKAGE=AS

 $\Gamma(2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                              |
|--------------------------|------|--------------------|----------|------------------------------------------------------|
| <b>1.5±0.5±0.1</b>       | 18   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-$ |

NODE=M077R06  
 NODE=M077R06

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P))] = (10 \pm 3 \pm 2) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R06;LINKAGE=AS

 $\Gamma(2\pi^+2\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                   |
|--------------------------|------|--------------------|----------|-----------------------------------------------------------|
| <b>3.5±1.2±0.2</b>       | 22   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-\pi^0$ |

NODE=M077R07  
 NODE=M077R07

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 2\pi^+2\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P))] = (24 \pm 6 \pm 6) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R07;LINKAGE=AS

 $\Gamma(2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                    |
|--------------------------|------|--------------------|----------|------------------------------------------------------------|
| <b>8.6±3.2±0.4</b>       | 26   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-2\pi^0$ |

NODE=M077R08  
 NODE=M077R08

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P))] = (59 \pm 14 \pm 17) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R08;LINKAGE=AS

 $\Gamma(3\pi^+2\pi^-K^-K_S^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                     |
|--------------------------|------|--------------------|----------|-------------------------------------------------------------|
| <b>9.3±3.3±0.5</b>       | 21   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+2\pi^-K^-K_S^0\pi^0$ |

NODE=M077R09  
 NODE=M077R09

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 3\pi^+2\pi^-K^-K_S^0\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P))] = (64 \pm 16 \pm 16) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R09;LINKAGE=AS

 $\Gamma(3\pi^+3\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                        |
|--------------------------|------|--------------------|----------|------------------------------------------------|
| <b>1.9±0.6±0.1</b>       | 25   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+3\pi^-$ |

NODE=M077R10  
 NODE=M077R10

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 3\pi^+3\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P))] = (13 \pm 3 \pm 3) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R10;LINKAGE=AS

$\Gamma(3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE (units $10^{-4}$ )           | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                |
|------------------------------------|------|--------------------|----------|--------------------------------------------------------|
| <b><math>17 \pm 5 \pm 1</math></b> | 56   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- 2\pi^0$ |

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$   
 $= (119 \pm 18 \pm 32) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))$   
 $= (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R11  
 NODE=M077R11

NODE=M077R11;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                 |
|-----------------------------------------|------|--------------------|----------|---------------------------------------------------------|
| <b><math>2.6 \pm 0.8 \pm 0.1</math></b> | 21   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^-$ |

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$   
 $= (18 \pm 4 \pm 4) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))$   
 $= (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R12  
 NODE=M077R12

NODE=M077R12;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                       |
|-----------------------------------------|------|--------------------|----------|---------------------------------------------------------------|
| <b><math>7.5 \pm 2.6 \pm 0.4</math></b> | 28   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$ |

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$   
 $= (52 \pm 11 \pm 14) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))$   
 $= (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R13  
 NODE=M077R13

NODE=M077R13;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID        | TECN     | COMMENT                                         |
|-----------------------------------------|------|--------------------|----------|-------------------------------------------------|
| <b><math>2.6 \pm 0.9 \pm 0.1</math></b> | 24   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^-$ |

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 4\pi^+ 4\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$   
 $= (18 \pm 4 \pm 5) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))$   
 $= (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R14  
 NODE=M077R14

NODE=M077R14;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

| VALUE (units $10^{-4}$ )           | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                |
|------------------------------------|------|--------------------|----------|--------------------------------------------------------|
| <b><math>14 \pm 5 \pm 1</math></b> | 26   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^- 2\pi^0$ |

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b1}(1P) \rightarrow 4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$   
 $= (96 \pm 24 \pm 29) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))$   
 $= (6.9 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M077R15  
 NODE=M077R15

NODE=M077R15;LINKAGE=AS

 $\Gamma(\omega \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE (units $10^{-2}$ )                | EVTS | DOCUMENT ID | TECN     | COMMENT                              |
|-----------------------------------------|------|-------------|----------|--------------------------------------|
| <b><math>4.9 \pm 1.3 \pm 0.6</math></b> | 51k  | JIA         | 17A BELL | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M077R19  
 NODE=M077R19

 $\Gamma(\omega X_{\text{tetra}})/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

| VALUE                                        | CL% | DOCUMENT ID      | TECN     | COMMENT                              |
|----------------------------------------------|-----|------------------|----------|--------------------------------------|
| <b><math>&lt; 44.4 \times 10^{-5}</math></b> | 90  | <sup>1</sup> JIA | 17A BELL | $e^+ e^- \rightarrow \text{hadrons}$ |

<sup>1</sup> For a tetraquark state  $X_{\text{tetra}}$ , with mass in the range 1.16–2.46 GeV and width in the range 0–0.3 GeV. Measured 90% CL limits as a function of  $X_{\text{tetra}}$  mass and width range from  $3.3 \times 10^{-5}$  to  $44.4 \times 10^{-5}$ .

NODE=M077R23  
 NODE=M077R23

NODE=M077R23;LINKAGE=A

 $\Gamma(J/\psi J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ 

| VALUE (units $10^{-5}$ )     | CL% | DOCUMENT ID       | TECN    | COMMENT                                  |
|------------------------------|-----|-------------------|---------|------------------------------------------|
| <b><math>&lt; 2.7</math></b> | 90  | <sup>1</sup> SHEN | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |

<sup>1</sup> SHEN 12 reports  $< 2.7 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{b1}(1P) \rightarrow J/\psi J/\psi)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$  assuming  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ .

NODE=M077R16  
 NODE=M077R16

NODE=M077R16;LINKAGE=SH

 $\Gamma(J/\psi \psi(2S))/\Gamma_{\text{total}}$  $\Gamma_{20}/\Gamma$ 

| VALUE (units $10^{-5}$ )     | CL% | DOCUMENT ID       | TECN    | COMMENT                                  |
|------------------------------|-----|-------------------|---------|------------------------------------------|
| <b><math>&lt; 1.7</math></b> | 90  | <sup>1</sup> SHEN | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |

<sup>1</sup> SHEN 12 reports  $< 1.7 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{b1}(1P) \rightarrow J/\psi \psi(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$  assuming  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ .

NODE=M077R17  
 NODE=M077R17

NODE=M077R17;LINKAGE=SH

$\Gamma(\psi(2S)\psi(2S))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID       | TECN    | COMMENT                                 |
|--------------------------|-----|-------------------|---------|-----------------------------------------|
| <b>&lt;6</b>             | 90  | <sup>1</sup> SHEN | 12 BELL | $\Upsilon(2S) \rightarrow \gamma\psi X$ |

<sup>1</sup> SHEN 12 reports  $< 6.2 \times 10^{-5}$  from a measurement of  $[\Gamma(\chi_{b1}(1P) \rightarrow \psi(2S)\psi(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P))]$  assuming  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b1}(1P)) = (6.9 \pm 0.4) \times 10^{-2}$ .

 $\Gamma_{21}/\Gamma$ 

NODE=M077R18  
 NODE=M077R18

NODE=M077R18;LINKAGE=SH

 $\Gamma(J/\psi(1S)\text{anything})/\Gamma_{\text{total}}$ 

| VALUE                                      | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|--------------------------------------------|-----|-------------|----------|-------------------------------------|
| <b>&lt;1.1 <math>\times 10^{-3}</math></b> | 90  | JIA         | 17A BELL | $e^+e^- \rightarrow \text{hadrons}$ |

 $\Gamma_{22}/\Gamma$ 

NODE=M077R00  
 NODE=M077R00

 $\Gamma(J/\psi(1S)X_{\text{tetra}})/\Gamma_{\text{total}}$ 

| VALUE                                       | CL% | DOCUMENT ID      | TECN     | COMMENT                             |
|---------------------------------------------|-----|------------------|----------|-------------------------------------|
| <b>&lt;22.7 <math>\times 10^{-5}</math></b> | 90  | <sup>1</sup> JIA | 17A BELL | $e^+e^- \rightarrow \text{hadrons}$ |

 $\Gamma_{23}/\Gamma$ 

NODE=M077R22  
 NODE=M077R22

<sup>1</sup> For a tetraquark state  $X_{\text{tetra}}$ , with mass in the range 1.16–2.46 GeV and width in the range 0–0.3 GeV. Measured 90% CL limits as a function of  $X_{\text{tetra}}$  mass and width range from  $1.8 \times 10^{-5}$  to  $22.7 \times 10^{-5}$ .

NODE=M077R22;LINKAGE=A

 $\chi_{b1}(1P)$  Cross-Particle Branching Ratios

NODE=M077230

$$\Gamma(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))/\Gamma_{\text{total}} \times \Gamma_1/\Gamma \times \Gamma_{59}^{\Upsilon(2S)}/\Gamma \Upsilon(2S)$$

| VALUE (units $10^{-3}$ )                          | EVTS | DOCUMENT ID | TECN     | COMMENT                            |
|---------------------------------------------------|------|-------------|----------|------------------------------------|
| <b>24.1<math>\pm</math>0.6<math>\pm</math>1.5</b> | 13k  | LEES        | 11J BABR | $\Upsilon(2S) \rightarrow X\gamma$ |

NODE=M077B03  
 NODE=M077B03

 $B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$ 

| VALUE (units $10^{-4}$ )                    | EVTS | DOCUMENT ID | TECN | COMMENT                                                     |
|---------------------------------------------|------|-------------|------|-------------------------------------------------------------|
| <b>5.90<math>\pm</math>0.34 OUR AVERAGE</b> |      |             |      | Error includes scale factor of 1.3. See the ideogram below. |

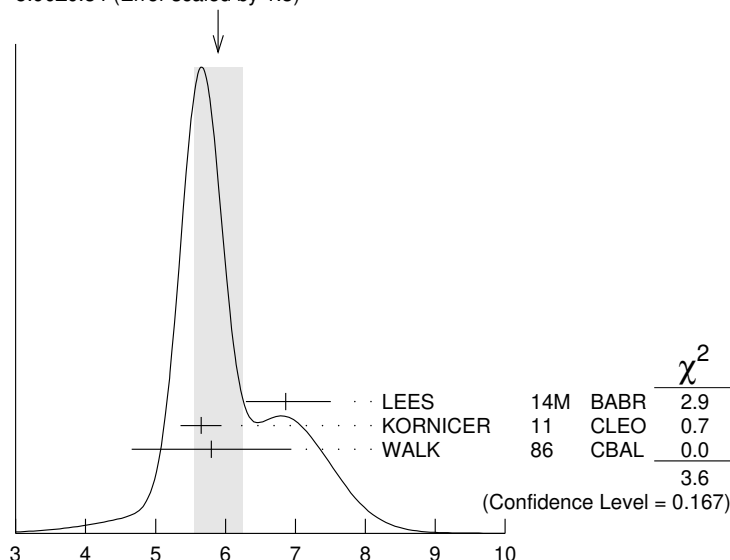
NODE=M077B01  
 NODE=M077B01

|                                   |      |                   |          |                                                     |
|-----------------------------------|------|-------------------|----------|-----------------------------------------------------|
| 6.86 $^{+0.47+0.44}_{-0.45-0.35}$ |      | <sup>1</sup> LEES | 14M BABR | $\Upsilon(2S) \rightarrow \gamma\gamma\mu^+\mu^-$   |
| 5.65 $\pm$ 0.11 $\pm$ 0.27        | 3222 | KORNICER          | 11 CLEO  | $e^+e^- \rightarrow \gamma\gamma\ell^+\ell^-$       |
| 5.8 $\pm$ 0.9 $\pm$ 0.7           | 53   | WALK              | 86 CBAL  | $\Upsilon(2S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

<sup>1</sup> From a sample of  $\Upsilon(2S) \rightarrow \gamma\gamma\mu^+\mu^-$  with one converted photon.

NODE=M077B01;LINKAGE=A

WEIGHTED AVERAGE  
 5.90 $\pm$ 0.34 (Error scaled by 1.3)



$$B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$$

(units  $10^{-4}$ )

 $B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(1P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$ 

| VALUE (units $10^{-5}$ )                    | EVTS | DOCUMENT ID | TECN | COMMENT |
|---------------------------------------------|------|-------------|------|---------|
| <b>1.30<math>\pm</math>0.34 OUR AVERAGE</b> |      |             |      |         |

NODE=M077B02  
 NODE=M077B02

|                                   |    |                   |          |                                                   |
|-----------------------------------|----|-------------------|----------|---------------------------------------------------|
| 1.16 $^{+0.78+0.14}_{-0.67-0.16}$ |    | <sup>1</sup> LEES | 14M BABR | $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$ |
| 1.33 $\pm$ 0.30 $\pm$ 0.23        | 50 | KORNICER          | 11 CLEO  | $e^+e^- \rightarrow \gamma\gamma\ell^+\ell^-$     |

<sup>1</sup> From a sample of  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  with converted photons.

NODE=M077B02;LINKAGE=A

**$B(\chi_{b2}(1P) \rightarrow pX + \bar{p}X)/B(\chi_{b1}(1P) \rightarrow pX + \bar{p}X)$** 

| VALUE                                         | DOCUMENT ID | TECN | COMMENT                                              |
|-----------------------------------------------|-------------|------|------------------------------------------------------|
| <b><math>1.068 \pm 0.010 \pm 0.040</math></b> | BRIERE      | 07   | CLEO $\Upsilon(2S) \rightarrow \gamma \chi_{bJ}(1P)$ |

NODE=M077R20  
NODE=M077R20

 **$B(\chi_{b0}(1P) \rightarrow pX + \bar{p}X)/B(\chi_{b1}(1P) \rightarrow pX + \bar{p}X)$** 

| VALUE                                      | DOCUMENT ID | TECN | COMMENT                                              |
|--------------------------------------------|-------------|------|------------------------------------------------------|
| <b><math>1.11 \pm 0.15 \pm 0.20</math></b> | BRIERE      | 07   | CLEO $\Upsilon(2S) \rightarrow \gamma \chi_{bJ}(1P)$ |

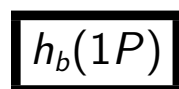
NODE=M077R21  
NODE=M077R21

 **$\chi_{b1}(1P)$  REFERENCES**

|            |     |                |                             |                          |
|------------|-----|----------------|-----------------------------|--------------------------|
| FULSOM     | 18  | PRL 121 232001 | B.G. Fulsom <i>et al.</i>   | (BELLE Collab.)          |
| JIA        | 17A | PR D96 112002  | S. Jia <i>et al.</i>        | (BELLE Collab.)          |
| LEES       | 14M | PR D90 112010  | J.P. Lees <i>et al.</i>     | (BABAR Collab.)          |
| SHEN       | 12  | PR D85 071102  | C.P. Shen <i>et al.</i>     | (BELLE Collab.)          |
| KORNICER   | 11  | PR D83 054003  | M. Kornicer <i>et al.</i>   | (CLEO Collab.)           |
| LEES       | 11J | PR D84 072002  | J.P. Lees <i>et al.</i>     | (BABAR Collab.)          |
| ASNER      | 08A | PR D78 091103  | D.M. Asner <i>et al.</i>    | (CLEO Collab.)           |
| BRIERE     | 08  | PR D78 092007  | R.A. Briere <i>et al.</i>   | (CLEO Collab.)           |
| BRIERE     | 07  | PR D76 012005  | R.A. Briere <i>et al.</i>   | (CLEO Collab.)           |
| ARTUSO     | 05  | PRL 94 032001  | M. Artuso <i>et al.</i>     | (CLEO Collab.)           |
| EDWARDS    | 99  | PR D59 032003  | K.W. Edwards <i>et al.</i>  | (CLEO Collab.)           |
| SKWARNICKI | 87  | PRL 58 972     | T. Skwarnicki <i>et al.</i> | (Crystal Ball Collab.)   |
| WALK       | 86  | PR D34 2611    | W.S. Walk <i>et al.</i>     | (Crystal Ball Collab.)   |
| ALBRECHT   | 85E | PL 160B 331    | H. Albrecht <i>et al.</i>   | (ARGUS Collab.)          |
| NERNST     | 85  | PRL 54 2195    | R. Nernst <i>et al.</i>     | (Crystal Ball Collab.)   |
| HAAS       | 84  | PRL 52 799     | J. Haas <i>et al.</i>       | (CLEO Collab.)           |
| KLOPFEN... | 83  | PRL 51 160     | C. Klopstein <i>et al.</i>  | (CUSB Collab.)           |
| PAUSS      | 83  | PL 130B 439    | F. Pauss <i>et al.</i>      | (MPIM, COLU, CORN, LSU+) |

NODE=M077

REFID=59535  
REFID=58318  
REFID=56343  
REFID=54313  
REFID=16769  
REFID=53936  
REFID=52574  
REFID=52577  
REFID=51887  
REFID=50454  
REFID=46612  
REFID=40019  
REFID=22290  
REFID=22288  
REFID=22289  
REFID=22287  
REFID=22285  
REFID=22286



$$I^G(J^{PC}) = 0^-(1^{+-})$$

Quantum numbers are quark model predictions,  $C = -$  established by  $\eta_b \gamma$  decay.

NODE=M204

NODE=M204

 **$h_b(1P)$  MASS**

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID         | TECN | COMMENT                                                |
|-------------------------------------------------------------------------------|-------|---------------------|------|--------------------------------------------------------|
| <b><math>9899.3 \pm 0.8</math> OUR AVERAGE</b>                                |       |                     |      |                                                        |
| $9899.3 \pm 0.4 \pm 1.0$                                                      | 112k  | TAMPONI             | 15   | BELL $e^+e^- \rightarrow \gamma \eta + \text{hadrons}$ |
| $9899.1 \pm 0.4 \pm 1.0$                                                      | 70k   | MIZUK               | 12   | BELL $e^+e^- \rightarrow \pi^+\pi^- \text{hadrons}$    |
| $9902 \pm 4 \pm 2$                                                            | 10.8k | LEES                | 11k  | BABR $\Upsilon(3S) \rightarrow \eta_b \gamma \pi^0$    |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                     |      |                                                        |
| $9898.2^{+1.1+1.0}_{-1.0-1.1}$                                                | 50.0k | <sup>1</sup> ADACHI | 12   | BELL $10.86 e^+e^- \rightarrow \pi^+\pi^- \text{MM}$   |

<sup>1</sup> Superseded by MIZUK 12.

NODE=M204M

NODE=M204M

NODE=M204M;LINKAGE=AD

 **$h_b(1P)$  DECAY MODES**

| Mode                               | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------------------|--------------------------------|
| $\Gamma_1 \quad \eta_b(1S) \gamma$ | $(52^{+6}_{-5}) \%$            |

NODE=M204215;NODE=M204

DESIG=1

 **$h_b(1P)$  BRANCHING RATIOS**

| $\Gamma(\eta_b(1S)\gamma)/\Gamma_{\text{total}}$                              |                 |                  |             |                      |         |                                              | $\Gamma_1/\Gamma$                                      |
|-------------------------------------------------------------------------------|-----------------|------------------|-------------|----------------------|---------|----------------------------------------------|--------------------------------------------------------|
| VALUE (units $10^{-2}$ )                                                      |                 | EVTS             | DOCUMENT ID | TECN                 | COMMENT |                                              |                                                        |
| 52                                                                            | $\pm 6$<br>$-5$ | OUR AVERAGE      |             |                      |         |                                              |                                                        |
| 56                                                                            | $\pm 8$         | $\pm 4$          | 33.1k       | <sup>1</sup> TAMPONI | 15      | BELL                                         | $e^+e^- \rightarrow \gamma\eta + \text{hadrons}$       |
| 49.2                                                                          | $\pm 5.7$       | $+5.6$<br>$-3.3$ | 24k         | MIZUK                | 12      | BELL                                         | $e^+e^- \rightarrow (\gamma)\pi^+\pi^- \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                 |                  |             |                      |         |                                              |                                                        |
| seen                                                                          |                 | 10.8k            | LEES        | 11k                  | BABR    | $\Upsilon(3S) \rightarrow \eta_b\gamma\pi^0$ |                                                        |

<sup>1</sup> Using  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20)\%$ .

NODE=M204225

NODE=M204R01  
NODE=M204R01

NODE=M204R01;LINKAGE=A

 **$h_b(1P)$  REFERENCES**

|         |     |                |                          |                 |
|---------|-----|----------------|--------------------------|-----------------|
| TAMPONI | 15  | PRL 115 142001 | U. Tamponi <i>et al.</i> | (BELLE Collab.) |
| ADACHI  | 12  | PRL 108 032001 | I. Adachi <i>et al.</i>  | (BELLE Collab.) |
| MIZUK   | 12  | PRL 109 232002 | R. Mizuk <i>et al.</i>   | (BELLE Collab.) |
| LEES    | 11K | PR D84 091101  | J.P. Lees <i>et al.</i>  | (BABAR Collab.) |

NODE=M204

REFID=56996  
REFID=53962  
REFID=54718  
REFID=53937



$\chi_{b2}(1P)$ 

$$I^G(J^{PC}) = 0^+(2^{++})$$

$J$  needs confirmation.

Observed in radiative decay of the  $\Upsilon(2S)$ , therefore  $C = +$ . Branching ratio requires E1 transition, M1 is strongly disfavored, therefore  $P = +$ .  $J = 2$  from SKWARNICKI 87.

NODE=M078

NODE=M078

 $\chi_{b2}(1P)$  MASS

NODE=M078M

VALUE (MeV)

DOCUMENT ID

**9912.21 $\pm$ 0.26 $\pm$ 0.31 OUR EVALUATION** From average  $\gamma$  energy below, using  $\Upsilon(2S)$  mass = 10023.26  $\pm$  0.31 MeV

NODE=M078M

→ UNCHECKED ←

 $m_{\chi_{b2}(1P)} - m_{\chi_{b1}(1P)}$ 

NODE=M078DM2

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

**19.10 $\pm$ 0.25 OUR AVERAGE** Error includes scale factor of 1.1.

19.81 $\pm$ 0.65 $\pm$ 0.20<sup>1</sup> AAIJ

14BG LHCb

 $pp \rightarrow \gamma \mu^+ \mu^- X$ 19.01 $\pm$ 0.24

LEES

14M BABR

 $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ 

<sup>1</sup> From the  $\chi_{bj}(1P) \rightarrow \Upsilon(1S)\gamma$  transition.

NODE=M078DM2

NODE=M078DM2;LINKAGE=A

 $\gamma$  ENERGY IN  $\Upsilon(2S)$  DECAY

NODE=M078DM

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

**110.44 $\pm$ 0.29 OUR AVERAGE** Error includes scale factor of 1.1.

110.58 $\pm$ 0.08 $\pm$ 0.30

ARTUSO

05

CLEO

 $\Upsilon(2S) \rightarrow \gamma X$ 110.8  $\pm$ 0.3  $\pm$ 0.6

EDWARDS

99

CLE2

 $\Upsilon(2S) \rightarrow \gamma \chi(1P)$ 107.0  $\pm$ 1.1  $\pm$ 1.3

WALK

86

CBAL

 $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ 110.6  $\pm$ 0.3  $\pm$ 0.9

ALBRECHT

85E

ARG

 $\Upsilon(2S) \rightarrow \text{conv.} \gamma X$ 110.4  $\pm$ 0.8  $\pm$ 2.2

NERNST

85

CBAL

 $\Upsilon(2S) \rightarrow \gamma X$ 109.5  $\pm$ 0.7  $\pm$ 1.0

HAAS

84

CLEO

 $\Upsilon(2S) \rightarrow \text{conv.} \gamma X$ 108.2  $\pm$ 0.3  $\pm$ 2.0

KLOPFEN...

83

CUSB

 $\Upsilon(2S) \rightarrow \gamma X$ 108.8  $\pm$ 4.0

PAUSS

83

CUSB

 $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ 

NODE=M078DM

 $\chi_{b2}(1P)$  DECAY MODES

NODE=M078215;NODE=M078

| Mode                                          | Fraction ( $\Gamma_i/\Gamma$ )     | Confidence level |
|-----------------------------------------------|------------------------------------|------------------|
| $\Gamma_1$ $\gamma \Upsilon(1S)$              | (18.0 $\pm$ 1.0) %                 |                  |
| $\Gamma_2$ $D^0 X$                            | < 7.9 %                            | 90%              |
| $\Gamma_3$ $\pi^+ \pi^- K^+ K^- \pi^0$        | ( 8 $\pm$ 5 ) $\times 10^{-5}$     |                  |
| $\Gamma_4$ $2\pi^+ \pi^- K^- K_S^0$           | < 1.0 $\times 10^{-4}$             | 90%              |
| $\Gamma_5$ $2\pi^+ \pi^- K^- K_S^0 2\pi^0$    | ( 5.3 $\pm$ 2.4 ) $\times 10^{-4}$ |                  |
| $\Gamma_6$ $2\pi^+ 2\pi^- 2\pi^0$             | ( 3.5 $\pm$ 1.4 ) $\times 10^{-4}$ |                  |
| $\Gamma_7$ $2\pi^+ 2\pi^- K^+ K^-$            | ( 1.1 $\pm$ 0.4 ) $\times 10^{-4}$ |                  |
| $\Gamma_8$ $2\pi^+ 2\pi^- K^+ K^- \pi^0$      | ( 2.1 $\pm$ 0.9 ) $\times 10^{-4}$ |                  |
| $\Gamma_9$ $2\pi^+ 2\pi^- K^+ K^- 2\pi^0$     | ( 3.9 $\pm$ 1.8 ) $\times 10^{-4}$ |                  |
| $\Gamma_{10}$ $3\pi^+ 2\pi^- K^- K_S^0 \pi^0$ | < 5 $\times 10^{-4}$               | 90%              |
| $\Gamma_{11}$ $3\pi^+ 3\pi^-$                 | ( 7.0 $\pm$ 3.1 ) $\times 10^{-5}$ |                  |
| $\Gamma_{12}$ $3\pi^+ 3\pi^- 2\pi^0$          | ( 1.0 $\pm$ 0.4 ) $\times 10^{-3}$ |                  |
| $\Gamma_{13}$ $3\pi^+ 3\pi^- K^+ K^-$         | < 8 $\times 10^{-5}$               | 90%              |
| $\Gamma_{14}$ $3\pi^+ 3\pi^- K^+ K^- \pi^0$   | ( 3.6 $\pm$ 1.5 ) $\times 10^{-4}$ |                  |
| $\Gamma_{15}$ $4\pi^+ 4\pi^-$                 | ( 8 $\pm$ 4 ) $\times 10^{-5}$     |                  |
| $\Gamma_{16}$ $4\pi^+ 4\pi^- 2\pi^0$          | ( 1.8 $\pm$ 0.7 ) $\times 10^{-3}$ |                  |
| $\Gamma_{17}$ $J/\psi J/\psi$                 | < 4 $\times 10^{-5}$               | 90%              |
| $\Gamma_{18}$ $J/\psi \psi(2S)$               | < 5 $\times 10^{-5}$               | 90%              |
| $\Gamma_{19}$ $\psi(2S) \psi(2S)$             | < 1.6 $\times 10^{-5}$             | 90%              |
| $\Gamma_{20}$ $J/\psi(1S)$ anything           | ( 1.5 $\pm$ 0.4 ) $\times 10^{-3}$ |                  |

DESIG=1

DESIG=2

DESIG=3

DESIG=4

DESIG=5

DESIG=6

DESIG=7

DESIG=8

DESIG=9

DESIG=10

DESIG=11

DESIG=12

DESIG=13

DESIG=14

DESIG=15

DESIG=16

DESIG=17

DESIG=18

DESIG=19

DESIG=20

$\chi_{b2}(1P)$  BRANCHING RATIOS

NODE=M078220

 $\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ NODE=M078R1  
NODE=M078R1

| VALUE                               | EVTS | DOCUMENT ID             | TECN     | COMMENT                                                |
|-------------------------------------|------|-------------------------|----------|--------------------------------------------------------|
| <b>0.180±0.010 OUR AVERAGE</b>      |      |                         |          |                                                        |
| $0.164^{+0.009}_{-0.010} \pm 0.008$ | 503k | <sup>1</sup> FULSOM     | 18 BELL  | $\Upsilon(2S) \rightarrow \gamma X$                    |
| $0.185 \pm 0.008 \pm 0.009$         |      | <sup>2,3,4</sup> LEES   | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$   |
| $0.186 \pm 0.011 \pm 0.009$         | 1770 | <sup>4,5</sup> KORNICER | 11 CLEO  | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$      |
| $0.194^{+0.014}_{-0.017} \pm 0.009$ | 8k   | <sup>6</sup> LEES       | 11J BABR | $\Upsilon(2S) \rightarrow X \gamma$                    |
| $0.25 \pm 0.06 \pm 0.01$            | 35   | <sup>4,7,8</sup> WALK   | 86 CBAL  | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| $0.20 \pm 0.05$                     |      | KLOPFEN...              | 83 CUSB  | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

OCCUR=2

<sup>1</sup> FULSOM 18 reports  $[\Gamma(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (1.17 \pm 0.01^{+0.06}_{-0.07}) \times 10^{-2}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R1;LINKAGE=H

<sup>2</sup> LEES 14M quotes  $\Gamma(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))/\Gamma_{\text{total}} = (1.32 \pm 0.06)\%$  combining the results from samples of  $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$  with and without converted photons.

NODE=M078R1;LINKAGE=B

<sup>3</sup> LEES 14M reports  $[\Gamma(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (1.32 \pm 0.06) \times 10^{-2}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R1;LINKAGE=F

<sup>4</sup> Assuming  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\%$ .

NODE=M078R1;LINKAGE=KA

<sup>5</sup> KORNICER 11 reports  $[\Gamma(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (1.33 \pm 0.04 \pm 0.07) \times 10^{-2}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R1;LINKAGE=KR

<sup>6</sup> LEES 11J reports  $[\Gamma(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (13.9 \pm 0.5^{+0.9}_{-1.1}) \times 10^{-3}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R1;LINKAGE=LE

<sup>7</sup> WALK 86 quotes  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) \times B(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-) = (4.4 \pm 0.9 \pm 0.5) \%$ .

NODE=M078R1;LINKAGE=A

<sup>8</sup> WALK 86 reports  $[\Gamma(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (17.7 \pm 3.6 \pm 2.0) \times 10^{-3}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R1;LINKAGE=E

 $\Gamma(D^0 X)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ NODE=M078R01  
NODE=M078R01

| VALUE                                      | CL% | DOCUMENT ID           | TECN    | COMMENT                                 |
|--------------------------------------------|-----|-----------------------|---------|-----------------------------------------|
| <b><math>&lt;7.9 \times 10^{-2}</math></b> | 90  | <sup>1,2</sup> BRIERE | 08 CLEO | $\Upsilon(2S) \rightarrow \gamma D^0 X$ |

<sup>1</sup> For  $p_{D^0} > 2.5$  GeV/c.

NODE=M078R01;LINKAGE=BR

<sup>2</sup> The authors also present their result as  $(5.4 \pm 1.9 \pm 0.5) \times 10^{-2}$ .

NODE=M078R01;LINKAGE=RI

 $\Gamma(\pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ NODE=M078R02  
NODE=M078R02

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                     |
|--------------------------|------|--------------------|----------|-------------------------------------------------------------|
| <b>0.84±0.50±0.04</b>    | 8    | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma \pi^+ \pi^- K^+ K^- \pi^0$ |

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(1P) \rightarrow \pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (6 \pm 3 \pm 2) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R02;LINKAGE=AS

 $\Gamma(2\pi^+ \pi^- K^- K_S^0)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ NODE=M078R03  
NODE=M078R03

| VALUE (units $10^{-4}$ )    | CL% | DOCUMENT ID        | TECN     | COMMENT                                                  |
|-----------------------------|-----|--------------------|----------|----------------------------------------------------------|
| <b><math>&lt;1.0</math></b> | 90  | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+ \pi^- K^- K_S^0$ |

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(1P) \rightarrow 2\pi^+ \pi^- K^- K_S^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] < 7 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = 7.15 \times 10^{-2}$ .

NODE=M078R03;LINKAGE=AS

$\Gamma(2\pi^+\pi^-K^-K_S^02\pi^0)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                |
|--------------------------|------|--------------------|----------|--------------------------------------------------------|
| <b>5.3±2.4±0.3</b>       | 11   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+\pi^-K^-2\pi^0$ |

NODE=M078R04  
 NODE=M078R04

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(1P) \rightarrow 2\pi^+\pi^-K^-K_S^02\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P))] = (38 \pm 14 \pm 10) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R04;LINKAGE=AS

 $\Gamma(2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                              |
|--------------------------|------|--------------------|----------|------------------------------------------------------|
| <b>3.5±1.4±0.2</b>       | 19   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-2\pi^0$ |

NODE=M078R05  
 NODE=M078R05

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(1P) \rightarrow 2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P))] = (25 \pm 8 \pm 6) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R05;LINKAGE=AS

 $\Gamma(2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                              |
|--------------------------|------|--------------------|----------|------------------------------------------------------|
| <b>1.1±0.4±0.1</b>       | 14   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-$ |

NODE=M078R06  
 NODE=M078R06

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(1P) \rightarrow 2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P))] = (8 \pm 2 \pm 2) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R06;LINKAGE=AS

 $\Gamma(2\pi^+2\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                   |
|--------------------------|------|--------------------|----------|-----------------------------------------------------------|
| <b>2.1±0.9±0.1</b>       | 13   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-\pi^0$ |

NODE=M078R07  
 NODE=M078R07

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(1P) \rightarrow 2\pi^+2\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P))] = (15 \pm 5 \pm 4) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R07;LINKAGE=AS

 $\Gamma(2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                    |
|--------------------------|------|--------------------|----------|------------------------------------------------------------|
| <b>3.9±1.8±0.2</b>       | 11   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-2\pi^0$ |

NODE=M078R08  
 NODE=M078R08

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(1P) \rightarrow 2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P))] = (28 \pm 11 \pm 7) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R08;LINKAGE=AS

 $\Gamma(3\pi^+2\pi^-K^-K_S^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID        | TECN     | COMMENT                                                     |
|--------------------------|-----|--------------------|----------|-------------------------------------------------------------|
| <b>&lt;5</b>             | 90  | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+2\pi^-K^-K_S^0\pi^0$ |

NODE=M078R09  
 NODE=M078R09

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(1P) \rightarrow 3\pi^+2\pi^-K^-K_S^0\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P))] < 36 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P)) = 7.15 \times 10^{-2}$ .

NODE=M078R09;LINKAGE=AS

 $\Gamma(3\pi^+3\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                        |
|--------------------------|------|--------------------|----------|------------------------------------------------|
| <b>0.70±0.31±0.03</b>    | 9    | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+3\pi^-$ |

NODE=M078R10  
 NODE=M078R10

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(1P) \rightarrow 3\pi^+3\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P))] = (5 \pm 2 \pm 1) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R10;LINKAGE=AS

 $\Gamma(3\pi^+3\pi^-2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | EVTS | DOCUMENT ID        | TECN     | COMMENT                                              |
|--------------------------|------|--------------------|----------|------------------------------------------------------|
| <b>10.2±3.6±0.5</b>      | 34   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+3\pi^-2\pi^0$ |

NODE=M078R11  
 NODE=M078R11

<sup>1</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(1P) \rightarrow 3\pi^+3\pi^-2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P))] = (73 \pm 16 \pm 20) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \gamma\chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M078R11;LINKAGE=AS

$\Gamma(3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                   | CL% | DOCUMENT ID        | TECN     | COMMENT                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------------|----------|---------------------------------------------------------|
| <b>&lt;0.8</b>                                                                                                                                                                                                                                                                                             | 90  | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^-$ |
| <sup>1</sup> ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \rightarrow 3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] < 6 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = 7.15 \times 10^{-2}$ . |     |                    |          |                                                         |

NODE=M078R12  
 NODE=M078R12

NODE=M078R12;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                       | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------|----------|---------------------------------------------------------------|
| <b><math>3.6 \pm 1.5 \pm 0.2</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                        | 14   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$ |
| <sup>1</sup> ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \rightarrow 3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (26 \pm 8 \pm 7) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                    |          |                                                               |

NODE=M078R13  
 NODE=M078R13

NODE=M078R13;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                        | EVTS | DOCUMENT ID        | TECN     | COMMENT                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------|----------|-------------------------------------------------|
| <b><math>0.84 \pm 0.40 \pm 0.04</math></b>                                                                                                                                                                                                                                                                                                                                                                                                      | 7    | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^-$ |
| <sup>1</sup> ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \rightarrow 4\pi^+ 4\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (6 \pm 2 \pm 2) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                    |          |                                                 |

NODE=M078R14  
 NODE=M078R14

NODE=M078R14;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                   | EVTS | DOCUMENT ID        | TECN     | COMMENT                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------|----------|--------------------------------------------------------|
| <b><math>18 \pm 7 \pm 1</math></b>                                                                                                                                                                                                                                                                                                                                                                                                                         | 29   | <sup>1</sup> ASNER | 08A CLEO | $\Upsilon(2S) \rightarrow \gamma 4\pi^+ 4\pi^- 2\pi^0$ |
| <sup>1</sup> ASNER 08A reports $[\Gamma(\chi_{b2}(1P) \rightarrow 4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] = (132 \pm 31 \pm 40) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                    |          |                                                        |

NODE=M078R15  
 NODE=M078R15

NODE=M078R15;LINKAGE=AS

 $\Gamma(J/\psi J/\psi)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                     | CL% | DOCUMENT ID       | TECN    | COMMENT                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------------|---------|------------------------------------------|
| <b>&lt;5</b>                                                                                                                                                                                                                                                                                                 | 90  | <sup>1</sup> SHEN | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| <sup>1</sup> SHEN 12 reports $< 4.5 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b2}(1P) \rightarrow J/\psi J/\psi)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))]$ assuming $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . |     |                   |         |                                          |

NODE=M078R16  
 NODE=M078R16

NODE=M078R16;LINKAGE=SH

 $\Gamma(J/\psi \psi(2S))/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                       | CL% | DOCUMENT ID       | TECN    | COMMENT                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------------|---------|------------------------------------------|
| <b>&lt;5</b>                                                                                                                                                                                                                                                                                                   | 90  | <sup>1</sup> SHEN | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| <sup>1</sup> SHEN 12 reports $< 4.9 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b2}(1P) \rightarrow J/\psi \psi(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))]$ assuming $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . |     |                   |         |                                          |

NODE=M078R17  
 NODE=M078R17

NODE=M078R17;LINKAGE=SH

 $\Gamma(\psi(2S) \psi(2S))/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ 

| VALUE (units $10^{-5}$ )                                                                                                                                                                                                                                                                                         | CL% | DOCUMENT ID       | TECN    | COMMENT                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------------|---------|------------------------------------------|
| <b>&lt;1.6</b>                                                                                                                                                                                                                                                                                                   | 90  | <sup>1</sup> SHEN | 12 BELL | $\Upsilon(2S) \rightarrow \gamma \psi X$ |
| <sup>1</sup> SHEN 12 reports $< 1.6 \times 10^{-5}$ from a measurement of $[\Gamma(\chi_{b2}(1P) \rightarrow \psi(2S) \psi(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))]$ assuming $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = (7.15 \pm 0.35) \times 10^{-2}$ . |     |                   |         |                                          |

NODE=M078R18  
 NODE=M078R18

NODE=M078R18;LINKAGE=SH

 $\Gamma(J/\psi(1S) \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{20}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID | TECN     | COMMENT                              |
|--------------------------------------------|------|-------------|----------|--------------------------------------|
| <b><math>1.50 \pm 0.34 \pm 0.22</math></b> | 462  | JIA         | 17A BELL | $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M078R00  
 NODE=M078R00

 $\chi_{b2}(1P)$  Cross-Particle Branching Ratios

NODE=M078230

$$\Gamma(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))/\Gamma_{\text{total}}$$

$$\Gamma_1/\Gamma \times \Gamma_{60}^{\Upsilon(2S)}/\Gamma \Upsilon(2S)$$

| VALUE (units $10^{-3}$ )                       | EVTS | DOCUMENT ID | TECN     | COMMENT                             |
|------------------------------------------------|------|-------------|----------|-------------------------------------|
| <b><math>13.9 \pm 0.5^{+0.9}_{-1.1}</math></b> | 8k   | LEES        | 11J BABR | $\Upsilon(2S) \rightarrow X \gamma$ |

NODE=M078B03  
 NODE=M078B03

$$B(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$$

| VALUE (units $10^{-4}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**3.38 $\pm$ 0.16 OUR AVERAGE**

|                                                  |      |                   |          |                                                        |
|--------------------------------------------------|------|-------------------|----------|--------------------------------------------------------|
| 3.63 <sup>+0.36+0.18</sup> <sub>-0.34-0.19</sub> |      | <sup>1</sup> LEES | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$   |
| 3.29 $\pm$ 0.09 $\pm$ 0.16                       | 1770 | KORNICER          | 11 CLEO  | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$      |
| 4.4 $\pm$ 0.9 $\pm$ 0.5                          | 35   | WALK              | 86 CBAL  | $\Upsilon(2S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

<sup>1</sup> From a sample of  $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$  with converted photons.

$$[B(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))] / [B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$$

| VALUE (%) | DOCUMENT ID | TECN | COMMENT |
|-----------|-------------|------|---------|
|-----------|-------------|------|---------|

|                                |                   |          |                                                      |
|--------------------------------|-------------------|----------|------------------------------------------------------|
| <b>55.6<math>\pm</math>1.6</b> | <sup>1</sup> LEES | 14M BABR | $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |
|--------------------------------|-------------------|----------|------------------------------------------------------|

<sup>1</sup> From a sample of  $\Upsilon(2S) \rightarrow \gamma \gamma \mu^+ \mu^-$  events without converted photons.

$$B(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(1P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$$

| VALUE (units $10^{-5}$ ) | EVTs | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**3.8  $\pm$ 0.5 OUR AVERAGE**

|                                                   |     |                   |          |                                                      |
|---------------------------------------------------|-----|-------------------|----------|------------------------------------------------------|
| 4.68 <sup>+0.99</sup> <sub>-0.92</sub> $\pm$ 0.37 |     | <sup>1</sup> LEES | 14M BABR | $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |
| 3.56 $\pm$ 0.40 $\pm$ 0.41                        | 126 | KORNICER          | 11 CLEO  | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$    |

<sup>1</sup> From a sample of  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$  with converted photons.

### $\chi_{b2}(1P)$ REFERENCES

|            |      |                |                               |                          |
|------------|------|----------------|-------------------------------|--------------------------|
| FULSOM     | 18   | PRL 121 232001 | B.G. Fulsom <i>et al.</i>     | (BELLE Collab.)          |
| JIA        | 17A  | PR D96 112002  | S. Jia <i>et al.</i>          | (BELLE Collab.)          |
| AAIJ       | 14BG | JHEP 1410 088  | R. Aaij <i>et al.</i>         | (LHCb Collab.)           |
| LEES       | 14M  | PR D90 112010  | J.P. Lees <i>et al.</i>       | (BABAR Collab.)          |
| SHEN       | 12   | PR D85 071102  | C.P. Shen <i>et al.</i>       | (BELLE Collab.)          |
| KORNICER   | 11   | PR D83 054003  | M. Kornicer <i>et al.</i>     | (CLEO Collab.)           |
| LEES       | 11J  | PR D84 072002  | J.P. Lees <i>et al.</i>       | (BABAR Collab.)          |
| ASNER      | 08A  | PR D78 091103  | D.M. Asner <i>et al.</i>      | (CLEO Collab.)           |
| BRIERE     | 08   | PR D78 092007  | R.A. Briere <i>et al.</i>     | (CLEO Collab.)           |
| ARTUSO     | 05   | PRL 94 032001  | M. Artuso <i>et al.</i>       | (CLEO Collab.)           |
| EDWARDS    | 99   | PR D59 032003  | K.W. Edwards <i>et al.</i>    | (CLEO Collab.)           |
| SKWARNICKI | 87   | PRL 58 972     | T. Skwarnicki <i>et al.</i>   | (Crystal Ball Collab.)   |
| WALK       | 86   | PR D34 2611    | W.S. Walk <i>et al.</i>       | (Crystal Ball Collab.)   |
| ALBRECHT   | 85E  | PL 160B 331    | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)          |
| NERNST     | 85   | PRL 54 2195    | R. Nernst <i>et al.</i>       | (Crystal Ball Collab.)   |
| HAAS       | 84   | PRL 52 799     | J. Haas <i>et al.</i>         | (CLEO Collab.)           |
| KLOPFEN... | 83   | PRL 51 160     | C. Klopfenstein <i>et al.</i> | (CUSB Collab.)           |
| PAUSS      | 83   | PL 130B 439    | F. Pauss <i>et al.</i>        | (MPIM, COLU, CORN, LSU+) |

$$\eta_b(2S)$$

$$J^G(J^{PC}) = 0^+(0^-+)$$

OMITTED FROM SUMMARY TABLE

Quantum numbers shown are quark-model predictions.

### $\eta_b(2S)$ MASS

| VALUE (MeV) | EVTs | DOCUMENT ID | TECN | COMMENT |
|-------------|------|-------------|------|---------|
|-------------|------|-------------|------|---------|

|                                                                |     |                    |         |                                                           |
|----------------------------------------------------------------|-----|--------------------|---------|-----------------------------------------------------------|
| <b>9999.0<math>\pm</math>3.5<sup>+2.8</sup><sub>-1.9</sub></b> | 26k | <sup>1</sup> MIZUK | 12 BELL | $e^+ e^- \rightarrow \gamma \pi^+ \pi^- + \text{hadrons}$ |
|----------------------------------------------------------------|-----|--------------------|---------|-----------------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                            |            |                        |    |                                                   |
|----------------------------|------------|------------------------|----|---------------------------------------------------|
| 9974.6 $\pm$ 2.3 $\pm$ 2.1 | 11 $\pm$ 4 | <sup>2,3,4</sup> DOBBS | 12 | $\Upsilon(2S) \rightarrow \gamma \text{ hadrons}$ |
|----------------------------|------------|------------------------|----|---------------------------------------------------|

<sup>1</sup> Assuming  $\Gamma_{\eta_b(2S)} = 4.9$  MeV. Not independent of the corresponding mass difference measurement.

<sup>2</sup> SANDILYA 13 (Belle Collab.) search for such a state reconstructed in the same 26 exclusive hadronic final states as DOBBS 12 using a sample of  $(157.8 \pm 3.6) \times 10^6$   $\Upsilon(2S)$  decays or about 17 times larger and find no evidence for a signal. Their 90% C.L. upper limit on the branching fraction  $B(\Upsilon(2S) \rightarrow \eta_b(2S) \gamma) \times \sum_i B(\eta_b(2S) \rightarrow X_i) < 4.9 \times 10^{-6}$ , summed over the exclusive hadronic final states  $X_i$ , is an order of magnitude smaller than that reported by DOBBS 12.

<sup>3</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

<sup>4</sup> Assuming  $\Gamma_{\eta_b(2S)} = 5$  MeV. Not independent of the corresponding mass difference measurement.

$$m_{\Upsilon(2S)} - m_{\eta_b(2S)}$$

| VALUE (MeV)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | EVTS       | DOCUMENT ID            | TECN | COMMENT                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------|------|---------------------------------------------------------|
| $24.3 \pm 3.5^{+2.8}_{-1.9}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 26k        | <sup>5</sup> MIZUK     | 12   | BELL $e^+e^- \rightarrow \gamma\pi^+\pi^- +$<br>hadrons |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |                        |      |                                                         |
| $48.7 \pm 2.3 \pm 2.1$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | $11 \pm 4$ | <sup>6,7,8</sup> DOBBS | 12   | $\Upsilon(2S) \rightarrow \gamma$ hadrons               |
| <sup>5</sup> Assuming $\Gamma_{\eta_b(2S)} = 4.9$ MeV. Not independent of the corresponding mass measurement.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |                        |      |                                                         |
| <sup>6</sup> SANDILYA 13 (Belle Collab.) search for such a state reconstructed in the same 26 exclusive hadronic final states as DOBBS 12 using a sample of $(157.8 \pm 3.6) \times 10^6$ $\Upsilon(2S)$ decays or about 17 times larger and find no evidence for a signal. Their 90% C.L. upper limit on the branching fraction $B(\Upsilon(2S) \rightarrow \eta_b(2S)\gamma) \times \sum_i B(\eta_b(2S) \rightarrow X_i) < 4.9 \times 10^{-6}$ , summed over the exclusive hadronic final states $X_i$ , is an order of magnitude smaller than that reported by DOBBS 12. |            |                        |      |                                                         |
| <sup>7</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |            |                        |      |                                                         |
| <sup>8</sup> Assuming $\Gamma_{\eta_b(2S)} = 5$ MeV. Not independent of the corresponding mass measurement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |            |                        |      |                                                         |

### $\eta_b(2S)$ WIDTH

| VALUE (MeV)   | CL% | DOCUMENT ID | TECN | COMMENT                                            |
|---------------|-----|-------------|------|----------------------------------------------------|
| <b>&lt;24</b> | 90  | MIZUK       | 12   | BELL $e^+e^- \rightarrow \gamma\pi^+\pi^-$ hadrons |

### $\eta_b(2S)$ DECAY MODES

| Mode               | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------|--------------------------------|
| $\Gamma_1$ hadrons | seen                           |

### $\eta_b(2S)$ BRANCHING RATIOS

| $\Gamma(\text{hadrons})/\Gamma_{\text{total}}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                 |             |      | $\Gamma_1/\Gamma$                                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------|------|----------------------------------------------------|--|
| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | EVTS            | DOCUMENT ID | TECN | COMMENT                                            |  |
| <b>seen</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 26k             | MIZUK       | 12   | BELL $e^+e^- \rightarrow \gamma\pi^+\pi^-$ hadrons |  |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |             |      |                                                    |  |
| seen                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <sup>9,10</sup> | DOBBS       | 12   | $\Upsilon(2S) \rightarrow \gamma$ hadrons          |  |
| <sup>9</sup> SANDILYA 13 (Belle Collab.) search for such a state reconstructed in the same 26 exclusive hadronic final states as DOBBS 12 using a sample of $(157.8 \pm 3.6) \times 10^6$ $\Upsilon(2S)$ decays or about 17 times larger and find no evidence for a signal. Their 90% C.L. upper limit on the branching fraction $B(\Upsilon(2S) \rightarrow \eta_b(2S)\gamma) \times \sum_i B(\eta_b(2S) \rightarrow X_i) < 4.9 \times 10^{-6}$ , summed over the exclusive hadronic final states $X_i$ , is an order of magnitude smaller than that reported by DOBBS 12. |                 |             |      |                                                    |  |
| <sup>10</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                 |             |      |                                                    |  |

### $\eta_b(2S)$ REFERENCES

|          |    |                |                           |                 |
|----------|----|----------------|---------------------------|-----------------|
| SANDILYA | 13 | PRL 111 112001 | S. Sandilya <i>et al.</i> | (BELLE Collab.) |
| DOBBS    | 12 | PRL 109 082001 | S. Dobbs <i>et al.</i>    |                 |
| MIZUK    | 12 | PRL 109 232002 | R. Mizuk <i>et al.</i>    | (BELLE Collab.) |

NODE=M200DM

NODE=M200DM;LINKAGE=MI

NODE=M200DM;LINKAGE=A

NODE=M200DM;LINKAGE=DO

NODE=M200DM;LINKAGE=NI

NODE=M200W

NODE=M200W

NODE=M200215;NODE=M200

DESIG=1

NODE=M200225

NODE=M200R01  
NODE=M200R01

NODE=M200R01;LINKAGE=A

NODE=M200R01;LINKAGE=DO

NODE=M200

REFID=55590  
REFID=54288  
REFID=54718

$\Upsilon(2S)$ 

$$J^G(J^{PC}) = 0^-(1^{--})$$

NODE=M052

 **$\Upsilon(2S)$  MASS**

NODE=M052M

| VALUE (MeV)                                                                   | DOCUMENT ID               | TECN | COMMENT                             |
|-------------------------------------------------------------------------------|---------------------------|------|-------------------------------------|
| <b>10023.26±0.31 OUR AVERAGE</b>                                              |                           |      |                                     |
| 10023.5 ±0.5                                                                  | <sup>1</sup> ARTAMONOV 00 | MD1  | $e^+e^- \rightarrow \text{hadrons}$ |
| 10023.1 ±0.4                                                                  | BARBER 84                 | REDE | $e^+e^- \rightarrow \text{hadrons}$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                           |      |                                     |
| 10023.6 ±0.5                                                                  | <sup>2,3</sup> BARU 86B   | REDE | $e^+e^- \rightarrow \text{hadrons}$ |
| <sup>1</sup> Reanalysis of BARU 86B using new electron mass (COHEN 87).       |                           |      |                                     |
| <sup>2</sup> Reanalysis of ARTAMONOV 84.                                      |                           |      |                                     |
| <sup>3</sup> Superseded by ARTAMONOV 00.                                      |                           |      |                                     |

NODE=M052M

NODE=M052M;LINKAGE=AR  
 NODE=M052M;LINKAGE=C  
 NODE=M052M;LINKAGE=RZ

 **$m\Upsilon(3S) - m\Upsilon(2S)$** 

NODE=M052DM3

| VALUE (MeV)             | DOCUMENT ID | TECN | COMMENT                          |
|-------------------------|-------------|------|----------------------------------|
| <b>331.50±0.02±0.13</b> | LEES 11C    | BABR | $e^+e^- \rightarrow \pi^+\pi^-X$ |

NODE=M052DM3

 **$\Upsilon(2S)$  WIDTH**

NODE=M052W

| VALUE (keV)                      | DOCUMENT ID                                                     |
|----------------------------------|-----------------------------------------------------------------|
| <b>31.98±2.63 OUR EVALUATION</b> | See the Note on "Width Determinations of the $\Upsilon$ States" |

NODE=M052W  
 → UNCHECKED ←

 **$\Upsilon(2S)$  DECAY MODES**

NODE=M052215;NODE=M052

| Mode                                            | Fraction ( $\Gamma_i/\Gamma$ )   | Scale factor/<br>Confidence level |           |
|-------------------------------------------------|----------------------------------|-----------------------------------|-----------|
| $\Gamma_1 \quad \Upsilon(1S)\pi^+\pi^-$         | (17.85 ± 0.26) %                 |                                   | DESIG=4   |
| $\Gamma_2 \quad \Upsilon(1S)\pi^0\pi^0$         | ( 8.6 ± 0.4 ) %                  |                                   | DESIG=5   |
| $\Gamma_3 \quad \tau^+\tau^-$                   | ( 2.00 ± 0.21 ) %                |                                   | DESIG=3   |
| $\Gamma_4 \quad \mu^+\mu^-$                     | ( 1.93 ± 0.17 ) %                | S=2.2                             | DESIG=1   |
| $\Gamma_5 \quad e^+e^-$                         | ( 1.91 ± 0.16 ) %                |                                   | DESIG=2   |
| $\Gamma_6 \quad \Upsilon(1S)\pi^0$              | < 4 × 10 <sup>-5</sup>           | CL=90%                            | DESIG=10  |
| $\Gamma_7 \quad \Upsilon(1S)\eta$               | ( 2.9 ± 0.4 ) × 10 <sup>-4</sup> | S=2.0                             | DESIG=6   |
| $\Gamma_8 \quad J/\psi(1S) \text{ anything}$    | < 6 × 10 <sup>-3</sup>           | CL=90%                            | DESIG=20  |
| $\Gamma_9 \quad J/\psi(1S)\eta_c$               | < 5.4 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=143 |
| $\Gamma_{10} \quad J/\psi(1S)\chi_{c0}$         | < 3.4 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=144 |
| $\Gamma_{11} \quad J/\psi(1S)\chi_{c1}$         | < 1.2 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=145 |
| $\Gamma_{12} \quad J/\psi(1S)\chi_{c2}$         | < 2.0 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=146 |
| $\Gamma_{13} \quad J/\psi(1S)\eta_c(2S)$        | < 2.5 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=147 |
| $\Gamma_{14} \quad J/\psi(1S)X(3940)$           | < 2.0 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=148 |
| $\Gamma_{15} \quad J/\psi(1S)X(4160)$           | < 2.0 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=149 |
| $\Gamma_{16} \quad \chi_{c1} \text{ anything}$  | ( 2.2 ± 0.5 ) × 10 <sup>-4</sup> |                                   | DESIG=157 |
| $\Gamma_{17} \quad \chi_{c1}(1P)^0 X_{tetra}$   | < 3.67 × 10 <sup>-5</sup>        | CL=90%                            | DESIG=160 |
| $\Gamma_{18} \quad \chi_{c2} \text{ anything}$  | ( 2.3 ± 0.8 ) × 10 <sup>-4</sup> |                                   | DESIG=158 |
| $\Gamma_{19} \quad \psi(2S)\eta_c$              | < 5.1 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=150 |
| $\Gamma_{20} \quad \psi(2S)\chi_{c0}$           | < 4.7 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=151 |
| $\Gamma_{21} \quad \psi(2S)\chi_{c1}$           | < 2.5 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=152 |
| $\Gamma_{22} \quad \psi(2S)\chi_{c2}$           | < 1.9 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=153 |
| $\Gamma_{23} \quad \psi(2S)\eta_c(2S)$          | < 3.3 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=154 |
| $\Gamma_{24} \quad \psi(2S)X(3940)$             | < 3.9 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=155 |
| $\Gamma_{25} \quad \psi(2S)X(4160)$             | < 3.9 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=156 |
| $\Gamma_{26} \quad Z_c(3900)^+ Z_c(3900)^-$     | < 1.0 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=162 |
| $\Gamma_{27} \quad Z_c(4200)^+ Z_c(4200)^-$     | < 1.67 × 10 <sup>-5</sup>        | CL=90%                            | DESIG=163 |
| $\Gamma_{28} \quad Z_c(3900)^\pm Z_c(4200)^\mp$ | < 7.3 × 10 <sup>-6</sup>         | CL=90%                            | DESIG=164 |
| $\Gamma_{29} \quad X(4050)^+ X(4050)^-$         | < 1.35 × 10 <sup>-5</sup>        | CL=90%                            | DESIG=165 |

|     |                                                     |                                         |        |           |
|-----|-----------------------------------------------------|-----------------------------------------|--------|-----------|
| Г30 | $X(4250)^+ X(4250)^-$                               | $< 2.67 \times 10^{-5}$                 | CL=90% | DESIG=166 |
| Г31 | $X(4050)^\pm X(4250)^\mp$                           | $< 2.72 \times 10^{-5}$                 | CL=90% | DESIG=167 |
| Г32 | $Z_c(4430)^+ Z_c(4430)^-$                           | $< 2.03 \times 10^{-5}$                 | CL=90% | DESIG=168 |
| Г33 | $X(4055)^\pm X(4055)^\mp$                           | $< 1.11 \times 10^{-5}$                 | CL=90% | DESIG=170 |
| Г34 | $X(4055)^\pm Z_c(4430)^\mp$                         | $< 2.11 \times 10^{-5}$                 | CL=90% | DESIG=171 |
| Г35 | $\overline{2H}$ anything                            | $(2.78^{+0.30}_{-0.26}) \times 10^{-5}$ | S=1.2  | DESIG=16  |
| Г36 | hadrons                                             | $(94 \pm 11) \%$                        |        | DESIG=101 |
| Г37 | $g g g$                                             | $(58.8 \pm 1.2) \%$                     |        | DESIG=105 |
| Г38 | $\gamma g g$                                        | $(1.87 \pm 0.28) \%$                    |        | DESIG=106 |
| Г39 | $\phi K^+ K^-$                                      | $(1.6 \pm 0.4) \times 10^{-6}$          |        | DESIG=133 |
| Г40 | $\omega \pi^+ \pi^-$                                | $< 2.58 \times 10^{-6}$                 | CL=90% | DESIG=134 |
| Г41 | $K^*(892)^0 K^- \pi^+ + \text{c.c.}$                | $(2.3 \pm 0.7) \times 10^{-6}$          |        | DESIG=135 |
| Г42 | $\phi f'_2(1525)$                                   | $< 1.33 \times 10^{-6}$                 | CL=90% | DESIG=136 |
| Г43 | $\omega f_2(1270)$                                  | $< 5.7 \times 10^{-7}$                  | CL=90% | DESIG=137 |
| Г44 | $\rho(770) a_2(1320)$                               | $< 8.8 \times 10^{-7}$                  | CL=90% | DESIG=138 |
| Г45 | $K^*(892)^0 \overline{K}_2^*(1430)^0 + \text{c.c.}$ | $(1.5 \pm 0.6) \times 10^{-6}$          |        | DESIG=139 |
| Г46 | $K_1(1270)^\pm K^\mp$                               | $< 3.22 \times 10^{-6}$                 | CL=90% | DESIG=140 |
| Г47 | $K_1(1400)^\pm K^\mp$                               | $< 8.3 \times 10^{-7}$                  | CL=90% | DESIG=141 |
| Г48 | $b_1(1235)^\pm \pi^\mp$                             | $< 4.0 \times 10^{-7}$                  | CL=90% | DESIG=142 |
| Г49 | $\rho \pi$                                          | $< 1.16 \times 10^{-6}$                 | CL=90% | DESIG=126 |
| Г50 | $\pi^+ \pi^- \pi^0$                                 | $< 8.0 \times 10^{-7}$                  | CL=90% | DESIG=127 |
| Г51 | $\omega \pi^0$                                      | $< 1.63 \times 10^{-6}$                 | CL=90% | DESIG=128 |
| Г52 | $\pi^+ \pi^- \pi^0 \pi^0$                           | $(1.30 \pm 0.28) \times 10^{-5}$        |        | DESIG=129 |
| Г53 | $K_S^0 K^+ \pi^- + \text{c.c.}$                     | $(1.14 \pm 0.33) \times 10^{-6}$        |        | DESIG=130 |
| Г54 | $K^*(892)^0 \overline{K}^0 + \text{c.c.}$           | $< 4.22 \times 10^{-6}$                 | CL=90% | DESIG=131 |
| Г55 | $K^*(892)^- K^+ + \text{c.c.}$                      | $< 1.45 \times 10^{-6}$                 | CL=90% | DESIG=132 |
| Г56 | $f_1(1285) \text{ anything}$                        | $(2.2 \pm 1.6) \times 10^{-3}$          |        | DESIG=159 |
| Г57 | $f_1(1285) X_{tetra}$                               | $< 6.47 \times 10^{-5}$                 | CL=90% | DESIG=161 |
| Г58 | Sum of 100 exclusive modes                          | $(2.90 \pm 0.30) \times 10^{-3}$        |        | DESIG=121 |

## Radiative decays

NODE=M052;CLUMP=A

|     |                                                                           |                                      |        |           |
|-----|---------------------------------------------------------------------------|--------------------------------------|--------|-----------|
| Г59 | $\gamma \chi_{b1}(1P)$                                                    | $(6.9 \pm 0.4) \%$                   |        | DESIG=8   |
| Г60 | $\gamma \chi_{b2}(1P)$                                                    | $(7.15 \pm 0.35) \%$                 |        | DESIG=7   |
| Г61 | $\gamma \chi_{b0}(1P)$                                                    | $(3.8 \pm 0.4) \%$                   |        | DESIG=9   |
| Г62 | $\gamma f_0(1710)$                                                        | $< 5.9 \times 10^{-4}$               | CL=90% | DESIG=13  |
| Г63 | $\gamma f'_2(1525)$                                                       | $< 5.3 \times 10^{-4}$               | CL=90% | DESIG=12  |
| Г64 | $\gamma f_2(1270)$                                                        | $< 2.41 \times 10^{-4}$              | CL=90% | DESIG=11  |
| Г65 | $\gamma f_J(2220)$                                                        |                                      |        | DESIG=14  |
| Г66 | $\gamma \eta_c(1S)$                                                       | $< 2.7 \times 10^{-5}$               | CL=90% | DESIG=111 |
| Г67 | $\gamma \chi_{c0}$                                                        | $< 1.0 \times 10^{-4}$               | CL=90% | DESIG=112 |
| Г68 | $\gamma \chi_{c1}$                                                        | $< 3.6 \times 10^{-6}$               | CL=90% | DESIG=113 |
| Г69 | $\gamma \chi_{c2}$                                                        | $< 1.5 \times 10^{-5}$               | CL=90% | DESIG=114 |
| Г70 | $\gamma \chi_{c1}(3872)$                                                  | $< 2.3 \times 10^{-5}$               | CL=90% | DESIG=172 |
| Г71 | $\gamma \chi_{c1}(3872), \chi_{c1} \rightarrow \pi^+ \pi^- \pi^0 J/\psi$  | $< 2.4 \times 10^{-6}$               | CL=90% | DESIG=116 |
| Г72 | $\gamma X(3915) \rightarrow \omega J/\psi$                                | $< 2.8 \times 10^{-6}$               | CL=90% | DESIG=117 |
| Г73 | $\gamma \chi_{c1}(4140) \rightarrow \phi J/\psi$                          | $< 1.2 \times 10^{-6}$               | CL=90% | DESIG=118 |
| Г74 | $\gamma X(4350) \rightarrow \phi J/\psi$                                  | $< 1.3 \times 10^{-6}$               | CL=90% | DESIG=119 |
| Г75 | $\gamma \eta_b(1S)$                                                       | $(5.5^{+1.1}_{-0.9}) \times 10^{-4}$ | S=1.2  | DESIG=102 |
| Г76 | $\gamma \eta_b(1S) \rightarrow \gamma \text{Sum of 26 exclusive modes}$   | $< 3.7 \times 10^{-6}$               | CL=90% | DESIG=124 |
| Г77 | $\gamma X_{b\bar{b}} \rightarrow \gamma \text{Sum of 26 exclusive modes}$ | $< 4.9 \times 10^{-6}$               | CL=90% | DESIG=125 |
| Г78 | $\gamma X \rightarrow \gamma + \geq 4 \text{ prongs}$                     | [a] $< 1.95 \times 10^{-4}$          | CL=95% | DESIG=103 |
| Г79 | $\gamma A^0 \rightarrow \gamma \text{hadrons}$                            | $< 8 \times 10^{-5}$                 | CL=90% | DESIG=108 |
| Г80 | $\gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-$                             | $< 8.3 \times 10^{-6}$               | CL=90% | DESIG=123 |



**Lepton Family number (LF) violating modes**

|               |                    |    |       |                  |        |
|---------------|--------------------|----|-------|------------------|--------|
| $\Gamma_{81}$ | $e^\pm \tau^\mp$   | LF | < 3.2 | $\times 10^{-6}$ | CL=90% |
| $\Gamma_{82}$ | $\mu^\pm \tau^\mp$ | LF | < 3.3 | $\times 10^{-6}$ | CL=90% |

[a] 1.5 GeV <  $m_X$  < 5.0 GeV

NODE=M052;CLUMP=B

DESIG=107

DESIG=104

LINKAGE=C52

**CONSTRAINED FIT INFORMATION**

An overall fit to 3 branching ratios uses 13 measurements and one constraint to determine 3 parameters. The overall fit has a  $\chi^2 = 11.8$  for 11 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients  $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$ , in percent, from the fit to the branching fractions,  $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$ . The fit constrains the  $x_i$  whose labels appear in this array to sum to one.

$$x_7 \quad \left| \quad \frac{2}{x_1} \right.$$

 **$\tau(2S) \Gamma(i) \Gamma(e^+ e^-) / \Gamma(\text{total})$** 

NODE=M052218

| $\Gamma(\mu^+ \mu^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$ | $\Gamma_4 \Gamma_5 / \Gamma$                    |
|----------------------------------------------------------------------|-------------------------------------------------|
| VALUE (eV)                                                           | DOCUMENT ID TECN COMMENT                        |
| <b><math>6.5 \pm 1.5 \pm 1.0</math></b>                              | KOBEL 92 CBAL $e^+ e^- \rightarrow \mu^+ \mu^-$ |

NODE=M052G1  
NODE=M052G1

| $\Gamma(\tau(1S) \pi^+ \pi^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$ | $\Gamma_1 \Gamma_5 / \Gamma$                                                                     |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| VALUE (eV) EVTS                                                               | DOCUMENT ID TECN COMMENT                                                                         |
| <b><math>105.4 \pm 1.0 \pm 4.2</math></b>                                     | 11.8k <sup>1</sup> AUBERT 08BP BABR 10.58 $e^+ e^- \rightarrow \gamma \pi^+ \pi^- \ell^+ \ell^-$ |

NODE=M052G03  
NODE=M052G03

<sup>1</sup> Using  $B(\tau(1S) \rightarrow e^+ e^-) = (2.38 \pm 0.11)\%$  and  $B(\tau(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\%$ .

NODE=M052G03;LINKAGE=AU

| $\Gamma(\text{hadrons}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$ | $\Gamma_{36} \Gamma_5 / \Gamma$ |
|-------------------------------------------------------------------------|---------------------------------|
| VALUE (keV)                                                             | DOCUMENT ID TECN COMMENT        |
| <b><math>0.577 \pm 0.009</math> OUR AVERAGE</b>                         |                                 |

NODE=M052G2  
NODE=M052G2

|                                   |                                                                       |
|-----------------------------------|-----------------------------------------------------------------------|
| 0.581 $\pm 0.004 \pm 0.009$       | <sup>1</sup> ROSNER 06 CLEO 10.0 $e^+ e^- \rightarrow \text{hadrons}$ |
| 0.552 $\pm 0.031 \pm 0.017$       | <sup>1</sup> BARU 96 MD1 $e^+ e^- \rightarrow \text{hadrons}$         |
| 0.54 $\pm 0.04 \pm 0.02$          | <sup>1</sup> JAKUBOWSKI 88 CBAL $e^+ e^- \rightarrow \text{hadrons}$  |
| 0.58 $\pm 0.03 \pm 0.04$          | <sup>2</sup> GILES 84B CLEO $e^+ e^- \rightarrow \text{hadrons}$      |
| 0.60 $\pm 0.12 \pm 0.07$          | <sup>2</sup> ALBRECHT 82 DASP $e^+ e^- \rightarrow \text{hadrons}$    |
| 0.54 $\pm 0.07 \pm 0.09$<br>-0.05 | <sup>2</sup> NICZYPORUK 81C LENA $e^+ e^- \rightarrow \text{hadrons}$ |
| 0.41 $\pm 0.18$                   | <sup>2</sup> BOCK 80 CNTR $e^+ e^- \rightarrow \text{hadrons}$        |

<sup>1</sup> Radiative corrections evaluated following KURAEV 85.

<sup>2</sup> Radiative corrections reevaluated by BUCHMUELLER 88 following KURAEV 85.

NODE=M052G2;LINKAGE=P  
NODE=M052G2;LINKAGE=R **$\tau(2S)$  PARTIAL WIDTHS**

NODE=M052220

| $\Gamma(e^+ e^-)$                                  | $\Gamma_5$  |
|----------------------------------------------------|-------------|
| VALUE (keV)                                        | DOCUMENT ID |
| <b><math>0.612 \pm 0.011</math> OUR EVALUATION</b> |             |

NODE=M052W2  
NODE=M052W2

→ UNCHECKED ←

 **$\tau(2S)$  BRANCHING RATIOS**

NODE=M052225

| $\Gamma(\tau(1S) \pi^+ \pi^-) / \Gamma_{\text{total}}$ | $\Gamma_1 / \Gamma$      |
|--------------------------------------------------------|--------------------------|
| VALUE (units $10^{-2}$ ) EVTS                          | DOCUMENT ID TECN COMMENT |
| <b><math>17.85 \pm 0.26</math> OUR FIT</b>             |                          |
| <b><math>17.92 \pm 0.26</math> OUR AVERAGE</b>         |                          |

Abbreviation MM in the COMMENT field below stands for missing mass.

|                           |       |                                                                                      |
|---------------------------|-------|--------------------------------------------------------------------------------------|
| 16.8 $\pm 1.1 \pm 1.3$    | 906k  | <sup>1</sup> LEES 11C BABR $e^+ e^- \rightarrow \pi^+ \pi^- X$                       |
| 17.80 $\pm 0.05 \pm 0.37$ | 170k  | <sup>2</sup> LEES 11L BABR $\tau(2S) \rightarrow \pi^+ \pi^- \mu^+ \mu^-$            |
| 18.02 $\pm 0.02 \pm 0.61$ | 851k  | <sup>3</sup> BHARI 09 CLEO $e^+ e^- \rightarrow \pi^+ \pi^- \text{MM}$               |
| 17.22 $\pm 0.17 \pm 0.75$ | 11.8k | <sup>4</sup> AUBERT 08BP BABR $e^+ e^- \rightarrow \gamma \pi^+ \pi^- \ell^+ \ell^-$ |
| 19.2 $\pm 0.2 \pm 1.0$    | 52.6k | <sup>5</sup> ALEXANDER 98 CLE2 $\pi^+ \pi^- \ell^+ \ell^-, \pi^+ \pi^- \text{MM}$    |

NODE=M052R4  
NODE=M052R4  
NODE=M052R4

|                |       |            |     |      |                                             |
|----------------|-------|------------|-----|------|---------------------------------------------|
| 18.1 ±0.5 ±1.0 | 11.6k | ALBRECHT   | 87  | ARG  | $e^+e^- \rightarrow \pi^+\pi^-$ MM          |
| 16.9 ±4.0      |       | GELPHMAN   | 85  | CBAL | $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$       |
| 19.1 ±1.2 ±0.6 |       | BESSON     | 84  | CLEO | $\pi^+\pi^-$ MM                             |
| 18.9 ±2.6      |       | FONSECA    | 84  | CUSB | $e^+e^- \rightarrow \ell^+\ell^-\pi^+\pi^-$ |
| 21 ±7          | 7     | NICZYPORUK | 81B | LENA | $e^+e^- \rightarrow \ell^+\ell^-\pi^+\pi^-$ |

<sup>1</sup> LEES 11C reports  $[\Gamma(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \Upsilon(2S)\text{anything})] = (1.78 \pm 0.02 \pm 0.11) \times 10^{-2}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \Upsilon(2S)\text{anything}) = (10.6 \pm 0.8) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Using  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ .

<sup>3</sup> A weighted average of the inclusive and exclusive results.

<sup>4</sup> Using  $B(\Upsilon(2S) \rightarrow e^+e^-) = (1.91 \pm 0.16)\%$ ,  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.93 \pm 0.17)\%$  and,  $\Gamma_{ee}(\Upsilon(2S)) = 0.612 \pm 0.011$  keV.

<sup>5</sup> Using  $B(\Upsilon(1S) \rightarrow e^+e^-) = (2.52 \pm 0.17)\%$  and  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.07)\%$ .

NODE=M052R4;LINKAGE=ES

NODE=M052R4;LINKAGE=LE

NODE=M052R4;LINKAGE=BH

NODE=M052R4;LINKAGE=AU

NODE=M052R4;LINKAGE=T

## $\Gamma(\Upsilon(1S)\pi^0\pi^0)/\Gamma_{\text{total}}$ $\Gamma_2/\Gamma$

| VALUE (units $10^{-2}$ )    | EVTS | DOCUMENT ID            | TECN | COMMENT                                          |
|-----------------------------|------|------------------------|------|--------------------------------------------------|
| <b>8.6 ±0.4 OUR AVERAGE</b> |      |                        |      |                                                  |
| 8.43 ±0.16 ±0.42            | 38k  | <sup>1</sup> BHARI     | 09   | CLEO $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$ |
| 9.2 ±0.6 ±0.8               | 275  | <sup>2</sup> ALEXANDER | 98   | CLE2 $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$ |
| 9.5 ±1.9 ±1.9               | 25   | ALBRECHT               | 87   | ARG $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$  |
| 8.0 ±1.5                    |      | GELPHMAN               | 85   | CBAL $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$ |
| 10.3 ±2.3                   |      | FONSECA                | 84   | CUSB $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$ |

<sup>1</sup> Authors assume  $B(\Upsilon(1S) \rightarrow e^+e^-) + B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = 4.96\%$ .

<sup>2</sup> Using  $B(\Upsilon(1S) \rightarrow e^+e^-) = (2.52 \pm 0.17)\%$  and  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.07)\%$ .

NODE=M052R5

NODE=M052R5

NODE=M052R5;LINKAGE=BH

NODE=M052R5;LINKAGE=T

## $\Gamma(\Upsilon(1S)\pi^0\pi^0)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$ $\Gamma_2/\Gamma_1$

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.462 ±0.037 <sup>1</sup> BHARI 09 CLEO  $e^+e^- \rightarrow \Upsilon(2S)$

<sup>1</sup> Not independent of other values reported by BHARI 09.

NODE=M052R21

NODE=M052R21

NODE=M052R21;LINKAGE=BH

## $\Gamma(\tau^+\tau^-)/\Gamma_{\text{total}}$ $\Gamma_3/\Gamma$

| VALUE (units $10^{-2}$ )      | EVTS | DOCUMENT ID         | TECN | COMMENT                                                         |
|-------------------------------|------|---------------------|------|-----------------------------------------------------------------|
| <b>2.00 ±0.21 OUR AVERAGE</b> |      |                     |      |                                                                 |
| 2.00 ±0.12 ±0.18              | 22k  | <sup>1</sup> BESSON | 07   | CLEO $e^+e^- \rightarrow \Upsilon(2S) \rightarrow \tau^+\tau^-$ |
| 1.7 ±1.5 ±0.6                 |      | HAAS                | 84B  | CLEO $e^+e^- \rightarrow \tau^+\tau^-$                          |

<sup>1</sup> BESSON 07 reports  $[\Gamma(\Upsilon(2S) \rightarrow \tau^+\tau^-)/\Gamma_{\text{total}}] / [B(\Upsilon(2S) \rightarrow \mu^+\mu^-)] = 1.04 \pm 0.04 \pm 0.05$  which we multiply by our best value  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.93 \pm 0.17) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M052R3

NODE=M052R3

NODE=M052R3;LINKAGE=BE

## $\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$ $\Gamma_4/\Gamma$

| VALUE                             | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                                                     |
|-----------------------------------|-----|------|-------------|------|-------------------------------------------------------------|
| <b>0.0193 ±0.0017 OUR AVERAGE</b> |     |      |             |      | Error includes scale factor of 2.2. See the ideogram below. |

|                        |      |                       |     |      |                                 |
|------------------------|------|-----------------------|-----|------|---------------------------------|
| 0.0203 ±0.0003 ±0.0008 | 120k | ADAMS                 | 05  | CLEO | $e^+e^- \rightarrow \mu^+\mu^-$ |
| 0.0122 ±0.0028 ±0.0019 |      | <sup>1</sup> KOBEL    | 92  | CBAL | $e^+e^- \rightarrow \mu^+\mu^-$ |
| 0.0138 ±0.0025 ±0.0015 |      | KAARSBERG             | 89  | CSB2 | $e^+e^- \rightarrow \mu^+\mu^-$ |
| 0.009 ±0.006 ±0.006    |      | <sup>2</sup> ALBRECHT | 85  | ARG  | $e^+e^- \rightarrow \mu^+\mu^-$ |
| 0.018 ±0.008 ±0.005    |      | HAAS                  | 84B | CLEO | $e^+e^- \rightarrow \mu^+\mu^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.038 90 NICZYPORUK 81C LENA  $e^+e^- \rightarrow \mu^+\mu^-$

<sup>1</sup> Taking into account interference between the resonance and continuum.

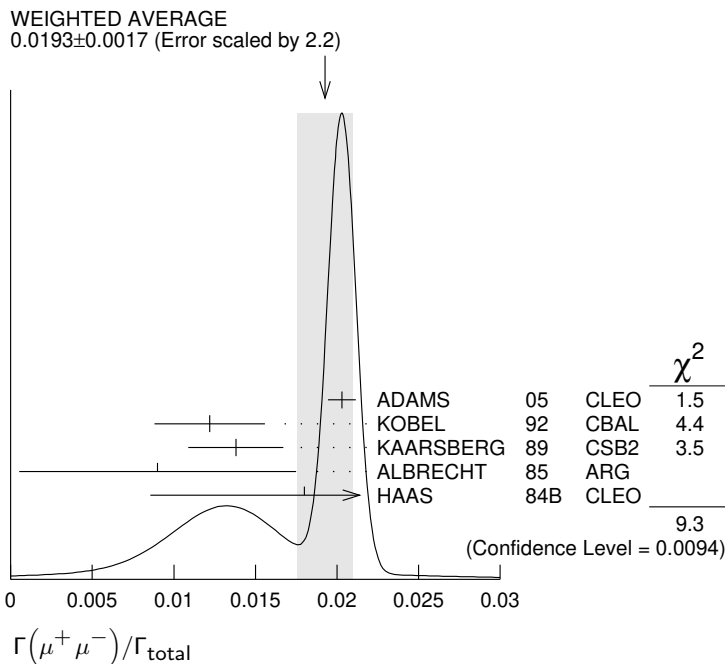
<sup>2</sup> Re-evaluated using  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = 0.026$ .

NODE=M052R1

NODE=M052R1

NODE=M052R1;LINKAGE=A

NODE=M052R1;LINKAGE=R



### $\Gamma(\tau^+ \tau^-)/\Gamma(\mu^+ \mu^-)$

| VALUE                 | EVTS | DOCUMENT ID | TECN | COMMENT                             | $\Gamma_3/\Gamma_4$ |
|-----------------------|------|-------------|------|-------------------------------------|---------------------|
| <b>1.04±0.04±0.05</b> | 22k  | BESSION     | 07   | CLEO $e^+ e^- \rightarrow \tau(2S)$ |                     |

NODE=M052R17  
NODE=M052R17

### $\Gamma(\tau(1S)\pi^0)/\Gamma_{\text{total}}$

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN | COMMENT | $\Gamma_6/\Gamma$ |
|--------------------------|-----|-------------|------|---------|-------------------|
|--------------------------|-----|-------------|------|---------|-------------------|

NODE=M052R10  
NODE=M052R10

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                      |     |      |                                                   |
|-------|----|----------------------|-----|------|---------------------------------------------------|
| < 4   | 90 | <sup>1</sup> TAMPONI | 13  | BELL | $e^+ e^- \rightarrow \tau(1S)\pi^0$               |
| < 18  | 90 | <sup>2</sup> HE      | 08A | CLEO | $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$ |
| < 110 | 90 | ALEXANDER            | 98  | CLE2 | $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$ |
| < 800 | 90 | LURZ                 | 87  | CBAL | $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$ |

<sup>1</sup> TAMPONI 13 reports  $[\Gamma(\tau(2S) \rightarrow \tau(1S)\pi^0)/\Gamma_{\text{total}}] / [B(\tau(2S) \rightarrow \tau(1S)\pi^+\pi^-)] < 2.3 \times 10^{-4}$  which we multiply by our best value  $B(\tau(2S) \rightarrow \tau(1S)\pi^+\pi^-) = 17.85 \times 10^{-2}$ .

NODE=M052R10;LINKAGE=TA

<sup>2</sup> Authors assume  $B(\tau(1S) \rightarrow e^+ e^-) + B(\tau(1S) \rightarrow \mu^+ \mu^-) = 4.96\%$ .

NODE=M052R10;LINKAGE=HE

### $\Gamma(\tau(1S)\pi^0)/\Gamma(\tau(1S)\pi^+\pi^-)$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                  | $\Gamma_6/\Gamma_1$ |
|--------------------------|-----|-------------|------|------------------------------------------|---------------------|
| <b>&lt;2.3</b>           | 90  | TAMPONI     | 13   | BELL $e^+ e^- \rightarrow \tau(1S)\pi^0$ |                     |

NODE=M052R09  
NODE=M052R09

### $\Gamma(\tau(1S)\eta)/\Gamma_{\text{total}}$

| VALUE (units $10^{-4}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT | $\Gamma_7/\Gamma$ |
|--------------------------|-----|------|-------------|------|---------|-------------------|
|--------------------------|-----|------|-------------|------|---------|-------------------|

NODE=M052R6  
NODE=M052R6

**2.9 ±0.4 OUR FIT** Error includes scale factor of 2.0.

**2.9 ±0.4 OUR AVERAGE** Error includes scale factor of 1.9. See the ideogram below.

|                                          |     |                   |     |      |                                           |
|------------------------------------------|-----|-------------------|-----|------|-------------------------------------------|
| 2.39±0.31±0.14                           | 112 | <sup>1</sup> LEES | 11L | BABR | $\tau(2S) \rightarrow \ell^+ \ell^- \eta$ |
| 2.1 <sup>+0.7</sup> <sub>-0.6</sub> ±0.3 | 14  | <sup>2</sup> HE   | 08A | CLEO | $e^+ e^- \rightarrow \ell^+ \ell^- \eta$  |

• • • We use the following data for averages but not for fits. • • •

|                |     |                      |    |      |                                    |
|----------------|-----|----------------------|----|------|------------------------------------|
| 3.55±0.32±0.05 | 241 | <sup>3</sup> TAMPONI | 13 | BELL | $e^+ e^- \rightarrow \tau(1S)\eta$ |
|----------------|-----|----------------------|----|------|------------------------------------|

NOTFITTED

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                       |      |      |                                                                        |
|-------|----|-----------------------|------|------|------------------------------------------------------------------------|
| < 9   | 90 | <sup>1,4</sup> AUBERT | 08BP | BABR | $e^+ e^- \rightarrow \gamma \pi^+ \pi^- \pi^0 \ell^+ \ell^-$           |
| < 28  | 90 | ALEXANDER             | 98   | CLE2 | $e^+ e^- \rightarrow \ell^+ \ell^- \eta$                               |
| < 50  | 90 | ALBRECHT              | 87   | ARG  | $e^+ e^- \rightarrow \pi^+ \pi^- \ell^+ \ell^- \text{MM}$              |
| < 70  | 90 | LURZ                  | 87   | CBAL | $e^+ e^- \rightarrow \ell^+ \ell^- (\gamma \gamma, 3\pi^0)$            |
| < 100 | 90 | BESSION               | 84   | CLEO | $e^+ e^- \rightarrow \pi^+ \pi^- \ell^+ \ell^- \text{MM}$              |
| < 20  | 90 | FONSECA               | 84   | CUSB | $e^+ e^- \rightarrow \ell^+ \ell^- (\gamma \gamma, \pi^+ \pi^- \pi^0)$ |

<sup>1</sup> Using  $B(\Upsilon(1S) \rightarrow e^+e^-) = (2.38 \pm 0.11)\%$  and  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ .

<sup>2</sup> Authors assume  $B(\Upsilon(1S) \rightarrow e^+e^-) + B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = 4.96\%$ .

<sup>3</sup> TAMPONI 13 reports  $[\Gamma(\Upsilon(2S) \rightarrow \Upsilon(1S)\eta)/\Gamma_{\text{total}}] / [B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-)] = (1.99 \pm 0.14 \pm 0.11) \times 10^{-3}$  which we multiply by our best value  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-) = (17.85 \pm 0.26) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

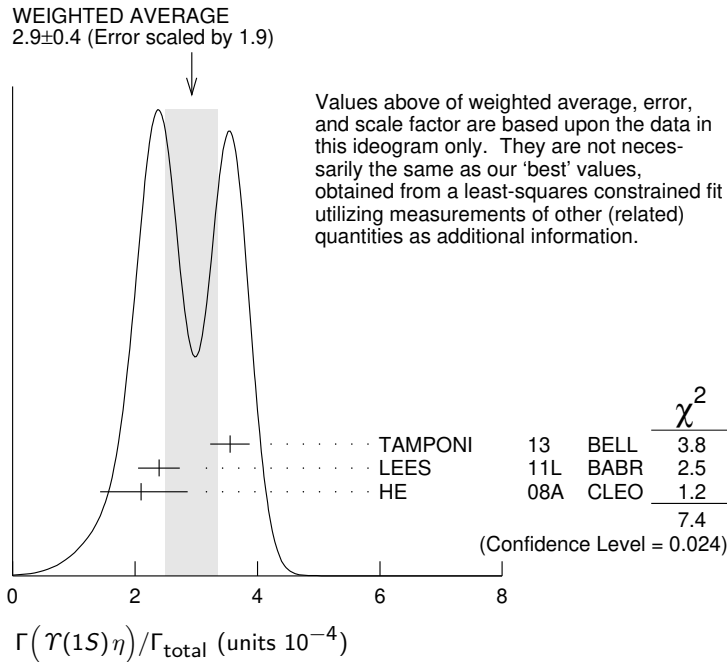
<sup>4</sup> Using  $\Gamma_{ee}(\Upsilon(2S)) = 0.612 \pm 0.011$  keV.

NODE=M052R6;LINKAGE=AU

NODE=M052R6;LINKAGE=HE

NODE=M052R6;LINKAGE=TA

NODE=M052R6;LINKAGE=UB



### $\Gamma(\Upsilon(1S)\eta)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$

$\Gamma_7/\Gamma_1$

| VALUE (units $10^{-3}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                             |
|--------------------------|-----|------|-------------|------|-------------------------------------|
| <b>1.64±0.25 OUR FIT</b> |     |      |             |      | Error includes scale factor of 2.0. |

**1.99±0.14±0.11** 241 TAMPONI 13 BELL  $e^+e^- \rightarrow \Upsilon(1S)\eta$

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.35±0.17±0.08 <sup>1</sup> LEES 11L BABR  $\Upsilon(2S) \rightarrow (\pi^+\pi^-)(\gamma\gamma)\mu^+\mu^-$   
 $< 5.2$  90 <sup>2</sup> AUBERT 08BP BABR  $e^+e^- \rightarrow \gamma\pi^+\pi^-(\pi^0)\ell^+\ell^-$

<sup>1</sup> Not independent of other values reported by LEES 11L.

<sup>2</sup> Not independent of other values reported by AUBERT 08BP.

NODE=M052R22  
NODE=M052R22

NODE=M052R22;LINKAGE=LE  
NODE=M052R22;LINKAGE=AU

### $\Gamma(\Upsilon(1S)\pi^0)/\Gamma(\Upsilon(1S)\eta)$

$\Gamma_6/\Gamma_7$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

$< 0.13$  90 TAMPONI 13 BELL  $e^+e^- \rightarrow \Upsilon(1S)\pi^0$

NODE=M052R23  
NODE=M052R23

### $\Gamma(J/\psi(1S) \text{ anything})/\Gamma_{\text{total}}$

$\Gamma_8/\Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

**< 0.006** 90 MASCHMANN 90 CBAL  $e^+e^- \rightarrow \text{hadrons}$

NODE=M052R16  
NODE=M052R16

### $\Gamma(J/\psi(1S)\eta_c)/\Gamma_{\text{total}}$

$\Gamma_9/\Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

**< 5.4 × 10<sup>-6</sup>** 90 YANG 14 BELL  $e^+e^- \rightarrow J/\psi X$

NODE=M052R53  
NODE=M052R53

### $\Gamma(J/\psi(1S)\chi_{c0})/\Gamma_{\text{total}}$

$\Gamma_{10}/\Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

**< 3.4 × 10<sup>-6</sup>** 90 YANG 14 BELL  $e^+e^- \rightarrow J/\psi X$

NODE=M052R54  
NODE=M052R54

### $\Gamma(J/\psi(1S)\chi_{c1})/\Gamma_{\text{total}}$

$\Gamma_{11}/\Gamma$

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

**< 1.2 × 10<sup>-6</sup>** 90 YANG 14 BELL  $e^+e^- \rightarrow J/\psi X$

NODE=M052R55  
NODE=M052R55

|                                                                                                                                                                                                                                                        |      |                      |      |                                                   |  |                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------|------|---------------------------------------------------|--|------------------------------|
| $\Gamma(J/\psi(1S)\chi_{c2})/\Gamma_{\text{total}}$                                                                                                                                                                                                    |      | $\Gamma_{12}/\Gamma$ |      |                                                   |  | NODE=M052R56<br>NODE=M052R56 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<2.0 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow J/\psi X$               |  |                              |
| $\Gamma(J/\psi(1S)\eta_c(2S))/\Gamma_{\text{total}}$                                                                                                                                                                                                   |      | $\Gamma_{13}/\Gamma$ |      |                                                   |  | NODE=M052R57<br>NODE=M052R57 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<2.5 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow J/\psi X$               |  |                              |
| $\Gamma(J/\psi(1S)X(3940))/\Gamma_{\text{total}}$                                                                                                                                                                                                      |      | $\Gamma_{14}/\Gamma$ |      |                                                   |  | NODE=M052R58<br>NODE=M052R58 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<2.0 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow J/\psi X$               |  |                              |
| $\Gamma(J/\psi(1S)X(4160))/\Gamma_{\text{total}}$                                                                                                                                                                                                      |      | $\Gamma_{15}/\Gamma$ |      |                                                   |  | NODE=M052R59<br>NODE=M052R59 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<2.0 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow J/\psi X$               |  |                              |
| $\Gamma(\chi_{c1} \text{ anything})/\Gamma_{\text{total}}$                                                                                                                                                                                             |      | $\Gamma_{16}/\Gamma$ |      |                                                   |  | NODE=M052R00<br>NODE=M052R00 |
| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                               | EVTS | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $2.24 \pm 0.44 \pm 0.20$                                                                                                                                                                                                                               | 376  | JIA                  | 17   | BELL $\Upsilon(2S) \rightarrow \gamma J/\psi(1S)$ |  |                              |
| $\Gamma(\chi_{c1}(1P)^0 X_{tetra})/\Gamma_{\text{total}}$                                                                                                                                                                                              |      | $\Gamma_{17}/\Gamma$ |      |                                                   |  | NODE=M052R69<br>NODE=M052R69 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<36.7 \times 10^{-6}$                                                                                                                                                                                                                                 | 90   | <sup>1</sup> JIA     | 17A  | BELL $e^+ e^- \rightarrow \text{hadrons}$         |  |                              |
| <sup>1</sup> For a tetraquark state $X_{tetra}$ , with mass in the range 1.16–2.46 GeV and width in the range 0–0.3 GeV. Measured 90% CL limits as a function of $X_{tetra}$ mass and width range from $4.4 \times 10^{-6}$ to $36.7 \times 10^{-6}$ . |      |                      |      |                                                   |  | NODE=M052R69;LINKAGE=A       |
| $\Gamma(\chi_{c2} \text{ anything})/\Gamma_{\text{total}}$                                                                                                                                                                                             |      | $\Gamma_{18}/\Gamma$ |      |                                                   |  | NODE=M052R67<br>NODE=M052R67 |
| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                               |      | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $2.28 \pm 0.73 \pm 0.34$                                                                                                                                                                                                                               |      | JIA                  | 17   | BELL $\Upsilon(2S) \rightarrow \gamma J/\psi(1S)$ |  |                              |
| $\Gamma(\psi(2S)\eta_c)/\Gamma_{\text{total}}$                                                                                                                                                                                                         |      | $\Gamma_{19}/\Gamma$ |      |                                                   |  | NODE=M052R60<br>NODE=M052R60 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<5.1 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow \psi(2S) X$             |  |                              |
| $\Gamma(\psi(2S)\chi_{c0})/\Gamma_{\text{total}}$                                                                                                                                                                                                      |      | $\Gamma_{20}/\Gamma$ |      |                                                   |  | NODE=M052R61<br>NODE=M052R61 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<4.7 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow \psi(2S) X$             |  |                              |
| $\Gamma(\psi(2S)\chi_{c1})/\Gamma_{\text{total}}$                                                                                                                                                                                                      |      | $\Gamma_{21}/\Gamma$ |      |                                                   |  | NODE=M052R62<br>NODE=M052R62 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<2.5 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow \psi(2S) X$             |  |                              |
| $\Gamma(\psi(2S)\chi_{c2})/\Gamma_{\text{total}}$                                                                                                                                                                                                      |      | $\Gamma_{22}/\Gamma$ |      |                                                   |  | NODE=M052R63<br>NODE=M052R63 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<1.9 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow \psi(2S) X$             |  |                              |
| $\Gamma(\psi(2S)\eta_c(2S))/\Gamma_{\text{total}}$                                                                                                                                                                                                     |      | $\Gamma_{23}/\Gamma$ |      |                                                   |  | NODE=M052R64<br>NODE=M052R64 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<3.3 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow \psi(2S) X$             |  |                              |
| $\Gamma(\psi(2S)X(3940))/\Gamma_{\text{total}}$                                                                                                                                                                                                        |      | $\Gamma_{24}/\Gamma$ |      |                                                   |  | NODE=M052R65<br>NODE=M052R65 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<3.9 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow \psi(2S) X$             |  |                              |
| $\Gamma(\psi(2S)X(4160))/\Gamma_{\text{total}}$                                                                                                                                                                                                        |      | $\Gamma_{25}/\Gamma$ |      |                                                   |  | NODE=M052R66<br>NODE=M052R66 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<3.9 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | YANG                 | 14   | BELL $e^+ e^- \rightarrow \psi(2S) X$             |  |                              |
| $\Gamma(Z_c(3900)^+ Z_c(3900)^-)/\Gamma_{\text{total}}$                                                                                                                                                                                                |      | $\Gamma_{26}/\Gamma$ |      |                                                   |  | NODE=M052R71<br>NODE=M052R71 |
| VALUE                                                                                                                                                                                                                                                  | CL%  | DOCUMENT ID          | TECN | COMMENT                                           |  |                              |
| $<1.0 \times 10^{-6}$                                                                                                                                                                                                                                  | 90   | <sup>1</sup> JIA     | 18   | BELL $\Upsilon(2S) \rightarrow J/\psi \pi^\pm X$  |  |                              |
| <sup>1</sup> Assuming $B(Z_c(3900)^\pm \rightarrow J/\psi \pi^\pm) = 1$ .                                                                                                                                                                              |      |                      |      |                                                   |  | NODE=M052R71;LINKAGE=A       |

$\Gamma(Z_c(4200)^+ Z_c(4200)^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{27}/\Gamma$ 

| VALUE                                                                   | CL% | DOCUMENT ID      | TECN | COMMENT                                          |
|-------------------------------------------------------------------------|-----|------------------|------|--------------------------------------------------|
| $<16.7 \times 10^{-6}$                                                  | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(1S) \rightarrow J/\psi \pi^\pm X$ |
| <sup>1</sup> Assuming $B(Z_c(4200)^\pm \rightarrow J/\psi \pi^\pm) = 1$ |     |                  |      |                                                  |

NODE=M052R72  
NODE=M052R72

NODE=M052R72;LINKAGE=A

 $\Gamma(Z_c(3900)^\pm Z_c(4200)^\mp)/\Gamma_{\text{total}}$ 
 $\Gamma_{28}/\Gamma$ 

| VALUE                                                                                                                   | CL% | DOCUMENT ID      | TECN | COMMENT                                          |
|-------------------------------------------------------------------------------------------------------------------------|-----|------------------|------|--------------------------------------------------|
| $<7.3 \times 10^{-6}$                                                                                                   | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(2S) \rightarrow J/\psi \pi^\pm X$ |
| <sup>1</sup> Assuming $B(Z_c(4200)^\pm \rightarrow J/\psi \pi^\pm) = 1 = B(Z_c(3900)^\pm \rightarrow J/\psi \pi^\pm)$ . |     |                  |      |                                                  |

NODE=M052R73  
NODE=M052R73

NODE=M052R73;LINKAGE=A

 $\Gamma(X(4050)^+ X(4050)^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{29}/\Gamma$ 

| VALUE                                                                    | CL% | DOCUMENT ID      | TECN | COMMENT                                                 |
|--------------------------------------------------------------------------|-----|------------------|------|---------------------------------------------------------|
| $<13.5 \times 10^{-6}$                                                   | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(2S) \rightarrow \chi_{c1}(1P) \pi^\pm X$ |
| <sup>1</sup> Assuming $B(X(4050)^\pm \rightarrow \chi_{c1}(1P) \pi^\pm)$ |     |                  |      |                                                         |

NODE=M052R74  
NODE=M052R74

NODE=M052R74;LINKAGE=A

 $\Gamma(X(4250)^+ X(4250)^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{30}/\Gamma$ 

| VALUE                                                                        | CL% | DOCUMENT ID      | TECN | COMMENT                                                 |
|------------------------------------------------------------------------------|-----|------------------|------|---------------------------------------------------------|
| $<26.7 \times 10^{-6}$                                                       | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(2S) \rightarrow \chi_{c1}(1P) \pi^\pm X$ |
| <sup>1</sup> Assuming $B(X(4250)^\pm \rightarrow \chi_{c1}(1P) \pi^\pm) = 1$ |     |                  |      |                                                         |

NODE=M052R75  
NODE=M052R75

NODE=M052R75;LINKAGE=A

 $\Gamma(X(4050)^\pm X(4250)^\mp)/\Gamma_{\text{total}}$ 
 $\Gamma_{31}/\Gamma$ 

| VALUE                                                                                                                           | CL% | DOCUMENT ID      | TECN | COMMENT                                                 |
|---------------------------------------------------------------------------------------------------------------------------------|-----|------------------|------|---------------------------------------------------------|
| $<27.2 \times 10^{-6}$                                                                                                          | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(2S) \rightarrow \chi_{c1}(1P) \pi^\pm X$ |
| <sup>1</sup> Assuming $B(X(4050)^\pm \rightarrow \chi_{c1}(1P) \pi^\pm) = 1 = B(X(4250)^\pm \rightarrow \chi_{c1}(1P) \pi^\pm)$ |     |                  |      |                                                         |

NODE=M052R76  
NODE=M052R76

NODE=M052R76;LINKAGE=A

 $\Gamma(Z_c(4430)^+ Z_c(4430)^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{32}/\Gamma$ 

| VALUE                                                                     | CL% | DOCUMENT ID      | TECN | COMMENT                                            |
|---------------------------------------------------------------------------|-----|------------------|------|----------------------------------------------------|
| $<20.3 \times 10^{-6}$                                                    | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(2S) \rightarrow \psi(2S) \pi^\pm X$ |
| <sup>1</sup> Assuming $B(Z_c(4430)^\pm \rightarrow \psi(2S) \pi^\pm) = 1$ |     |                  |      |                                                    |

NODE=M052R77  
NODE=M052R77

NODE=M052R77;LINKAGE=A

 $\Gamma(X(4055)^\pm X(4055)^\mp)/\Gamma_{\text{total}}$ 
 $\Gamma_{33}/\Gamma$ 

| VALUE                                                                   | CL% | DOCUMENT ID      | TECN | COMMENT                                            |
|-------------------------------------------------------------------------|-----|------------------|------|----------------------------------------------------|
| $<11.1 \times 10^{-6}$                                                  | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(2S) \rightarrow \psi(2S) \pi^\pm X$ |
| <sup>1</sup> Assuming $B(X(4055)^\pm \rightarrow \psi(2S) \pi^\pm) = 1$ |     |                  |      |                                                    |

NODE=M052R79  
NODE=M052R79

NODE=M052R79;LINKAGE=A

 $\Gamma(X(4055)^\pm Z_c(4430)^\mp)/\Gamma_{\text{total}}$ 
 $\Gamma_{34}/\Gamma$ 

| VALUE                                                                                                                   | CL% | DOCUMENT ID      | TECN | COMMENT                                            |
|-------------------------------------------------------------------------------------------------------------------------|-----|------------------|------|----------------------------------------------------|
| $<21.1 \times 10^{-6}$                                                                                                  | 90  | <sup>1</sup> JIA | 18   | BELL $\Upsilon(2S) \rightarrow \psi(2S) \pi^\pm X$ |
| <sup>1</sup> Assuming $B(X(4055)^\pm \rightarrow \psi(2S) \pi^\pm) = 1 = B(Z_c(4430)^\pm \rightarrow \psi(2S) \pi^\pm)$ |     |                  |      |                                                    |

NODE=M052R80  
NODE=M052R80

NODE=M052R80;LINKAGE=A

 $\Gamma(\overline{2H} \text{ anything})/\Gamma_{\text{total}}$ 
 $\Gamma_{35}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                         |
|--------------------------|------|-------------|------|-------------------------------------------------|
| $2.78^{+0.30}_{-0.26}$   |      |             |      | OUR AVERAGE Error includes scale factor of 1.2. |

|                                 |    |       |     |                                            |
|---------------------------------|----|-------|-----|--------------------------------------------|
| $2.64 \pm 0.11^{+0.26}_{-0.21}$ |    | LEES  | 14G | BABR $e^+ e^- \rightarrow \overline{2H} X$ |
| $3.37 \pm 0.50 \pm 0.25$        | 58 | ASNER | 07  | CLEO $e^+ e^- \rightarrow \overline{2H} X$ |

NODE=M052R18  
NODE=M052R18

 $\Gamma(g g g)/\Gamma_{\text{total}}$ 
 $\Gamma_{37}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID         | TECN | COMMENT                                        |
|--------------------------|------|---------------------|------|------------------------------------------------|
| $58.8 \pm 1.2$           | 6M   | <sup>1</sup> BESSON | 06A  | CLEO $\Upsilon(2S) \rightarrow \text{hadrons}$ |

NODE=M052R01  
NODE=M052R01

<sup>1</sup> Calculated using the value  $\Gamma(\gamma g g)/\Gamma(g g g) = (3.18 \pm 0.04 \pm 0.22 \pm 0.41)\%$  from BESSON 06A and PDG 08 values of  $B(\pi^+ \pi^- \Upsilon(1S)) = (18.1 \pm 0.4)\%$ ,  $B(\pi^0 \pi^0 \Upsilon(1S)) = (8.6 \pm 0.4)\%$ ,  $B(\mu^+ \mu^-) = (1.93 \pm 0.17)\%$ , and  $R_{\text{hadrons}} = 3.51$ . The statistical error is negligible and the systematic error is partially correlated with that of  $\Gamma(\gamma g g)/\Gamma_{\text{total}}$  measurement of BESSON 06A.

NODE=M052R01;LINKAGE=BE

 $\Gamma(\gamma g g)/\Gamma(g g g)$ 
 $\Gamma_{38}/\Gamma_{37}$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                                   |
|--------------------------|------|-------------|------|-----------------------------------------------------------|
| $3.18 \pm 0.04 \pm 0.47$ | 6M   | BESSON      | 06A  | CLEO $\Upsilon(2S) \rightarrow (\gamma +) \text{hadrons}$ |

NODE=M052R03  
NODE=M052R03

$\Gamma(\phi K^+ K^-)/\Gamma_{\text{total}}$   $\Gamma_{39}/\Gamma$ 

| VALUE (units $10^{-6}$ )                   | EVTS | DOCUMENT ID | TECN     | COMMENT                               |
|--------------------------------------------|------|-------------|----------|---------------------------------------|
| <b><math>1.58 \pm 0.33 \pm 0.18</math></b> | 58   | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow 2(K^+ K^-)$ |

NODE=M052R43  
NODE=M052R43

 $\Gamma(\omega \pi^+ \pi^-)/\Gamma_{\text{total}}$   $\Gamma_{40}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN     | COMMENT                                         |
|------------------------------|-----|-------------|----------|-------------------------------------------------|
| <b><math>&lt;2.58</math></b> | 90  | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow 2(\pi^+ \pi^-) \pi^0$ |

NODE=M052R44  
NODE=M052R44

 $\Gamma(K^*(892)^0 K^- \pi^+ + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{41}/\Gamma$ 

| VALUE (units $10^{-6}$ )                   | EVTS | DOCUMENT ID | TECN     | COMMENT                                        |
|--------------------------------------------|------|-------------|----------|------------------------------------------------|
| <b><math>2.32 \pm 0.40 \pm 0.54</math></b> | 135  | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$ |

NODE=M052R45  
NODE=M052R45

 $\Gamma(\phi f'_2(1525))/\Gamma_{\text{total}}$   $\Gamma_{42}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN     | COMMENT                               |
|------------------------------|-----|-------------|----------|---------------------------------------|
| <b><math>&lt;1.33</math></b> | 90  | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow 2(K^+ K^-)$ |

NODE=M052R46  
NODE=M052R46

 $\Gamma(\omega f_2(1270))/\Gamma_{\text{total}}$   $\Gamma_{43}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN     | COMMENT                                         |
|------------------------------|-----|-------------|----------|-------------------------------------------------|
| <b><math>&lt;0.57</math></b> | 90  | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow 2(\pi^+ \pi^-) \pi^0$ |

NODE=M052R47  
NODE=M052R47

 $\Gamma(\rho(770) a_2(1320))/\Gamma_{\text{total}}$   $\Gamma_{44}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN     | COMMENT                                         |
|------------------------------|-----|-------------|----------|-------------------------------------------------|
| <b><math>&lt;0.88</math></b> | 90  | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow 2(\pi^+ \pi^-) \pi^0$ |

NODE=M052R48  
NODE=M052R48

 $\Gamma(K^*(892)^0 \bar{K}_2^*(1430)^0 + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{45}/\Gamma$ 

| VALUE (units $10^{-6}$ )                   | EVTS | DOCUMENT ID | TECN     | COMMENT                                        |
|--------------------------------------------|------|-------------|----------|------------------------------------------------|
| <b><math>1.53 \pm 0.52 \pm 0.19</math></b> | 32   | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$ |

NODE=M052R49  
NODE=M052R49

 $\Gamma(K_1(1270)^\pm K^\mp)/\Gamma_{\text{total}}$   $\Gamma_{46}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN     | COMMENT                                        |
|------------------------------|-----|-------------|----------|------------------------------------------------|
| <b><math>&lt;3.22</math></b> | 90  | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$ |

NODE=M052R50  
NODE=M052R50

 $\Gamma(K_1(1400)^\pm K^\mp)/\Gamma_{\text{total}}$   $\Gamma_{47}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN     | COMMENT                                        |
|------------------------------|-----|-------------|----------|------------------------------------------------|
| <b><math>&lt;0.83</math></b> | 90  | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow K^+ K^- \pi^+ \pi^-$ |

NODE=M052R51  
NODE=M052R51

 $\Gamma(b_1(1235)^\pm \pi^\mp)/\Gamma_{\text{total}}$   $\Gamma_{48}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN     | COMMENT                                         |
|------------------------------|-----|-------------|----------|-------------------------------------------------|
| <b><math>&lt;0.40</math></b> | 90  | SHEN        | 12A BELL | $\Upsilon(1S) \rightarrow 2(\pi^+ \pi^-) \pi^0$ |

NODE=M052R52  
NODE=M052R52

 $\Gamma(\rho\pi)/\Gamma_{\text{total}}$   $\Gamma_{49}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN    | COMMENT                                      |
|------------------------------|-----|-------------|---------|----------------------------------------------|
| <b><math>&lt;1.16</math></b> | 90  | SHEN        | 13 BELL | $\Upsilon(2S) \rightarrow \pi^+ \pi^- \pi^0$ |

NODE=M052R27  
NODE=M052R27

 $\Gamma(\pi^+ \pi^- \pi^0)/\Gamma_{\text{total}}$   $\Gamma_{50}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN    | COMMENT                                      |
|------------------------------|-----|-------------|---------|----------------------------------------------|
| <b><math>&lt;0.80</math></b> | 90  | SHEN        | 13 BELL | $\Upsilon(2S) \rightarrow \pi^+ \pi^- \pi^0$ |

NODE=M052R28  
NODE=M052R28

 $\Gamma(\omega \pi^0)/\Gamma_{\text{total}}$   $\Gamma_{51}/\Gamma$ 

| VALUE (units $10^{-6}$ )     | CL% | DOCUMENT ID | TECN    | COMMENT                                            |
|------------------------------|-----|-------------|---------|----------------------------------------------------|
| <b><math>&lt;1.63</math></b> | 90  | SHEN        | 13 BELL | $\Upsilon(2S) \rightarrow \pi^+ \pi^- \pi^0 \pi^0$ |

NODE=M052R29  
NODE=M052R29

 $\Gamma(\pi^+ \pi^- \pi^0 \pi^0)/\Gamma_{\text{total}}$   $\Gamma_{52}/\Gamma$ 

| VALUE (units $10^{-6}$ )                 | EVTS         | DOCUMENT ID | TECN    | COMMENT                                            |
|------------------------------------------|--------------|-------------|---------|----------------------------------------------------|
| <b><math>13.0 \pm 1.9 \pm 2.1</math></b> | $261 \pm 37$ | SHEN        | 13 BELL | $\Upsilon(2S) \rightarrow \pi^+ \pi^- \pi^0 \pi^0$ |

NODE=M052R30  
NODE=M052R30

 $\Gamma(K_S^0 K^+ \pi^- + \text{c.c.})/\Gamma_{\text{total}}$   $\Gamma_{53}/\Gamma$ 

| VALUE (units $10^{-6}$ )                   | CL%         | EVTS | DOCUMENT ID | TECN    | COMMENT                                    |
|--------------------------------------------|-------------|------|-------------|---------|--------------------------------------------|
| <b><math>1.14 \pm 0.30 \pm 0.13</math></b> | $40 \pm 10$ |      | SHEN        | 13 BELL | $\Upsilon(2S) \rightarrow K_S^0 K^- \pi^+$ |

NODE=M052R40  
NODE=M052R40

• • • We do not use the following data for averages, fits, limits, etc. • • •

|        |    |                    |     |  |                                            |
|--------|----|--------------------|-----|--|--------------------------------------------|
| $<3.2$ | 90 | <sup>1</sup> DOBBS | 12A |  | $\Upsilon(2S) \rightarrow K_S^0 K^- \pi^+$ |
|--------|----|--------------------|-----|--|--------------------------------------------|

<sup>1</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M052R40;LINKAGE=DO

$\Gamma(K^*(892)^0 \bar{K}^0 + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{54}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                         |
|--------------------------|-----|-------------|------|-------------------------------------------------|
| <4.22                    | 90  | SHEN        | 13   | BELL $\Upsilon(2S) \rightarrow K_S^0 K^- \pi^+$ |

NODE=M052R41  
 NODE=M052R41

 $\Gamma(K^*(892)^- K^+ + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{55}/\Gamma$ 

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN | COMMENT                                         |
|--------------------------|-----|-------------|------|-------------------------------------------------|
| <1.45                    | 90  | SHEN        | 13   | BELL $\Upsilon(2S) \rightarrow K_S^0 K^- \pi^+$ |

NODE=M052R42  
 NODE=M052R42

 $\Gamma(f_1(1285) \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{56}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                   |
|--------------------------|------|-------------|------|-------------------------------------------|
| $2.20 \pm 1.50 \pm 0.63$ | 2.9k | JIA         | 17A  | BELL $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M052R68  
 NODE=M052R68

 $\Gamma(f_1(1285) X_{\text{tetra}})/\Gamma_{\text{total}}$  $\Gamma_{57}/\Gamma$ 

| VALUE                   | CL% | DOCUMENT ID      | TECN | COMMENT                                   |
|-------------------------|-----|------------------|------|-------------------------------------------|
| < $64.7 \times 10^{-6}$ | 90  | <sup>1</sup> JIA | 17A  | BELL $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M052R70  
 NODE=M052R70

<sup>1</sup> For a tetraquark state  $X_{\text{tetra}}$ , with mass in the range 1.16–2.46 GeV and width in the range 0–0.3 GeV. Measured 90% CL limits as a function of  $X_{\text{tetra}}$  mass and width range from  $7.8 \times 10^{-6}$  to  $64.7 \times 10^{-6}$ .

NODE=M052R70;LINKAGE=A

 $\Gamma(\text{Sum of 100 exclusive modes})/\Gamma_{\text{total}}$  $\Gamma_{58}/\Gamma$ 

| VALUE (units $10^{-2}$ ) | DOCUMENT ID          | COMMENT                                       |
|--------------------------|----------------------|-----------------------------------------------|
| $0.29 \pm 0.03$          | <sup>1,2</sup> DOBBS | 12A $\Upsilon(2S) \rightarrow \text{hadrons}$ |

NODE=M052R08  
 NODE=M052R08

<sup>1</sup> DOBBS 12A presents individual exclusive branching fractions or upper limits for 100 modes of four to ten pions, kaons, or protons.

NODE=M052R08;LINKAGE=DO

<sup>2</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M052R08;LINKAGE=NC

 $\Gamma(\gamma \chi_{b1}(1P))/\Gamma_{\text{total}}$  $\Gamma_{59}/\Gamma$ 

| VALUE                            | EVTS | DOCUMENT ID | TECN | COMMENT                                           |
|----------------------------------|------|-------------|------|---------------------------------------------------|
| <b>0.069 ± 0.004 OUR AVERAGE</b> |      |             |      |                                                   |
| $0.0693 \pm 0.0012 \pm 0.0041$   | 407k | ARTUSO      | 05   | CLEO $e^+ e^- \rightarrow \gamma X$               |
| $0.069 \pm 0.005 \pm 0.009$      |      | EDWARDS     | 99   | CLE2 $\Upsilon(2S) \rightarrow \gamma \chi(1P)$   |
| $0.091 \pm 0.018 \pm 0.022$      |      | ALBRECHT    | 85E  | ARG $e^+ e^- \rightarrow \gamma \text{conv. } X$  |
| $0.065 \pm 0.007 \pm 0.012$      |      | NERNST      | 85   | CBAL $e^+ e^- \rightarrow \gamma X$               |
| $0.080 \pm 0.017 \pm 0.016$      |      | HAAS        | 84   | CLEO $e^+ e^- \rightarrow \gamma \text{conv. } X$ |
| $0.059 \pm 0.014$                |      | KLOPFEN...  | 83   | CUSB $e^+ e^- \rightarrow \gamma X$               |

NODE=M052R8  
 NODE=M052R8

 $\Gamma(\gamma \chi_{b2}(1P))/\Gamma_{\text{total}}$  $\Gamma_{60}/\Gamma$ 

| VALUE                              | EVTS | DOCUMENT ID | TECN | COMMENT                                           |
|------------------------------------|------|-------------|------|---------------------------------------------------|
| <b>0.0715 ± 0.0035 OUR AVERAGE</b> |      |             |      |                                                   |
| $0.0724 \pm 0.0011 \pm 0.0040$     | 410k | ARTUSO      | 05   | CLEO $e^+ e^- \rightarrow \gamma X$               |
| $0.074 \pm 0.005 \pm 0.008$        |      | EDWARDS     | 99   | CLE2 $\Upsilon(2S) \rightarrow \gamma \chi(1P)$   |
| $0.098 \pm 0.021 \pm 0.024$        |      | ALBRECHT    | 85E  | ARG $e^+ e^- \rightarrow \gamma \text{conv. } X$  |
| $0.058 \pm 0.007 \pm 0.010$        |      | NERNST      | 85   | CBAL $e^+ e^- \rightarrow \gamma X$               |
| $0.102 \pm 0.018 \pm 0.021$        |      | HAAS        | 84   | CLEO $e^+ e^- \rightarrow \gamma \text{conv. } X$ |
| $0.061 \pm 0.014$                  |      | KLOPFEN...  | 83   | CUSB $e^+ e^- \rightarrow \gamma X$               |

NODE=M052R7  
 NODE=M052R7

 $\Gamma(\gamma \chi_{b0}(1P))/\Gamma_{\text{total}}$  $\Gamma_{61}/\Gamma$ 

| VALUE                                                                         | EVTS | DOCUMENT ID | TECN | COMMENT                                           |
|-------------------------------------------------------------------------------|------|-------------|------|---------------------------------------------------|
| <b>0.038 ± 0.004 OUR AVERAGE</b>                                              |      |             |      |                                                   |
| $0.0375 \pm 0.0012 \pm 0.0047$                                                | 198k | ARTUSO      | 05   | CLEO $e^+ e^- \rightarrow \gamma X$               |
| $0.034 \pm 0.005 \pm 0.006$                                                   |      | EDWARDS     | 99   | CLE2 $\Upsilon(2S) \rightarrow \gamma \chi(1P)$   |
| $0.064 \pm 0.014 \pm 0.016$                                                   |      | ALBRECHT    | 85E  | ARG $e^+ e^- \rightarrow \gamma \text{conv. } X$  |
| $0.036 \pm 0.008 \pm 0.009$                                                   |      | NERNST      | 85   | CBAL $e^+ e^- \rightarrow \gamma X$               |
| $0.044 \pm 0.023 \pm 0.009$                                                   |      | HAAS        | 84   | CLEO $e^+ e^- \rightarrow \gamma \text{conv. } X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |             |      |                                                   |
| $0.035 \pm 0.014$                                                             |      | KLOPFEN...  | 83   | CUSB $e^+ e^- \rightarrow \gamma X$               |

NODE=M052R9  
 NODE=M052R9

 $\Gamma(\gamma f_0(1710))/\Gamma_{\text{total}}$  $\Gamma_{62}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID           | TECN | COMMENT                                       |
|--------------------------|-----|-----------------------|------|-----------------------------------------------|
| <59                      | 90  | <sup>1</sup> ALBRECHT | 89   | ARG $\Upsilon(2S) \rightarrow \gamma K^+ K^-$ |

NODE=M052R13  
 NODE=M052R13

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                       |    |                                                   |
|-------|----|-----------------------|----|---------------------------------------------------|
| < 5.9 | 90 | <sup>2</sup> ALBRECHT | 89 | ARG $\Upsilon(2S) \rightarrow \gamma \pi^+ \pi^-$ |
|-------|----|-----------------------|----|---------------------------------------------------|

OCCUR=2

<sup>1</sup> Re-evaluated assuming  $B(f_0(1710) \rightarrow K^+ K^-) = 0.19$ .

NODE=M052R13;LINKAGE=M

<sup>2</sup> Includes unknown branching ratio of  $f_0(1710) \rightarrow \pi^+ \pi^-$ .

NODE=M052R13;LINKAGE=N



$\Gamma(\gamma f'_2(1525))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT                                   |
|--------------------------|-----|--------------------------|------|-------------------------------------------|
| <53                      | 90  | <sup>1</sup> ALBRECHT 89 | ARG  | $\Upsilon(2S) \rightarrow \gamma K^+ K^-$ |

<sup>1</sup> Re-evaluated assuming  $B(f'_2(1525) \rightarrow K \bar{K}) = 0.71$ .

 $\Gamma_{63}/\Gamma$ 

NODE=M052R12  
NODE=M052R12

NODE=M052R12;LINKAGE=L

 $\Gamma(\gamma f_2(1270))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID              | TECN | COMMENT                                       |
|--------------------------|-----|--------------------------|------|-----------------------------------------------|
| <24.1                    | 90  | <sup>1</sup> ALBRECHT 89 | ARG  | $\Upsilon(2S) \rightarrow \gamma \pi^+ \pi^-$ |

<sup>1</sup> Using  $B(f_2(1270) \rightarrow \pi \pi) = 0.84$ .

 $\Gamma_{64}/\Gamma$ 

NODE=M052R11  
NODE=M052R11

NODE=M052R11;LINKAGE=K

 $\Gamma(\gamma f_J(2220))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

<6.8 90 <sup>1</sup> ALBRECHT 89 ARG  $\Upsilon(2S) \rightarrow \gamma K^+ K^-$

<sup>1</sup> Includes unknown branching ratio of  $f_J(2220) \rightarrow K^+ K^-$ .

 $\Gamma_{65}/\Gamma$ 

NODE=M052R14  
NODE=M052R14

NODE=M052R14;LINKAGE=S

 $\Gamma(\gamma \eta_c(1S))/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-----------------------|-----|-------------|------|-------------------------------------|
| <2.7 $\times 10^{-5}$ | 90  | WANG 11B    | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{66}/\Gamma$ 

NODE=M052R31  
NODE=M052R31

 $\Gamma(\gamma \chi_{c0})/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-----------------------|-----|-------------|------|-------------------------------------|
| <1.0 $\times 10^{-4}$ | 90  | WANG 11B    | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{67}/\Gamma$ 

NODE=M052R32  
NODE=M052R32

 $\Gamma(\gamma \chi_{c1})/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-----------------------|-----|-------------|------|-------------------------------------|
| <3.6 $\times 10^{-6}$ | 90  | WANG 11B    | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{68}/\Gamma$ 

NODE=M052R33  
NODE=M052R33

 $\Gamma(\gamma \chi_{c2})/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-----------------------|-----|-------------|------|-------------------------------------|
| <1.5 $\times 10^{-5}$ | 90  | WANG 11B    | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{69}/\Gamma$ 

NODE=M052R34  
NODE=M052R34

 $\Gamma(\gamma \chi_{c1}(3872))/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID           | TECN | COMMENT                             |
|-----------------------|-----|-----------------------|------|-------------------------------------|
| <2.3 $\times 10^{-5}$ | 90  | <sup>1</sup> WANG 11B | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{70}/\Gamma$ 

NODE=M052R81  
NODE=M052R81

<sup>1</sup> WANG 11B reports  $[\Gamma(\Upsilon(2S) \rightarrow \gamma \chi_{c1}(3872))/\Gamma_{\text{total}}] \times [B(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S))] < 0.8 \times 10^{-6}$  which we divide by our best value  $B(\chi_{c1}(3872) \rightarrow \pi^+ \pi^- J/\psi(1S)) = 3.4 \times 10^{-2}$ .

NODE=M052R81;LINKAGE=A

 $\Gamma(\gamma \chi_{c1}(3872), \chi_{c1} \rightarrow \pi^+ \pi^- \pi^0 J/\psi)/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-----------------------|-----|-------------|------|-------------------------------------|
| <2.4 $\times 10^{-6}$ | 90  | WANG 11B    | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{71}/\Gamma$ 

NODE=M052R36  
NODE=M052R36

 $\Gamma(\gamma X(3915) \rightarrow \omega J/\psi)/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-----------------------|-----|-------------|------|-------------------------------------|
| <2.8 $\times 10^{-6}$ | 90  | WANG 11B    | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{72}/\Gamma$ 

NODE=M052R37  
NODE=M052R37

 $\Gamma(\gamma \chi_{c1}(4140) \rightarrow \phi J/\psi)/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-----------------------|-----|-------------|------|-------------------------------------|
| <1.2 $\times 10^{-6}$ | 90  | WANG 11B    | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{73}/\Gamma$ 

NODE=M052R38  
NODE=M052R38

 $\Gamma(\gamma X(4350) \rightarrow \phi J/\psi)/\Gamma_{\text{total}}$ 

| VALUE                 | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-----------------------|-----|-------------|------|-------------------------------------|
| <1.3 $\times 10^{-6}$ | 90  | WANG 11B    | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |

 $\Gamma_{74}/\Gamma$ 

NODE=M052R39  
NODE=M052R39

 $\Gamma(\gamma \eta_b(1S))/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

 $\Gamma_{75}/\Gamma$ 

NODE=M052R15  
NODE=M052R15

**5.5<sup>+1.1</sup><sub>-0.9</sub> OUR AVERAGE** Error includes scale factor of 1.2.

|                                               |             |                     |      |      |                                     |
|-----------------------------------------------|-------------|---------------------|------|------|-------------------------------------|
| 6.1 <sup>+0.6+0.9</sup> <sub>-0.7-0.6</sub>   | 29k         | FULSOM              | 18   | BELL | $\Upsilon(2S) \rightarrow \gamma X$ |
| 3.9 $\pm$ 1.1 <sup>+1.1</sup> <sub>-0.9</sub> | 13 $\pm$ 5k | <sup>1</sup> AUBERT | 09AQ | BABR | $\Upsilon(2S) \rightarrow \gamma X$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                        |     |      |                                     |
|-------|----|------------------------|-----|------|-------------------------------------|
| <21   | 90 | LEES                   | 11J | BABR | $\Upsilon(2S) \rightarrow X\gamma$  |
| < 8.4 | 90 | <sup>1</sup> BONVICINI | 10  | CLEO | $\Upsilon(2S) \rightarrow \gamma X$ |
| < 5.1 | 90 | <sup>2</sup> ARTUSO    | 05  | CLEO | $e^+e^- \rightarrow \gamma X$       |

<sup>1</sup> Assuming  $\Gamma_{\eta_b(1S)} = 10$  MeV.

<sup>2</sup> Superseded by BONVICINI 10.

NODE=M052R15;LINKAGE=BO  
NODE=M052R15;LINKAGE=SU

### $\Gamma(\gamma\eta_b(1S) \rightarrow \gamma \text{Sum of 26 exclusive modes})/\Gamma_{\text{total}}$ $\Gamma_{76}/\Gamma$

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                                        |
|----------------------------------|-----|-------------|------|------------------------------------------------|
| <b>&lt;3.7 × 10<sup>-6</sup></b> | 90  | SANDILYA    | 13   | BELL $\Upsilon(2S) \rightarrow \gamma$ hadrons |

NODE=M052R25  
NODE=M052R25

### $\Gamma(\gamma X_{b\bar{b}} \rightarrow \gamma \text{Sum of 26 exclusive modes})/\Gamma_{\text{total}}$ $\Gamma_{77}/\Gamma$

| VALUE (units 10 <sup>-6</sup> ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT                                        |
|---------------------------------|-----|------|-------------|------|------------------------------------------------|
| <b>&lt; 4.9</b>                 | 90  |      | SANDILYA    | 13   | BELL $\Upsilon(2S) \rightarrow \gamma$ hadrons |

NODE=M052R26  
NODE=M052R26

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                               |    |                    |    |  |                                           |
|-----------------------------------------------|----|--------------------|----|--|-------------------------------------------|
| 46.2 <sup>+29.7</sup> <sub>-14.2</sub> ± 10.6 | 10 | <sup>1</sup> DOBBS | 12 |  | $\Upsilon(2S) \rightarrow \gamma$ hadrons |
|-----------------------------------------------|----|--------------------|----|--|-------------------------------------------|

<sup>1</sup> Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M052R26;LINKAGE=DO

### $\Gamma(\gamma X \rightarrow \gamma + \geq 4 \text{ prongs})/\Gamma_{\text{total}}$ $\Gamma_{78}/\Gamma$

(1.5 GeV <  $m_X$  < 5.0 GeV)

| VALUE (units 10 <sup>-4</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT                            |
|---------------------------------|-----|-------------|------|------------------------------------|
| <b>&lt;1.95</b>                 | 95  | ROSNER      | 07A  | CLEO $e^+e^- \rightarrow \gamma X$ |

NODE=M052R19  
NODE=M052R19  
NODE=M052R19

### $\Gamma(\gamma A^0 \rightarrow \gamma \text{hadrons})/\Gamma_{\text{total}}$ $\Gamma_{79}/\Gamma$

(0.3 GeV <  $m_{A^0}$  < 7 GeV)

| VALUE                          | CL% | DOCUMENT ID       | TECN | COMMENT                                        |
|--------------------------------|-----|-------------------|------|------------------------------------------------|
| <b>&lt;8 × 10<sup>-5</sup></b> | 90  | <sup>1</sup> LEES | 11H  | BABR $\Upsilon(2S) \rightarrow \gamma$ hadrons |

NODE=M052R06  
NODE=M052R06  
NODE=M052R06

<sup>1</sup> For a narrow scalar or pseudoscalar  $A^0$ , excluding known resonances, with mass in the range 0.3–7 GeV. Measured 90% CL limits as a function of  $m_{A^0}$  range from  $1 \times 10^{-6}$  to  $8 \times 10^{-5}$ .

NODE=M052R06;LINKAGE=LE

### $\Gamma(\gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-)/\Gamma_{\text{total}}$ $\Gamma_{80}/\Gamma$

| VALUE (units 10 <sup>-6</sup> ) | CL% | DOCUMENT ID         | TECN | COMMENT                                                               |
|---------------------------------|-----|---------------------|------|-----------------------------------------------------------------------|
| <b>&lt;8.3</b>                  | 90  | <sup>1</sup> AUBERT | 09Z  | BABR $e^+e^- \rightarrow \gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-$ |

NODE=M052R24  
NODE=M052R24

<sup>1</sup> For a narrow scalar or pseudoscalar  $a_1^0$  with mass in the range 212–9300 MeV, excluding  $J/\psi$  and  $\psi(2S)$ . Measured 90% CL limits as a function of  $m_{a_1^0}$  range from 0.26–8.3 × 10<sup>-6</sup>.

NODE=M052R24;LINKAGE=AU

## LEPTON FAMILY NUMBER (LF) VIOLATING MODES

NODE=M052230

### $\Gamma(e^\pm \tau^\mp)/\Gamma_{\text{total}}$ $\Gamma_{81}/\Gamma$

| VALUE (units 10 <sup>-6</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|---------------------------------|-----|-------------|------|------------------------------------------|
| <b>&lt;3.2</b>                  | 90  | LEES        | 10B  | BABR $e^+e^- \rightarrow e^\pm \tau^\mp$ |

NODE=M052R04  
NODE=M052R04

### $\Gamma(\mu^\pm \tau^\mp)/\Gamma_{\text{total}}$ $\Gamma_{82}/\Gamma$

| VALUE (units 10 <sup>-6</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|---------------------------------|-----|-------------|------|--------------------------------------------|
| <b>&lt; 3.3</b>                 | 90  | LEES        | 10B  | BABR $e^+e^- \rightarrow \mu^\pm \tau^\mp$ |

NODE=M052R20  
NODE=M052R20

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |      |     |      |                                       |
|-------|----|------|-----|------|---------------------------------------|
| <14.4 | 95 | LOVE | 08A | CLEO | $e^+e^- \rightarrow \mu^\pm \tau^\mp$ |
|-------|----|------|-----|------|---------------------------------------|

## $\Upsilon(2S)$ Cross-Particle Branching Ratios

NODE=M052240

### $B(\Upsilon(2S) \rightarrow \pi^+ \pi^-) \times B(\Upsilon(3S) \rightarrow \Upsilon(2S) X)$

| VALUE (units 10 <sup>-2</sup> ) | EVTS | DOCUMENT ID | TECN | COMMENT                                 |
|---------------------------------|------|-------------|------|-----------------------------------------|
| <b>1.78 ± 0.02 ± 0.11</b>       | 906k | LEES        | 11C  | BABR $e^+e^- \rightarrow \pi^+ \pi^- X$ |

NODE=M052R05  
NODE=M052R05

**T(2S) REFERENCES**

NODE=M052

|                                                             |      |                         |                               |                           |                      |
|-------------------------------------------------------------|------|-------------------------|-------------------------------|---------------------------|----------------------|
| FULSOM                                                      | 18   | PRL 121 232001          | B.G. Fulsom <i>et al.</i>     | (BELLE Collab.)           | REFID=59535          |
| JIA                                                         | 18   | PR D97 112004           | S. Jia <i>et al.</i>          | (BELLE Collab.)           | REFID=58949          |
| JIA                                                         | 17   | PR D95 012001           | S. Jia <i>et al.</i>          | (BELLE Collab.)           | REFID=57635          |
| JIA                                                         | 17A  | PR D96 112002           | S. Jia <i>et al.</i>          | (BELLE Collab.)           | REFID=58318          |
| LEES                                                        | 14G  | PR D89 111102           | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           | REFID=55939          |
| YANG                                                        | 14   | PR D90 112008           | S.D. Yang <i>et al.</i>       | (BELLE Collab.)           | REFID=56345          |
| SANDILYA                                                    | 13   | PRL 111 112001          | S. Sandilya <i>et al.</i>     | (BELLE Collab.)           | REFID=55590          |
| SHEN                                                        | 13   | PR D88 011102           | C.P. Shen <i>et al.</i>       | (BELLE Collab.)           | REFID=55395          |
| TAMPONI                                                     | 13   | PR D87 011104           | U. Tamponi <i>et al.</i>      | (BELLE Collab.)           | REFID=54919          |
| DOBBS                                                       | 12   | PRL 109 082001          | S. Dobbs <i>et al.</i>        |                           | REFID=54288          |
| DOBBS                                                       | 12A  | PR D86 052003           | S. Dobbs <i>et al.</i>        |                           | REFID=54746          |
| SHEN                                                        | 12A  | PR D86 031102           | C.P. Shen <i>et al.</i>       | (BELLE Collab.)           | REFID=54314          |
| LEES                                                        | 11C  | PR D84 011104           | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           | REFID=16775          |
| LEES                                                        | 11H  | PRL 107 221803          | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           | REFID=53877          |
| LEES                                                        | 11J  | PR D84 072002           | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           | REFID=53936          |
| LEES                                                        | 11L  | PR D84 092003           | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           | REFID=53938          |
| WANG                                                        | 11B  | PR D84 071107           | X.L. Wang <i>et al.</i>       | (BELLE Collab.)           | REFID=53939          |
| BONVICINI                                                   | 10   | PR D81 031104           | G. Bonvicini <i>et al.</i>    | (CLEO Collab.)            | REFID=53231          |
| LEES                                                        | 10B  | PRL 104 151802          | J.P. Lees <i>et al.</i>       | (BABAR Collab.)           | REFID=53355          |
| AUBERT                                                      | 09AQ | PRL 103 161801          | B. Aubert <i>et al.</i>       | (BABAR Collab.)           | REFID=53106          |
| AUBERT                                                      | 09Z  | PRL 103 081803          | B. Aubert <i>et al.</i>       | (BABAR Collab.)           | REFID=52930          |
| BHARI                                                       | 09   | PR D79 011103           | S.R. Bhari <i>et al.</i>      | (CLEO Collab.)            | REFID=52662          |
| AUBERT                                                      | 08BP | PR D78 112002           | B. Aubert <i>et al.</i>       | (BABAR Collab.)           | REFID=52660          |
| HE                                                          | 08A  | PRL 101 192001          | Q. He <i>et al.</i>           | (CLEO Collab.)            | REFID=52587          |
| LOVE                                                        | 08A  | PRL 101 201601          | W. Love <i>et al.</i>         | (CLEO Collab.)            | REFID=52592          |
| PDG                                                         | 08   | PL B667 1               | C. Amsler <i>et al.</i>       | (PDG Collab.)             | REFID=52166          |
| ASNER                                                       | 07   | PR D75 012009           | D.M. Asner <i>et al.</i>      | (CLEO Collab.)            | REFID=51617          |
| BESSON                                                      | 07   | PRL 98 052002           | D. Besson <i>et al.</i>       | (CLEO Collab.)            | REFID=51620          |
| ROSNER                                                      | 07A  | PR D76 117102           | J.L. Rosner <i>et al.</i>     | (CLEO Collab.)            | REFID=52079          |
| BESSON                                                      | 06A  | PR D74 012003           | D. Besson <i>et al.</i>       | (CLEO Collab.)            | REFID=51147          |
| ROSNER                                                      | 06   | PRL 96 092003           | J.L. Rosner <i>et al.</i>     | (CLEO Collab.)            | REFID=51035          |
| ADAMS                                                       | 05   | PRL 94 012001           | G.S. Adams <i>et al.</i>      | (CLEO Collab.)            | REFID=50452          |
| ARTUSO                                                      | 05   | PRL 94 032001           | M. Artuso <i>et al.</i>       | (CLEO Collab.)            | REFID=50454          |
| ARTAMONOV                                                   | 00   | PL B474 427             | A.S. Artamonov <i>et al.</i>  |                           | REFID=47424          |
| EDWARDS                                                     | 99   | PR D59 032003           | K.W. Edwards <i>et al.</i>    | (CLEO Collab.)            | REFID=46612          |
| ALEXANDER                                                   | 98   | PR D58 052004           | J.P. Alexander <i>et al.</i>  | (CLEO Collab.)            | REFID=46329          |
| BARU                                                        | 96   | PRPL 267 71             | S.E. Baru <i>et al.</i>       | (NOVO)                    | REFID=44651          |
| KOBEL                                                       | 92   | ZPHY C53 193            | M. Kobel <i>et al.</i>        | (Crystal Ball Collab.)    | REFID=41861          |
| MASCHMANN                                                   | 90   | ZPHY C46 555            | W.S. Maschmann <i>et al.</i>  | (Crystal Ball Collab.)    | REFID=41224          |
| ALBRECHT                                                    | 89   | ZPHY C42 349            | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)           | REFID=40731          |
| KAARSBERG                                                   | 89   | PRL 62 2077             | T.M. Kaarsberg <i>et al.</i>  | (CUSB Collab.)            | REFID=40733          |
| BUCHMUEL...                                                 | 88   | HE $e^+e^-$ Physics 412 | W. Buchmueller, S. Cooper     | (HANN, DESY, MIT)         | REFID=40034          |
| Editors: A. Ali and P. Soeding, World Scientific, Singapore |      |                         |                               |                           |                      |
| JAKUBOWSKI                                                  | 88   | ZPHY C40 49             | Z. Jakubowski <i>et al.</i>   | (Crystal Ball Collab.)    | REFID=40742          |
| ALBRECHT                                                    | 87   | ZPHY C35 283            | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)           | REFID=40016          |
| COHEN                                                       | 87   | RMP 59 1121             | E.R. Cohen, B.N. Taylor       | (RISC, NBS)               | REFID=11616          |
| LURZ                                                        | 87   | ZPHY C36 383            | B. Lurz <i>et al.</i>         | (Crystal Ball Collab.)    | REFID=40021          |
| BARU                                                        | 86B  | ZPHY C32 622 (erratum)  | S.E. Baru <i>et al.</i>       | (NOVO)                    | REFID=22338          |
| ALBRECHT                                                    | 85   | ZPHY C28 45             | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)           | REFID=22334          |
| ALBRECHT                                                    | 85E  | PL 160B 331             | H. Albrecht <i>et al.</i>     | (ARGUS Collab.)           | REFID=22288          |
| GELPHMAN                                                    | 85   | PR D32 2893             | D. Gelphman <i>et al.</i>     | (Crystal Ball Collab.)    | REFID=22336          |
| KURAEV                                                      | 85   | SJNP 41 466             | E.A. Kuraev, V.S. Fadin       | (NOVO)                    | REFID=40033          |
| Translated from YAF 41 733.                                 |      |                         |                               |                           |                      |
| NERNST                                                      | 85   | PRL 54 2195             | R. Nernst <i>et al.</i>       | (Crystal Ball Collab.)    | REFID=22289          |
| ARTAMONOV                                                   | 84   | PL 137B 272             | A.S. Artamonov <i>et al.</i>  | (NOVO)                    | REFID=22278          |
| BARBER                                                      | 84   | PL 135B 498             | D.P. Barber <i>et al.</i>     |                           | REFID=22327; ERROR=9 |
| BESSON                                                      | 84   | PR D30 1433             | D. Besson <i>et al.</i>       | (CLEO Collab.)            | REFID=22279          |
| FONSECA                                                     | 84   | NP B242 31              | V. Fonseca <i>et al.</i>      | (CUSB Collab.)            | REFID=22329          |
| GILES                                                       | 84B  | PR D29 1285             | R. Giles <i>et al.</i>        | (CLEO Collab.)            | REFID=22280          |
| HAAS                                                        | 84   | PRL 52 799              | J. Haas <i>et al.</i>         | (CLEO Collab.)            | REFID=22287          |
| HAAS                                                        | 84B  | PR D30 1996             | J. Haas <i>et al.</i>         | (CLEO Collab.)            | REFID=22332          |
| KLOPFEN...                                                  | 83   | PRL 51 160              | C. Klopfenstein <i>et al.</i> | (CUSB Collab.)            | REFID=22285          |
| ALBRECHT                                                    | 82   | PL 116B 383             | H. Albrecht <i>et al.</i>     | (DESY, DORT, HEIDH+)      | REFID=22270          |
| NICZYPORUK                                                  | 81B  | PL 100B 95              | B. Niczyporuk <i>et al.</i>   | (LENA Collab.)            | REFID=22319          |
| NICZYPORUK                                                  | 81C  | PL 99B 169              | B. Niczyporuk <i>et al.</i>   | (LENA Collab.)            | REFID=22318          |
| BOCK                                                        | 80   | ZPHY C6 125             | P. Bock <i>et al.</i>         | (HEIDP, MPIM, DESY, HAMB) | REFID=22264          |

$\Upsilon_2(1D)$ 

$$J^{PC} = 0^-(2^--)$$

was  $\Upsilon(1D)$

First observed by BONVICINI 04 in the decay to  $\gamma\gamma \Upsilon(1S)$  and confirmed by DEL-AMO-SANCHEZ 10R in the decay to  $\pi^+\pi^- \Upsilon(1S)$ .

Data consistent with  $J^P = 2^-$ . The states with  $J = 1$  and 3 also possibly seen, but need confirmation.

### $\Upsilon_2(1D)$ MASS

| VALUE (MeV)                      | EVTS | DOCUMENT ID                         | TECN | COMMENT                                                       |
|----------------------------------|------|-------------------------------------|------|---------------------------------------------------------------|
| <b>10163.7 ± 1.4 OUR AVERAGE</b> |      | Error includes scale factor of 1.7. |      |                                                               |
| 10164.5 ± 0.8 ± 0.5              |      | DEL-AMO-SA..10R                     | BABR | $\Upsilon(3S) \rightarrow \gamma\gamma\pi^+\pi^-\ell^+\ell^-$ |
| 10161.1 ± 0.6 ± 1.6              | 38   | BONVICINI 04                        | CLE3 | $\Upsilon(3S) \rightarrow 4\gamma\ell^+\ell^-$                |

### $\Upsilon_2(1D)$ DECAY MODES

| Mode                                       | Fraction ( $\Gamma_i/\Gamma$ ) |
|--------------------------------------------|--------------------------------|
| $\Gamma_1 \quad \gamma\gamma \Upsilon(1S)$ | seen                           |
| $\Gamma_2 \quad \gamma\chi_{bJ}(1P)$       | seen                           |
| $\Gamma_3 \quad \eta \Upsilon(1S)$         | not seen                       |
| $\Gamma_4 \quad \pi^+\pi^- \Upsilon(1S)$   | $(6.6 \pm 1.6) \times 10^{-3}$ |

### $\Upsilon_2(1D)$ BRANCHING RATIOS

| $\Gamma(\eta \Upsilon(1S))/\Gamma(\gamma\gamma \Upsilon(1S))$ |     |              |      | $\Gamma_3/\Gamma_1$                              |
|---------------------------------------------------------------|-----|--------------|------|--------------------------------------------------|
| VALUE                                                         | CL% | DOCUMENT ID  | TECN | COMMENT                                          |
| <0.25                                                         | 90  | BONVICINI 04 | CLE3 | $\Upsilon(3S) \rightarrow 4\gamma \ell^+ \ell^-$ |

| $\Gamma(\pi^+\pi^-\Upsilon(1S))/\Gamma_{\text{total}}$ | $\Gamma_4/\Gamma$            |      |                                                               |
|--------------------------------------------------------|------------------------------|------|---------------------------------------------------------------|
| VALUE (units $10^{-2}$ )                               | DOCUMENT ID                  | TECN | COMMENT                                                       |
| $0.66^{+0.15}_{-0.14} \pm 0.06$                        | <sup>1</sup> DEL-AMO-SA..10R | BABR | $\Upsilon(3S) \rightarrow \gamma\gamma\pi^+\pi^-\ell^+\ell^-$ |

<sup>1</sup> Using theoretical predictions for  $B(\chi_{bJ}(2P) \rightarrow \gamma \Upsilon_2(1D))$ .

| $\Gamma(\pi^+\pi^-\Upsilon(1S))/\Gamma(\gamma\gamma\Upsilon(1S))$ |     |                           |      |                                                |  | $\Gamma_4/\Gamma_1$ |
|-------------------------------------------------------------------|-----|---------------------------|------|------------------------------------------------|--|---------------------|
| VALUE                                                             | CL% | DOCUMENT ID               | TECN | COMMENT                                        |  |                     |
| <b>&lt;1.2</b>                                                    | 90  | <sup>2</sup> BONVICINI 04 | CLE3 | $\Upsilon(3S) \rightarrow 4\gamma\ell^+\ell^-$ |  |                     |

<sup>2</sup> Assuming  $J = 2$ .

<sup>2</sup> Assuming  $J = 2$ .

### $\Upsilon_2(1D)$ REFERENCES

|                   |               |                                  |                 |
|-------------------|---------------|----------------------------------|-----------------|
| DEL-AMO-SA... 10R | PR D82 111102 | P. del Amo Sanchez <i>et al.</i> | (BABAR Collab.) |
| BONVICINI 04      | PR D70 032001 | G. Bonvicini <i>et al.</i>       | (CLEO Collab.)  |

NODE=M177

NODE=M177

NODE=M177M

NODE=M177M

NODE=M177215;NODE=M177

DESIG=1;OUR EVAL;→ UNCHECKED ←  
DESIG=2;OUR EVAL;→ UNCHECKED ←  
DESIG=3;OUR EVAL;→ UNCHECKED ←  
DESIG=4

NODE=M177225

NODE=M177R01  
NODE=M177R01

NODE=M177R03  
NODE=M177R03

NODE=M177R03;LINKAGE=DE

NODE=M177R02  
NODE=M177R02

NODE=M177R02;LINKAGE=BO

NODE=M177

REFID=53634  
REFID=49759

$\chi_{b0}(2P)$ 

$$J^G(J^{PC}) = 0^+(0^{++})$$

$J$  needs confirmation.

Observed in radiative decay of the  $\Upsilon(3S)$ , therefore  $C = +$ . Branching ratio requires E1 transition, M1 is strongly disfavored, therefore  $P = +$ .

NODE=M079

NODE=M079

### $\chi_{b0}(2P)$ MASS

VALUE (MeV) DOCUMENT ID  
**10232.5 ± 0.4 ± 0.5 OUR EVALUATION** From  $\gamma$  energy below, using  $\Upsilon(3S)$  mass = 10355.2 ± 0.5 MeV

NODE=M079M

NODE=M079M  
 → UNCHECKED ←

$$m_{\chi_{b1}(2P)} = m_{\chi_{b0}(2P)}$$

VALUE (MeV) DOCUMENT ID TECN COMMENT  
**23.8 ± 1.7** LEES 14M BABR  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$

NODE=M079M2  
 NODE=M079M2

### $\gamma$ ENERGY IN $\Upsilon(3S)$ DECAY

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT  
**121.9 ± 0.4 OUR EVALUATION** Treating systematic errors as correlated  
**122.2 ± 0.5 OUR AVERAGE** Error includes scale factor of 1.4. See the ideogram below.  
 121.55 ± 0.16 ± 0.46 ARTUSO 05 CLEO  $\Upsilon(3S) \rightarrow \gamma X$   
 123.0 ± 0.8 4959 <sup>1</sup> HEINTZ 92 CSB2  $e^+e^- \rightarrow \gamma X$   
 124.6 ± 1.4 17 <sup>2</sup> HEINTZ 92 CSB2  $e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$   
 122.3 ± 0.3 ± 0.6 9903 MORRISON 91 CLE2  $e^+e^- \rightarrow \gamma X$

NODE=M079DM

NODE=M079DM  
 → UNCHECKED ←

<sup>1</sup> A systematic uncertainty on the energy scale of 0.9% not included. Supersedes NARAIN 91.

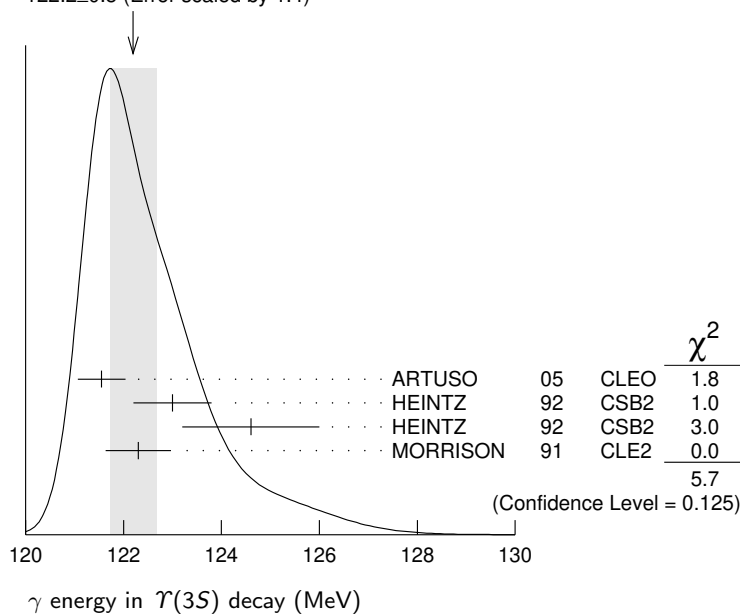
<sup>2</sup> A systematic uncertainty on the energy scale of 0.9% not included. Supersedes HEINTZ 91.

OCCUR=2

NODE=M079DM;LINKAGE=A

NODE=M079DM;LINKAGE=B

WEIGHTED AVERAGE  
 122.2 ± 0.5 (Error scaled by 1.4)



### $\chi_{b0}(2P)$ DECAY MODES

| Mode                                          | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|-----------------------------------------------|--------------------------------|------------------|
| $\Gamma_1 \quad \gamma \Upsilon(2S)$          | (1.38 ± 0.30) %                |                  |
| $\Gamma_2 \quad \gamma \Upsilon(1S)$          | (3.8 ± 1.7) × 10 <sup>-3</sup> |                  |
| $\Gamma_3 \quad D^0 X$                        | < 8.2 %                        | 90%              |
| $\Gamma_4 \quad \pi^+\pi^- K^+ K^- \pi^0$     | < 3.4 × 10 <sup>-5</sup>       | 90%              |
| $\Gamma_5 \quad 2\pi^+\pi^- K^- K_S^0$        | < 5 × 10 <sup>-5</sup>         | 90%              |
| $\Gamma_6 \quad 2\pi^+\pi^- K^- K_S^0 2\pi^0$ | < 2.2 × 10 <sup>-4</sup>       | 90%              |
| $\Gamma_7 \quad 2\pi^+ 2\pi^- 2\pi^0$         | < 2.4 × 10 <sup>-4</sup>       | 90%              |
| $\Gamma_8 \quad 2\pi^+ 2\pi^- K^+ K^-$        | < 1.5 × 10 <sup>-4</sup>       | 90%              |

NODE=M079215;NODE=M079

DESIG=2

DESIG=1

DESIG=3

DESIG=4

DESIG=5

DESIG=6

DESIG=7

DESIG=8

|               |                                 |         |                  |     |          |
|---------------|---------------------------------|---------|------------------|-----|----------|
| $\Gamma_9$    | $2\pi^+ 2\pi^- K^+ K^- \pi^0$   | $< 2.2$ | $\times 10^{-4}$ | 90% | DESIG=9  |
| $\Gamma_{10}$ | $2\pi^+ 2\pi^- K^+ K^- 2\pi^0$  | $< 1.1$ | $\times 10^{-3}$ | 90% | DESIG=10 |
| $\Gamma_{11}$ | $3\pi^+ 2\pi^- K^- K_S^0 \pi^0$ | $< 7$   | $\times 10^{-4}$ | 90% | DESIG=11 |
| $\Gamma_{12}$ | $3\pi^+ 3\pi^-$                 | $< 7$   | $\times 10^{-5}$ | 90% | DESIG=12 |
| $\Gamma_{13}$ | $3\pi^+ 3\pi^- 2\pi^0$          | $< 1.2$ | $\times 10^{-3}$ | 90% | DESIG=13 |
| $\Gamma_{14}$ | $3\pi^+ 3\pi^- K^+ K^-$         | $< 1.5$ | $\times 10^{-4}$ | 90% | DESIG=14 |
| $\Gamma_{15}$ | $3\pi^+ 3\pi^- K^+ K^- \pi^0$   | $< 7$   | $\times 10^{-4}$ | 90% | DESIG=15 |
| $\Gamma_{16}$ | $4\pi^+ 4\pi^-$                 | $< 1.7$ | $\times 10^{-4}$ | 90% | DESIG=16 |
| $\Gamma_{17}$ | $4\pi^+ 4\pi^- 2\pi^0$          | $< 6$   | $\times 10^{-4}$ | 90% | DESIG=17 |

 **$\chi_{b0}(2P)$  BRANCHING RATIOS**

NODE=M079220

 **$\Gamma(\gamma \Upsilon(2S))/\Gamma_{\text{total}}$**  **$\Gamma_1/\Gamma$** 

| VALUE (%) | CL% | DOCUMENT ID | TECN | COMMENT |
|-----------|-----|-------------|------|---------|
|-----------|-----|-------------|------|---------|

NODE=M079R2  
NODE=M079R2**1.38 $\pm$ 0.30 OUR AVERAGE**

1.31 $\pm$ 0.27 $^{+0.13}_{-0.12}$  3,4 LEES 14M BABR  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$

3.6  $\pm$ 1.6  $\pm$ 0.3 3,5 HEINTZ 92 CSB2  $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$< 2.8$  90 6 LEES 11J BABR  $\Upsilon(3S) \rightarrow X \gamma$

$< 8.9$  90 7 CRAWFORD 92B CLE2  $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$

<sup>3</sup> Assuming  $B(\Upsilon(2S) \rightarrow \mu^+ \mu^-) = (1.93 \pm 0.17)\%$ .

<sup>4</sup> LEES 14M reports  $[\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))] = (7.7 \pm 1.6) \times 10^{-4}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) = (5.9 \pm 0.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>5</sup> Recalculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) \times B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S)) = (0.28 \pm 0.12 \pm 0.03)\%$  using  $B(\Upsilon(2S) \rightarrow \mu^+ \mu^-) = (1.44 \pm 0.10)\%$ . Supersedes HEINTZ 91.

<sup>6</sup> LEES 11J quotes a central value of  $\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))/\Gamma_{\text{total}} = (-0.3 \pm 0.2^{+0.5}_{-0.4})\%$ .

<sup>7</sup> Using  $B(\Upsilon(2S) \rightarrow \mu^+ \mu^-) = (1.37 \pm 0.26)\%$ ,  $B(\Upsilon(3S) \rightarrow \gamma \gamma \Upsilon(2S)) \times 2 B(\Upsilon(2S) \rightarrow \mu^+ \mu^-) < 1.19 \times 10^{-4}$ , and  $B(\Upsilon(3S) \rightarrow \chi_{b0}(2P) \gamma) = 0.049$ .

NODE=M079R2;LINKAGE=D  
NODE=M079R2;LINKAGE=E

NODE=M079R2;LINKAGE=C

NODE=M079R2;LINKAGE=LE

NODE=M079R2;LINKAGE=B

 **$\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}}$**  **$\Gamma_2/\Gamma$** 

| VALUE (%) | CL% | DOCUMENT ID | TECN | COMMENT |
|-----------|-----|-------------|------|---------|
|-----------|-----|-------------|------|---------|

NODE=M079R1  
NODE=M079R1**0.38 $\pm$ 0.17 OUR AVERAGE**

0.36 $\pm$ 0.17 $\pm$ 0.03 8,9,10 LEES 14M BABR  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$

0.9  $\pm$ 0.7  $\pm$ 0.1 9,11 HEINTZ 92 CSB2  $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$< 1.2$  90 12 LEES 11J BABR  $\Upsilon(3S) \rightarrow X \gamma$

$< 2.5$  90 13 CRAWFORD 92B CLE2  $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$

<sup>8</sup> LEES 14M quotes  $\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))/\Gamma_{\text{total}} = (2.1 \pm 1.0) \times 10^{-4}$  combining the results from  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$  samples with and without photon conversions.

<sup>9</sup> Assuming  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\%$ .

<sup>10</sup> LEES 14M reports  $[\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))] = (2.1 \pm 1.0) \times 10^{-4}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) = (5.9 \pm 0.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>11</sup> Recalculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) \times B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S)) = (0.05 \pm 0.04 \pm 0.01)\%$  using  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.57 \pm 0.05)\%$ . Supersedes HEINTZ 91.

<sup>12</sup> LEES 11J quotes a central value of  $\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))/\Gamma_{\text{total}} = (3.9 \pm 2.2^{+1.2}_{-0.6}) \times 10^{-4}$ .

<sup>13</sup> Using  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.57 \pm 0.07)\%$ ,  $B(\Upsilon(3S) \rightarrow \gamma \gamma \Upsilon(1S)) \times 2 B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) < 0.63 \times 10^{-4}$ , and  $B(\Upsilon(3S) \rightarrow \chi_{b0}(2P) \gamma) = 0.049$ .

NODE=M079R1;LINKAGE=D

NODE=M079R1;LINKAGE=E  
NODE=M079R1;LINKAGE=F

NODE=M079R1;LINKAGE=C

NODE=M079R1;LINKAGE=LE

NODE=M079R1;LINKAGE=B

 **$\Gamma(D^0 X)/\Gamma_{\text{total}}$**  **$\Gamma_3/\Gamma$** 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

NODE=M079R01  
NODE=M079R01

**$< 8.2 \times 10^{-2}$**  90 14,15 BRIERE 08 CLEO  $\Upsilon(3S) \rightarrow \gamma D^0 X$

<sup>14</sup> For  $p_{D^0} > 2.5$  GeV/c.

<sup>15</sup> The authors also present their result as  $(4.1 \pm 3.0 \pm 0.4) \times 10^{-2}$ .

NODE=M079R01;LINKAGE=BR  
NODE=M079R01;LINKAGE=RI

$$\Gamma(\pi^+\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_4/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------|-----|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <0.34                    | 90  | 16 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma\pi^+\pi^-K^+K^-\pi^0$<br>16 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow \pi^+\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P))] < 2 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R02  
NODE=M079R02

NODE=M079R02;LINKAGE=AS

$$\Gamma(2\pi^+\pi^-K^-K_S^0)/\Gamma_{\text{total}}$$

 $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                              |
|--------------------------|-----|-------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <0.5                     | 90  | 17 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+\pi^-K^-K_S^0$<br>17 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 2\pi^+\pi^-K^-K_S^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P))] < 3 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R03  
NODE=M079R03

NODE=M079R03;LINKAGE=AS

$$\Gamma(2\pi^+\pi^-K^-K_S^0 2\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_6/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|-----|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <2.2                     | 90  | 18 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+\pi^-K^-2\pi^0$<br>18 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 2\pi^+\pi^-K^-K_S^0 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P))] < 13 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R04  
NODE=M079R04

NODE=M079R04;LINKAGE=AS

$$\Gamma(2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_7/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|-----|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <2.4                     | 90  | 19 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-2\pi^0$<br>19 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P))] < 14 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R05  
NODE=M079R05

NODE=M079R05;LINKAGE=AS

$$\Gamma(2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}}$$

 $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                            |
|--------------------------|-----|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <1.5                     | 90  | 20 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-$<br>20 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P))] < 9 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R06  
NODE=M079R06

NODE=M079R06;LINKAGE=AS

$$\Gamma(2\pi^+2\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|-----|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <2.2                     | 90  | 21 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-\pi^0$<br>21 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 2\pi^+2\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P))] < 13 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R07  
NODE=M079R07

NODE=M079R07;LINKAGE=AS

$$\Gamma(2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------|-----|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <11                      | 90  | 22 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-2\pi^0$<br>22 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P))] < 63 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R08  
NODE=M079R08

NODE=M079R08;LINKAGE=AS

$$\Gamma(3\pi^+2\pi^-K^-K_S^0\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_{11}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------|-----|-------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <7                       | 90  | 23 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+2\pi^-K^-K_S^0\pi^0$<br>23 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 3\pi^+2\pi^-K^-K_S^0\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P))] < 39 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R09  
NODE=M079R09

NODE=M079R09;LINKAGE=AS

$$\Gamma(3\pi^+3\pi^-)/\Gamma_{\text{total}}$$

 $\Gamma_{12}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                |
|--------------------------|-----|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <0.7                     | 90  | 24 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+3\pi^-$<br>24 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 3\pi^+3\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P))] < 4 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R10  
NODE=M079R10

NODE=M079R10;LINKAGE=AS

$\Gamma(3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------|-----|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;12</b>            | 90  | 25 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^- 2\pi^0$<br>25 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))]$<br>$< 72 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R11  
NODE=M079R11

NODE=M079R11;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------|-----|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;1.5</b>           | 90  | 26 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^-$<br>26 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))]$<br>$< 9 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R12  
NODE=M079R12

NODE=M079R12;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------|-----|-------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;7</b>             | 90  | 27 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$<br>27 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))]$<br>$< 43 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R13  
NODE=M079R13

NODE=M079R13;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                          |
|--------------------------|-----|-------------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;1.7</b>           | 90  | 28 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 4\pi^+ 4\pi^-$<br>28 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 4\pi^+ 4\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))]$<br>$< 10 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R14  
NODE=M079R14

NODE=M079R14;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------|-----|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;6</b>             | 90  | 29 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 4\pi^+ 4\pi^- 2\pi^0$<br>29 ASNER 08A reports $[\Gamma(\chi_{b0}(2P) \rightarrow 4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))]$<br>$< 38 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) = 5.9 \times 10^{-2}$ . |

NODE=M079R15  
NODE=M079R15

NODE=M079R15;LINKAGE=AS

$$\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))/\Gamma_{\text{total}}$$

$$\Gamma_2/\Gamma \times \Gamma_{22}^{\Upsilon(3S)}/\Gamma \Upsilon(3S)$$

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------|-----|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;8.2</b>           | 90  | 30 LEES     | 11J BABR | $\Upsilon(3S) \rightarrow X\gamma$<br>30 LEES 11J quotes a central value of $\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))/\Gamma_{\text{total}} = (3.9 \pm 2.2^{+1.2}_{-0.6}) \times 10^{-4}$ and derives a 90% CL upper limit of $B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S)) < 1.2\%$ using $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) = (5.9 \pm 0.6)\%$ . |

NODE=M079B01  
NODE=M079B01

NODE=M079B01;LINKAGE=LE

 $B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$ 

| VALUE (units $10^{-5}$ )                  | DOCUMENT ID | TECN | COMMENT |
|-------------------------------------------|-------------|------|---------|
| <b>1.4<math>\pm</math>0.9 OUR AVERAGE</b> |             |      |         |

|                                                                                                                                                                                                                                                     |           |          |                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------|--------------------------------------------------------|
| 1.7 $^{+1.5+0.1}_{-1.4-1.2}$                                                                                                                                                                                                                        | 31 LEES   | 14M BABR | $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$   |
| 1.3 $\pm$ 1.0 $\pm$ 0.3                                                                                                                                                                                                                             | 32 HEINTZ | 92 CSB2  | $\Upsilon(3S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| 31 From a sample of $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$ with one converted photon.                                                                                                                                                 |           |          |                                                        |
| 32 Calculated by us. HEINTZ 92 quotes $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) \times B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S)) = (0.05 \pm 0.04 \pm 0.01)\%$ using $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.57 \pm 0.05)\%$ . |           |          |                                                        |

NODE=M079A02  
NODE=M079A02NODE=M079A02;LINKAGE=A  
NODE=M079A02;LINKAGE=K
$$[B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))] / [B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$$

| VALUE (%)                                                                                           | DOCUMENT ID | TECN     | COMMENT                                              |
|-----------------------------------------------------------------------------------------------------|-------------|----------|------------------------------------------------------|
| <b>1.71<math>\pm</math>0.80</b>                                                                     | 33 LEES     | 14M BABR | $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$ |
| 33 From a sample of $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$ without converted photons. |             |          |                                                      |

NODE=M079A00  
NODE=M079A00

NODE=M079A00;LINKAGE=A

$$\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))/\Gamma_{\text{total}}$$

$$\Gamma_1/\Gamma \times \Gamma_{22}^{\Upsilon(3S)}/\Gamma \Upsilon(3S)$$

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|-----|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>&lt;1.6</b>           | 90  | 34 LEES     | 11J BABR | $\Upsilon(3S) \rightarrow X\gamma$<br>34 LEES 11J quotes a central value of $\Gamma(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))/\Gamma_{\text{total}} = (-0.3 \pm 0.2^{+0.5}_{-0.4})\%$ and derives a 90% CL upper limit of $B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S)) < 2.8\%$ using $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) = (5.9 \pm 0.6)\%$ . |

NODE=M079B02  
NODE=M079B02

NODE=M079B02;LINKAGE=LE



# $B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) \times B(\Upsilon(2S) \rightarrow \ell^+ \ell^-)$

VALUE (units  $10^{-5}$ )

DOCUMENT ID

TECN

COMMENT

## **4.4 ± 1.6 OUR AVERAGE**

6.6<sup>+4.9+2.0</sup><sub>-4.0-0.3</sub>

35 LEES

14M BABR

 $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$ 

4.0 ± 1.7 ± 0.3

36 HEINTZ

92 CSB2

 $\Upsilon(3S) \rightarrow \gamma \gamma \ell^+ \ell^-$ <sup>35</sup> From a sample of  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$  with one converted photon.<sup>36</sup> Calculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P)) \times B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S)) = (0.28 \pm 0.12 \pm 0.03)\%$  using  $B(\Upsilon(2S) \rightarrow \mu^+ \mu^-) = (1.44 \pm 0.10)\%$ .

# $[B(\chi_{b0}(2P) \rightarrow \gamma \Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(2P))] / [B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$

VALUE (%)

DOCUMENT ID

TECN

COMMENT

## **3.31 ± 0.56**

37 LEES

14M BABR

 $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$ <sup>37</sup> From a sample of  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$  without converted photons.

## $\chi_{b0}(2P)$ REFERENCES

|          |     |               |                             |                   |
|----------|-----|---------------|-----------------------------|-------------------|
| LEES     | 14M | PR D90 112010 | J.P. Lees <i>et al.</i>     | (BABAR Collab.)   |
| LEES     | 11J | PR D84 072002 | J.P. Lees <i>et al.</i>     | (BABAR Collab.)   |
| ASNER    | 08A | PR D78 091103 | D.M. Asner <i>et al.</i>    | (CLEO Collab.)    |
| BRIERE   | 08  | PR D78 092007 | R.A. Briere <i>et al.</i>   | (CLEO Collab.)    |
| ARTUSO   | 05  | PRL 94 032001 | M. Artuso <i>et al.</i>     | (CLEO Collab.)    |
| CRAWFORD | 92B | PL B294 139   | G. Crawford <i>et al.</i>   | (CLEO Collab.)    |
| HEINTZ   | 92  | PR D46 1928   | U. Heintz <i>et al.</i>     | (CUSB II Collab.) |
| HEINTZ   | 91  | PRL 66 1563   | U. Heintz <i>et al.</i>     | (CUSB Collab.)    |
| MORRISON | 91  | PRL 67 1696   | R.J. Morrison <i>et al.</i> | (CLEO Collab.)    |
| NARAIN   | 91  | PRL 66 3113   | M. Narain <i>et al.</i>     | (CUSB Collab.)    |

 $\chi_{b1}(2P)$ 
 $I^G(J^{PC}) = 0^+(1^{++})$ 

J needs confirmation.

Observed in radiative decay of the  $\Upsilon(3S)$ , therefore  $C = +$ . Branching ratio requires E1 transition, M1 is strongly disfavored, therefore  $P = +$ .

## $\chi_{b1}(2P)$ MASS

VALUE (MeV)

DOCUMENT ID

**10255.46 ± 0.22 ± 0.50 OUR EVALUATION** From  $\gamma$  energy below, using  $\Upsilon(3S)$  mass = 10355.2 ± 0.5 MeV

## $m_{\chi_{b1}(2P)} - m_{\chi_{b0}(2P)}$

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

## **23.5 ± 0.7 ± 0.7**

<sup>1</sup> HEINTZ

92 CSB2

 $e^+ e^- \rightarrow \gamma X, \ell^+ \ell^- \gamma \gamma$ <sup>1</sup> From the average photon energy for inclusive and exclusive events. Supersedes NARAIN 91.

## $\gamma$ ENERGY IN $\Upsilon(3S)$ DECAY

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

COMMENT

## **99.26 ± 0.22 OUR EVALUATION**

Treating systematic errors as correlated

## **99.53 ± 0.23 OUR AVERAGE**

Error includes scale factor of 1.3. See the ideogram below.

99.15 ± 0.07 ± 0.25

ARTUSO

05 CLEO

 $\Upsilon(3S) \rightarrow \gamma X$ 

99 ± 1

169

CRAWFORD

92B CLE2

 $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$ 

100.1 ± 0.4

11147

<sup>2</sup> HEINTZ

92 CSB2

 $e^+ e^- \rightarrow \gamma X$ 

100.2 ± 0.5

223

<sup>3</sup> HEINTZ

92 CSB2

 $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$ 

99.5 ± 0.1 ± 0.5

25759

MORRISON

91 CLE2

 $e^+ e^- \rightarrow \gamma X$ NODE=M079A03  
NODE=M079A03NODE=M079A03;LINKAGE=A  
NODE=M079A03;LINKAGE=BNODE=M079A01  
NODE=M079A01

NODE=M079A01;LINKAGE=A

NODE=M079

REFID=56343  
REFID=53936  
REFID=52574  
REFID=52577  
REFID=50454  
REFID=43177  
REFID=43604  
REFID=41580  
REFID=41634  
REFID=41586

NODE=M080

NODE=M080

NODE=M080M

NODE=M080M  
→ UNCHECKED ←

NODE=M080M2

NODE=M080M2

NODE=M080M2;LINKAGE=A

NODE=M080DM

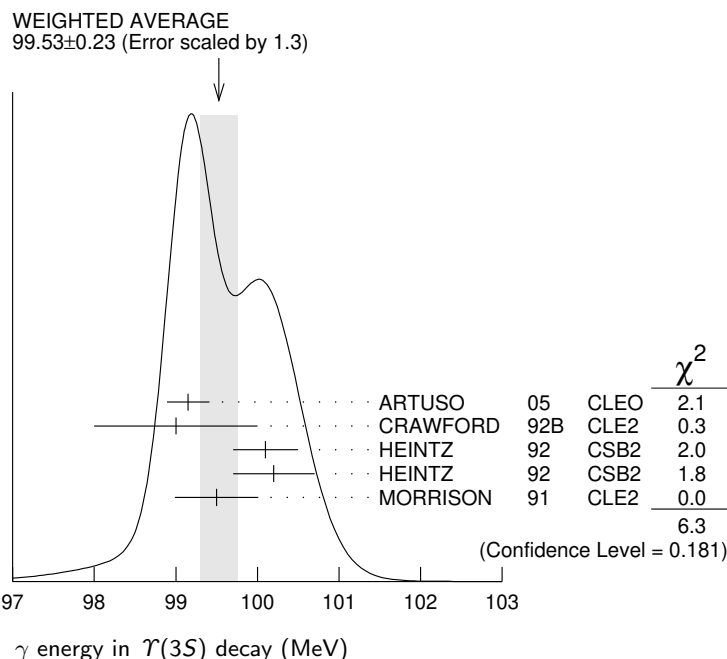
NODE=M080DM  
→ UNCHECKED ←

OCCUR=2

- <sup>2</sup>A systematic uncertainty on the energy scale of 0.9% not included. Supersedes NARAIN 91.
- <sup>3</sup>A systematic uncertainty on the energy scale of 0.9% not included. Supersedes HEINTZ 91.

NODE=M080DM;LINKAGE=A

NODE=M080DM;LINKAGE=B

 **$\chi_{b1}(2P)$  DECAY MODES**

NODE=M080215;NODE=M080

| Mode                                          | Fraction ( $\Gamma_i/\Gamma$ ) |          |
|-----------------------------------------------|--------------------------------|----------|
| $\Gamma_1 \quad \omega \Upsilon(1S)$          | $(1.63^{+0.40}_{-0.34}) \%$    | DESIG=3  |
| $\Gamma_2 \quad \gamma \Upsilon(2S)$          | $(18.1 \pm 1.9) \%$            | DESIG=2  |
| $\Gamma_3 \quad \gamma \Upsilon(1S)$          | $(9.9 \pm 1.0) \%$             | DESIG=1  |
| $\Gamma_4 \quad \pi\pi\chi_{b1}(1P)$          | $(9.1 \pm 1.3) \times 10^{-3}$ | DESIG=4  |
| $\Gamma_5 \quad D^0 X$                        | $(8.8 \pm 1.7) \%$             | DESIG=5  |
| $\Gamma_6 \quad \pi^+\pi^-K^+K^-\pi^0$        | $(3.1 \pm 1.0) \times 10^{-4}$ | DESIG=6  |
| $\Gamma_7 \quad 2\pi^+\pi^-K^-K_S^0$          | $(1.1 \pm 0.5) \times 10^{-4}$ | DESIG=7  |
| $\Gamma_8 \quad 2\pi^+\pi^-K^-K_S^02\pi^0$    | $(7.7 \pm 3.2) \times 10^{-4}$ | DESIG=8  |
| $\Gamma_9 \quad 2\pi^+2\pi^-2\pi^0$           | $(5.9 \pm 2.0) \times 10^{-4}$ | DESIG=9  |
| $\Gamma_{10} \quad 2\pi^+2\pi^-K^+K^-$        | $(10 \pm 4) \times 10^{-5}$    | DESIG=10 |
| $\Gamma_{11} \quad 2\pi^+2\pi^-K^+K^-\pi^0$   | $(5.5 \pm 1.8) \times 10^{-4}$ | DESIG=11 |
| $\Gamma_{12} \quad 2\pi^+2\pi^-K^+K^-2\pi^0$  | $(10 \pm 4) \times 10^{-4}$    | DESIG=12 |
| $\Gamma_{13} \quad 3\pi^+2\pi^-K^-K_S^0\pi^0$ | $(6.7 \pm 2.6) \times 10^{-4}$ | DESIG=13 |
| $\Gamma_{14} \quad 3\pi^+3\pi^-$              | $(1.2 \pm 0.4) \times 10^{-4}$ | DESIG=14 |
| $\Gamma_{15} \quad 3\pi^+3\pi^-2\pi^0$        | $(1.2 \pm 0.4) \times 10^{-3}$ | DESIG=15 |
| $\Gamma_{16} \quad 3\pi^+3\pi^-K^+K^-$        | $(2.0 \pm 0.8) \times 10^{-4}$ | DESIG=16 |
| $\Gamma_{17} \quad 3\pi^+3\pi^-K^+K^-\pi^0$   | $(6.1 \pm 2.2) \times 10^{-4}$ | DESIG=17 |
| $\Gamma_{18} \quad 4\pi^+4\pi^-$              | $(1.7 \pm 0.6) \times 10^{-4}$ | DESIG=18 |
| $\Gamma_{19} \quad 4\pi^+4\pi^-2\pi^0$        | $(1.9 \pm 0.7) \times 10^{-3}$ | DESIG=19 |

 **$\chi_{b1}(2P)$  BRANCHING RATIOS**

NODE=M080220

| $\Gamma(\omega \Upsilon(1S))/\Gamma_{\text{total}}$ |                      |                             |      |                                                      | $\Gamma_1/\Gamma$ |
|-----------------------------------------------------|----------------------|-----------------------------|------|------------------------------------------------------|-------------------|
| VALUE (units $10^{-2}$ )                            | EVTS                 | DOCUMENT ID                 | TECN | COMMENT                                              |                   |
| <b><math>1.63^{+0.35+0.16}_{-0.31-0.15}</math></b>  | $32.6^{+6.9}_{-6.1}$ | <sup>4</sup> CRONIN-HEN..04 | CLE3 | $\Upsilon(3S) \rightarrow \gamma\omega \Upsilon(1S)$ |                   |

NODE=M080R3  
NODE=M080R3

<sup>4</sup>Using  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (11.3 \pm 0.6)\%$  and  $B(\Upsilon(1S) \rightarrow \ell^+\ell^-) = 2$   
 $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = 2 (2.48 \pm 0.06)\%$ .

NODE=M080R3;LINKAGE=CR

$\Gamma(\gamma \Upsilon(2S))/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE                          | EVTS  | DOCUMENT ID | TECN | COMMENT                                                |
|--------------------------------|-------|-------------|------|--------------------------------------------------------|
| <b>0.181±0.019 OUR AVERAGE</b> |       |             |      |                                                        |
| 0.211±0.017±0.019              | 5,6,7 | LEES        | 14M  | BABR $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$ |
| 0.190±0.018±0.017              | 4.3k  | 8 LEES      | 11J  | BABR $\Upsilon(3S) \rightarrow X\gamma$                |
| 0.206±0.035±0.019              | 5,9   | CRAWFORD    | 92B  | CLE2 $e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$     |
| 0.132±0.018±0.012              | 5,10  | HEINTZ      | 92   | CSB2 $e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$     |

<sup>5</sup> Assuming  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.93 \pm 0.17)\%$ .

<sup>6</sup> LEES 14M quotes  $\Gamma(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(2S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))/\Gamma_{\text{total}} = (2.66 \pm 0.22)\%$  combining the results from  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  samples with and without photon conversions.

<sup>7</sup> LEES 14M reports  $[\Gamma(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))] = (2.66 \pm 0.22) \times 10^{-2}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>8</sup> LEES 11J reports  $[\Gamma(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))] = (2.4 \pm 0.1 \pm 0.2) \times 10^{-2}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>9</sup> CRAWFORD 92B quotes  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) \times B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(2S)) \times 2 B(\Upsilon(2S) \rightarrow \ell^+\ell^-) = (10.23 \pm 1.20 \pm 1.26) 10^{-4}$ .

<sup>10</sup> Recalculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) \times B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(2S)) = (2.29 \pm 0.23 \pm 0.21) \%$  using  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.44 \pm 0.10)\%$ . Supersedes HEINTZ 91.

NODE=M080R2;LINKAGE=D  
NODE=M080R2;LINKAGE=E

NODE=M080R2;LINKAGE=F

NODE=M080R2;LINKAGE=LE

NODE=M080R2;LINKAGE=B

NODE=M080R2;LINKAGE=C

 $\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE                          | EVTS     | DOCUMENT ID | TECN | COMMENT                                                |
|--------------------------------|----------|-------------|------|--------------------------------------------------------|
| <b>0.099±0.010 OUR AVERAGE</b> |          |             |      |                                                        |
| 0.107±0.006±0.010              | 11,12,13 | LEES        | 14M  | BABR $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$ |
| 0.098±0.005±0.009              | 15k      | 14 LEES     | 11J  | BABR $\Upsilon(3S) \rightarrow X\gamma$                |
| 0.103±0.023±0.009              | 11,15    | CRAWFORD    | 92B  | CLE2 $e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$     |
| 0.075±0.010±0.007              | 11,16    | HEINTZ      | 92   | CSB2 $e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$     |

<sup>11</sup> Assuming  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ .

<sup>12</sup> LEES 14M quotes  $\Gamma(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))/\Gamma_{\text{total}} = (13.48 \pm 0.72) \times 10^{-3}$  combining the results from samples of  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  with and without converted photons.

<sup>13</sup> LEES 14M reports  $[\Gamma(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))] = (13.48 \pm 0.72) \times 10^{-3}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>14</sup> LEES 11J reports  $[\Gamma(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))] = (12.4 \pm 0.3 \pm 0.6) \times 10^{-3}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>15</sup> CRAWFORD 92B quotes  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) \times B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(1S)) \times 2 B(\Upsilon(1S) \rightarrow \ell^+\ell^-) = (6.47 \pm 1.12 \pm 0.82) 10^{-4}$ .

<sup>16</sup> Recalculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) \times B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(1S)) = (0.91 \pm 0.11 \pm 0.06)\%$  using  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.57 \pm 0.05)\%$ . Supersedes HEINTZ 91.

NODE=M080R1;LINKAGE=D  
NODE=M080R1;LINKAGE=E

NODE=M080R1;LINKAGE=G

NODE=M080R1;LINKAGE=LE

NODE=M080R1;LINKAGE=B

NODE=M080R1;LINKAGE=F

 $\Gamma(\pi\pi\chi_{b1}(1P))/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE (units $10^{-3}$ )   | EVTS | DOCUMENT ID  | TECN | COMMENT                                          |
|----------------------------|------|--------------|------|--------------------------------------------------|
| <b>9.1±1.3 OUR AVERAGE</b> |      |              |      |                                                  |
| 9.2±1.1±0.8                | 31k  | 17 LEES      | 11C  | BABR $e^+e^- \rightarrow \pi^+\pi^-X$            |
| 8.6±2.3±2.1                |      | 18 CAWLFIELD | 06   | CLE3 $\Upsilon(3S) \rightarrow 2(\gamma\pi\ell)$ |

<sup>17</sup> LEES 11C measures  $B(\Upsilon(3S) \rightarrow \chi_{b1}(2P)X) \times B(\chi_{b1}(2P) \rightarrow \chi_{b1}(1P)\pi^+\pi^-) = (1.16 \pm 0.07 \pm 0.12) \times 10^{-3}$ . We derive the value assuming  $B(\Upsilon(3S) \rightarrow \chi_{b1}(2P)X) = B(\Upsilon(3S) \rightarrow \chi_{b1}(2P)\gamma) = (12.6 \pm 1.2) \times 10^{-2}$ .

<sup>18</sup> CAWLFIELD 06 quote  $\Gamma(\chi_b(2P) \rightarrow \pi\pi\chi_b(1P)) = 0.83 \pm 0.22 \pm 0.08 \pm 0.19$  keV assuming l-spin conservation, no D-wave contribution,  $\Gamma(\chi_{b1}(2P)) = 96 \pm 16$  keV, and  $\Gamma(\chi_{b2}(2P)) = 138 \pm 19$  keV.

NODE=M080R4  
NODE=M080R4

NODE=M080R4;LINKAGE=LE

NODE=M080R4;LINKAGE=CA

 $\Gamma(D^0 X)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT                                      |
|--------------------------|------|-------------|------|----------------------------------------------|
| <b>8.8±1.5±0.8</b>       |      |             |      |                                              |
|                          | 2243 | 19 BRIERE   | 08   | CLEO $\Upsilon(3S) \rightarrow \gamma D^0 X$ |

<sup>19</sup> For  $p_{D^0} > 2.5$  GeV/c.

NODE=M080R01  
NODE=M080R01

NODE=M080R01;LINKAGE=BR

$$\Gamma(\pi^+\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_6/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                      | EVTS | DOCUMENT ID | TECN     | COMMENT                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|--------------------------------------------------------|
| <b>3.1±1.0±0.3</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | 30   | 20 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma\pi^+\pi^-K^+K^-\pi^0$ |
| 20 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow \pi^+\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))]$ = $(39 \pm 8 \pm 9) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                        |

NODE=M080R02  
NODE=M080R02

NODE=M080R02;LINKAGE=AS

$$\Gamma(2\pi^+\pi^-K^-K_S^0)/\Gamma_{\text{total}}$$

 $\Gamma_7/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                    | EVTS | DOCUMENT ID | TECN     | COMMENT                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|-------------------------------------------------------|
| <b>1.1±0.5±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                          | 10   | 21 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+\pi^-K^-K_S^0$ |
| 21 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 2\pi^+\pi^-K^-K_S^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))]$ = $(14 \pm 5 \pm 3) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                       |

NODE=M080R03  
NODE=M080R03

NODE=M080R03;LINKAGE=AS

$$\Gamma(2\pi^+\pi^-K^-K_S^0 2\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                             | EVTS | DOCUMENT ID | TECN     | COMMENT                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|--------------------------------------------------------|
| <b>7.7±3.1±0.7</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | 15   | 22 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+\pi^-K^-2\pi^0$ |
| 22 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 2\pi^+\pi^-K^-K_S^0 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))]$ = $(97 \pm 30 \pm 26) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                        |

NODE=M080R04  
NODE=M080R04

NODE=M080R04;LINKAGE=AS

$$\Gamma(2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                     | EVTS | DOCUMENT ID | TECN     | COMMENT                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|------------------------------------------------------|
| <b>5.9±2.0±0.5</b>                                                                                                                                                                                                                                                                                                                                                                                                                           | 36   | 23 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-2\pi^0$ |
| 23 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 2\pi^+2\pi^-2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))]$ = $(74 \pm 16 \pm 19) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                      |

NODE=M080R05  
NODE=M080R05

NODE=M080R05;LINKAGE=AS

$$\Gamma(2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}}$$

 $\Gamma_{10}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                   | EVTS | DOCUMENT ID | TECN     | COMMENT                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|------------------------------------------------------|
| <b>1.0±0.4±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                         | 12   | 24 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-$ |
| 24 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 2\pi^+2\pi^-K^+K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))]$ = $(12 \pm 4 \pm 3) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                      |

NODE=M080R06  
NODE=M080R06

NODE=M080R06;LINKAGE=AS

$$\Gamma(2\pi^+2\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_{11}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                          | EVTS | DOCUMENT ID | TECN     | COMMENT                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|-----------------------------------------------------------|
| <b>5.5±1.7±0.5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                | 38   | 25 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-\pi^0$ |
| 25 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 2\pi^+2\pi^-K^+K^-\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))]$ = $(69 \pm 13 \pm 17) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                           |

NODE=M080R07  
NODE=M080R07

NODE=M080R07;LINKAGE=AS

$$\Gamma(2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_{12}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                            | EVTS | DOCUMENT ID | TECN     | COMMENT                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|------------------------------------------------------------|
| <b>9.6±3.5±0.9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  | 27   | 26 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+2\pi^-K^+K^-2\pi^0$ |
| 26 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 2\pi^+2\pi^-K^+K^-2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))]$ = $(121 \pm 29 \pm 33) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                            |

NODE=M080R08  
NODE=M080R08

NODE=M080R08;LINKAGE=AS

$$\Gamma(3\pi^+2\pi^-K^-K_S^0\pi^0)/\Gamma_{\text{total}}$$

 $\Gamma_{13}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                            | EVTS | DOCUMENT ID | TECN     | COMMENT                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|-------------------------------------------------------------|
| <b>6.7±2.5±0.6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  | 17   | 27 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+2\pi^-K^-K_S^0\pi^0$ |
| 27 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 3\pi^+2\pi^-K^-K_S^0\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))]$ = $(85 \pm 23 \pm 22) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) = (12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                             |

NODE=M080R09  
NODE=M080R09

NODE=M080R09;LINKAGE=AS

$\Gamma(3\pi^+ 3\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                           | EVTS | DOCUMENT ID | TECN     | COMMENT                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|-------------------------------------------------|
| <b>1.2<math>\pm</math>0.4<math>\pm</math>0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                   | 18   | 28 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^-$ |
| 28 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 3\pi^+ 3\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$<br>$= (15 \pm 4 \pm 3) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) =$<br>$(12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is<br>the systematic error from using our best value. |      |             |          |                                                 |

NODE=M080R10  
 NODE=M080R10

NODE=M080R10;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                     | EVTS | DOCUMENT ID | TECN     | COMMENT                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|--------------------------------------------------------|
| <b>12<math>\pm</math>4<math>\pm</math>1</b>                                                                                                                                                                                                                                                                                                                                                                                                                  | 44   | 29 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^- 2\pi^0$ |
| 29 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$<br>$= (150 \pm 30 \pm 40) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) =$<br>$(12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error<br>is the systematic error from using our best value. |      |             |          |                                                        |

NODE=M080R11  
 NODE=M080R11

NODE=M080R11;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                   | EVTS | DOCUMENT ID | TECN     | COMMENT                                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|---------------------------------------------------------|
| <b>2.0<math>\pm</math>0.7<math>\pm</math>0.2</b>                                                                                                                                                                                                                                                                                                                                                                                                           | 16   | 30 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^-$ |
| 30 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$<br>$= (25 \pm 7 \pm 6) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) =$<br>$(12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our<br>second error is the systematic error from using our best value. |      |             |          |                                                         |

NODE=M080R12  
 NODE=M080R12

NODE=M080R12;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                           | EVTS | DOCUMENT ID | TECN     | COMMENT                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|---------------------------------------------------------------|
| <b>6.1<math>\pm</math>2.1<math>\pm</math>0.6</b>                                                                                                                                                                                                                                                                                                                                                                                                                   | 25   | 31 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$ |
| 31 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$<br>$= (77 \pm 17 \pm 21) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) =$<br>$(12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our<br>second error is the systematic error from using our best value. |      |             |          |                                                               |

NODE=M080R13  
 NODE=M080R13

NODE=M080R13;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                           | EVTS | DOCUMENT ID | TECN     | COMMENT                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|-------------------------------------------------|
| <b>1.7<math>\pm</math>0.6<math>\pm</math>0.2</b>                                                                                                                                                                                                                                                                                                                                                                                                   | 16   | 32 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 4\pi^+ 4\pi^-$ |
| 32 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 4\pi^+ 4\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$<br>$= (22 \pm 6 \pm 5) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) =$<br>$(12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error is<br>the systematic error from using our best value. |      |             |          |                                                 |

NODE=M080R14  
 NODE=M080R14

NODE=M080R14;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                     | EVTS | DOCUMENT ID | TECN     | COMMENT                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|--------------------------------------------------------|
| <b>19<math>\pm</math>7<math>\pm</math>2</b>                                                                                                                                                                                                                                                                                                                                                                                                                  | 41   | 33 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 4\pi^+ 4\pi^- 2\pi^0$ |
| 33 ASNER 08A reports $[\Gamma(\chi_{b1}(2P) \rightarrow 4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$<br>$= (241 \pm 47 \pm 72) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) =$<br>$(12.6 \pm 1.2) \times 10^{-2}$ . Our first error is their experiment's error and our second error<br>is the systematic error from using our best value. |      |             |          |                                                        |

NODE=M080R15  
 NODE=M080R15

NODE=M080R15;LINKAGE=AS

 $\chi_{b1}(2P)$  Cross-Particle Branching Ratios

NODE=M080230

$$\Gamma(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))/\Gamma_{\text{total}}$$

$$\Gamma_3/\Gamma \times \Gamma_{21}^{\Upsilon(3S)}/\Gamma \Upsilon(3S)$$

| VALUE (units $10^{-3}$ )                          | EVTS | DOCUMENT ID | TECN     | COMMENT                            |
|---------------------------------------------------|------|-------------|----------|------------------------------------|
| <b>12.4<math>\pm</math>0.3<math>\pm</math>0.6</b> | 15k  | LEES        | 11J BABR | $\Upsilon(3S) \rightarrow X\gamma$ |

NODE=M080B01  
 NODE=M080B01

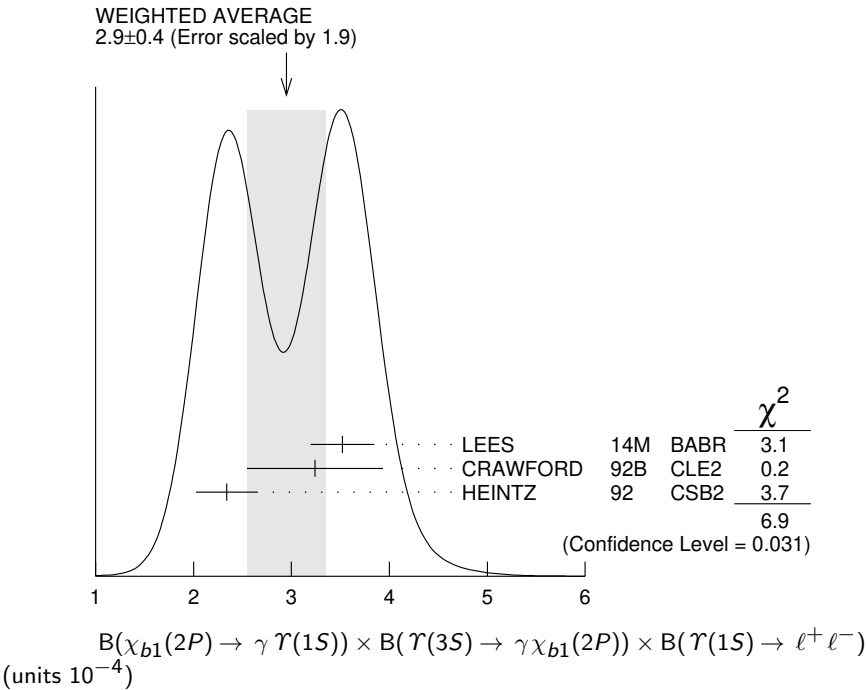
 $B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) \times B(\Upsilon(1S) \rightarrow \ell^+ \ell^-)$ 

NODE=M080A00  
 NODE=M080A00

| VALUE (units $10^{-4}$ )                   | EVTS                                                        | DOCUMENT ID | TECN     | COMMENT                                                |
|--------------------------------------------|-------------------------------------------------------------|-------------|----------|--------------------------------------------------------|
| <b>2.9 <math>\pm</math>0.4 OUR AVERAGE</b> | Error includes scale factor of 1.9. See the ideogram below. |             |          |                                                        |
| 3.52 $^{+0.28}_{-0.27} \pm 0.17$           |                                                             | 34 LEES     | 14M BABR | $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$   |
| 3.24 $\pm 0.56 \pm 0.41$                   | 58                                                          | 35 CRAWFORD | 92B CLE2 | $\Upsilon(3S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| 2.34 $\pm 0.28 \pm 0.15$                   |                                                             | 36 HEINTZ   | 92 CSB2  | $\Upsilon(3S) \rightarrow \gamma \gamma \ell^+ \ell^-$ |

- 34 From a sample of  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  with one converted photon.
- 35 CRAWFORD 92B quotes  $2\times B(\Upsilon(3S) \rightarrow \gamma\chi_{bJ}(2P)) B(\chi_{bJ}(2P) \rightarrow \gamma\Upsilon(nS))$   
 $B(\Upsilon(nS) \rightarrow \ell^+\ell^-)$ .
- 36 Calculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) \times B(\chi_{b1}(2P) \rightarrow \gamma\Upsilon(1S)) = (0.91 \pm 0.11 \pm 0.06)\%$  using  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.57 \pm 0.05)\%$ .

NODE=M080A00;LINKAGE=A  
NODE=M080A00;LINKAGE=C  
  
NODE=M080A00;LINKAGE=B



$\Gamma(\chi_{b1}(2P) \rightarrow \gamma\Upsilon(2S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P))/\Gamma_{\text{total}}$   
 $\Gamma_2/\Gamma \times \Gamma_{21}^{\Upsilon(3S)}/\Gamma^{\Upsilon(3S)}$

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                            |
|--------------------------|------|-------------|----------|------------------------------------|
| $2.4 \pm 0.1 \pm 0.2$    | 4.3k | LEES        | 11J BABR | $\Upsilon(3S) \rightarrow X\gamma$ |

NODE=M080B02  
NODE=M080B02

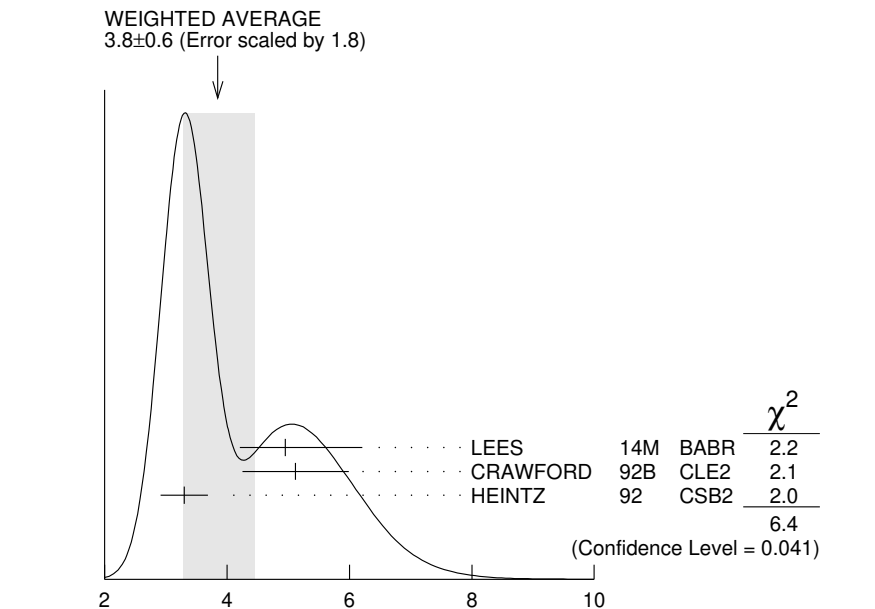
$B(\chi_{b1}(2P) \rightarrow \gamma\Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) \times B(\Upsilon(2S) \rightarrow \ell^+\ell^-)$

| VALUE (units $10^{-4}$ )         | EVTS        | DOCUMENT ID                                                 | TECN     | COMMENT                                             |
|----------------------------------|-------------|-------------------------------------------------------------|----------|-----------------------------------------------------|
| $3.8 \pm 0.6$                    | OUR AVERAGE | Error includes scale factor of 1.8. See the ideogram below. |          |                                                     |
| $4.95^{+0.75+1.01}_{-0.70-0.24}$ | 37          | LEES                                                        | 14M BABR | $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$   |
| $5.12 \pm 0.60 \pm 0.63$         | 111         | 38 CRAWFORD                                                 | 92B CLE2 | $\Upsilon(3S) \rightarrow \gamma\gamma\ell^+\ell^-$ |
| $3.30 \pm 0.33 \pm 0.20$         | 39          | HEINTZ                                                      | 92 CSB2  | $\Upsilon(3S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

NODE=M080A01  
NODE=M080A01

- 37 From a sample of  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  with one converted photon.
- 38 CRAWFORD 92B quotes  $2\times B(\Upsilon(3S) \rightarrow \gamma\chi_{bJ}(2P)) B(\chi_{bJ}(2P) \rightarrow \gamma\Upsilon(nS))$   
 $B(\Upsilon(nS) \rightarrow \ell^+\ell^-)$ .
- 39 Calculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b1}(2P)) \times B(\chi_{b1}(2P) \rightarrow \gamma\Upsilon(2S)) = (2.29 \pm 0.23 \pm 0.21)\%$  using  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.44 \pm 0.10)\%$ .

NODE=M080A01;LINKAGE=A  
NODE=M080A01;LINKAGE=C  
  
NODE=M080A01;LINKAGE=B



$$B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) \times B(\Upsilon(2S) \rightarrow \ell^+ \ell^-)$$

(units  $10^{-4}$ )

$$B(\chi_{b1}(2P) \rightarrow \chi_{b1}(1P) \pi^+ \pi^-) \times B(\Upsilon(3S) \rightarrow \chi_{b1}(2P) X)$$

| VALUE (units $10^{-3}$ )                   | EVTs | DOCUMENT ID | TECN     | COMMENT                             |
|--------------------------------------------|------|-------------|----------|-------------------------------------|
| <b><math>1.16 \pm 0.07 \pm 0.12</math></b> | 31k  | LEES        | 11C BABR | $e^+ e^- \rightarrow \pi^+ \pi^- X$ |

NODE=M080R16  
 NODE=M080R16

$$B(\chi_{b2}(2P) \rightarrow \rho X + \bar{\rho} X) / B(\chi_{b1}(2P) \rightarrow \rho X + \bar{\rho} X)$$

| VALUE                                         | DOCUMENT ID | TECN    | COMMENT                                         |
|-----------------------------------------------|-------------|---------|-------------------------------------------------|
| <b><math>1.109 \pm 0.007 \pm 0.040</math></b> | BRIERE      | 07 CLEO | $\Upsilon(3S) \rightarrow \gamma \chi_{bJ}(2P)$ |

NODE=M080R20  
 NODE=M080R20

$$B(\chi_{b0}(2P) \rightarrow \rho X + \bar{\rho} X) / B(\chi_{b1}(2P) \rightarrow \rho X + \bar{\rho} X)$$

| VALUE                                         | DOCUMENT ID | TECN    | COMMENT                                         |
|-----------------------------------------------|-------------|---------|-------------------------------------------------|
| <b><math>1.082 \pm 0.025 \pm 0.060</math></b> | BRIERE      | 07 CLEO | $\Upsilon(3S) \rightarrow \gamma \chi_{bJ}(2P)$ |

NODE=M080R21  
 NODE=M080R21

### $\chi_{b1}(2P)$ REFERENCES

|               |     |               |                                  |                   |
|---------------|-----|---------------|----------------------------------|-------------------|
| LEES          | 14M | PR D90 112010 | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   |
| LEES          | 11C | PR D84 011104 | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   |
| LEES          | 11J | PR D84 072002 | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   |
| ASNER         | 08A | PR D78 091103 | D.M. Asner <i>et al.</i>         | (CLEO Collab.)    |
| BRIERE        | 08  | PR D78 092007 | R.A. Briere <i>et al.</i>        | (CLEO Collab.)    |
| BRIERE        | 07  | PR D76 012005 | R.A. Briere <i>et al.</i>        | (CLEO Collab.)    |
| CAWLFIELD     | 06  | PR D73 012003 | C. Cawfield <i>et al.</i>        | (CLEO Collab.)    |
| ARTUSO        | 05  | PRL 94 032001 | M. Artuso <i>et al.</i>          | (CLEO Collab.)    |
| CRONIN-HEN... | 04  | PRL 92 222002 | D. Cronin-Hennessy <i>et al.</i> | (CLEO Collab.)    |
| CRAWFORD      | 92B | PL B294 139   | G. Crawford <i>et al.</i>        | (CLEO Collab.)    |
| HEINTZ        | 92  | PR D46 1928   | U. Heintz <i>et al.</i>          | (CUSB II Collab.) |
| HEINTZ        | 91  | PRL 66 1563   | U. Heintz <i>et al.</i>          | (CUSB Collab.)    |
| MORRISON      | 91  | PRL 67 1696   | R.J. Morrison <i>et al.</i>      | (CLEO Collab.)    |
| NARAIN        | 91  | PRL 66 3113   | M. Narain <i>et al.</i>          | (CUSB Collab.)    |

NODE=M080

REFID=56343  
 REFID=16775  
 REFID=53936  
 REFID=52574  
 REFID=52577  
 REFID=51887  
 REFID=50997  
 REFID=50454  
 REFID=49766  
 REFID=43177  
 REFID=43604  
 REFID=41580  
 REFID=41634  
 REFID=41586

$$h_b(2P)$$

$$J^{PC} = 0^-(1^{+-})$$

Quantum numbers are quark model predictions.

$h_b(2P)$  MASS

| VALUE (MeV)                                                                   | EVTS  | DOCUMENT ID         | TECN | COMMENT                                       |
|-------------------------------------------------------------------------------|-------|---------------------|------|-----------------------------------------------|
| <b>10259.8±0.5±1.1</b>                                                        | 90k   | MIZUK               | 12   | BELL $e^+e^- \rightarrow \pi^+\pi^-$ hadrons  |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |                     |      |                                               |
| 10259.8±0.6 <sup>+1.4</sup> <sub>-1.0</sub>                                   | 83.9k | <sup>1</sup> ADACHI | 12   | BELL 10.86 $e^+e^- \rightarrow \pi^+\pi^-$ MM |
| <sup>1</sup> Superseded by MIZUK 12.                                          |       |                     |      |                                               |

$h_b(2P)$  DECAY MODES

| Mode                          | Fraction ( $\Gamma_i/\Gamma$ ) |
|-------------------------------|--------------------------------|
| $\Gamma_1$ hadrons            | not seen                       |
| $\Gamma_2$ $\eta_b(1S)\gamma$ | (22± 5) %                      |
| $\Gamma_3$ $\eta_b(2S)\gamma$ | (48±13) %                      |

$h_b(2P)$  BRANCHING RATIOS

| $\Gamma(\text{hadrons})/\Gamma_{\text{total}}$   |       |             |      | $\Gamma_1/\Gamma$                                    |
|--------------------------------------------------|-------|-------------|------|------------------------------------------------------|
| VALUE                                            | EVTS  | DOCUMENT ID | TECN | COMMENT                                              |
| <b>not seen</b>                                  | 83.9k | ADACHI      | 12   | BELL 10.86 $e^+e^- \rightarrow \pi^+\pi^-$ MM        |
| $\Gamma(\eta_b(1S)\gamma)/\Gamma_{\text{total}}$ |       |             |      | $\Gamma_2/\Gamma$                                    |
| VALUE (units 10 <sup>-2</sup> )                  | EVTS  | DOCUMENT ID | TECN | COMMENT                                              |
| <b>22.3±3.8<sup>+3.1</sup><sub>-3.3</sub></b>    | 10k   | MIZUK       | 12   | BELL $e^+e^- \rightarrow (\gamma)\pi^+\pi^-$ hadrons |
| $\Gamma(\eta_b(2S)\gamma)/\Gamma_{\text{total}}$ |       |             |      | $\Gamma_3/\Gamma$                                    |
| VALUE (units 10 <sup>-2</sup> )                  | EVTS  | DOCUMENT ID | TECN | COMMENT                                              |
| <b>47.5±10.5<sup>+6.8</sup><sub>-7.7</sub></b>   | 26k   | MIZUK       | 12   | BELL $e^+e^- \rightarrow (\gamma)\pi^+\pi^-$ hadrons |

$h_b(2P)$  REFERENCES

|        |    |                |                         |                 |
|--------|----|----------------|-------------------------|-----------------|
| ADACHI | 12 | PRL 108 032001 | I. Adachi <i>et al.</i> | (BELLE Collab.) |
| MIZUK  | 12 | PRL 109 232002 | R. Mizuk <i>et al.</i>  | (BELLE Collab.) |

NODE=M205

NODE=M205

NODE=M205M

NODE=M205M

NODE=M205M;LINKAGE=AD

NODE=M205215;NODE=M205

DESIG=1

DESIG=2

DESIG=3

NODE=M205225

NODE=M205R01  
NODE=M205R01

NODE=M205R02  
NODE=M205R02

NODE=M205R03  
NODE=M205R03

NODE=M205

REFID=53962  
REFID=54718



$\chi_{b2}(2P)$ 

$$I^G(J^{PC}) = 0^+(2^{++})$$

$J$  needs confirmation.

Observed in radiative decay of the  $\Upsilon(3S)$ , therefore  $C = +$ . Branching ratio requires E1 transition, M1 is strongly disfavored, therefore  $P = +$ .

NODE=M081

NODE=M081

 $\chi_{b2}(2P)$  MASS

VALUE (MeV)

DOCUMENT ID

**10268.65 ± 0.22 ± 0.50 OUR EVALUATION** From  $\gamma$  energy below, using  $\Upsilon(3S)$  mass = 10355.2 ± 0.5 MeV

NODE=M081M

NODE=M081M

→ UNCHECKED ←

 $m_{\chi_{b2}(2P)} - m_{\chi_{b1}(2P)}$ 

VALUE (MeV)

DOCUMENT ID

TECN

COMMENT

**13.10 ± 0.24 OUR AVERAGE**

12.3 ± 2.6 ± 0.6

<sup>1</sup> AAIJ

14BG LHCb

 $pp \rightarrow \gamma \mu^+ \mu^- X$ 

13.04 ± 0.26

LEES

14M BABR

 $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$ 

13.5 ± 0.4 ± 0.5

<sup>2</sup> HEINTZ

92 CSB2

 $e^+ e^- \rightarrow \gamma X, \ell^+ \ell^- \gamma \gamma$ <sup>1</sup> From the  $\chi_{bj}(2P) \rightarrow \Upsilon(1S) \gamma$  transition.<sup>2</sup> From the average photon energy for inclusive and exclusive events. Supersedes NARAIN 91.

NODE=M081M2

NODE=M081M2

NODE=M081M2;LINKAGE=B

NODE=M081M2;LINKAGE=A

 $\gamma$  ENERGY IN  $\Upsilon(3S)$  DECAY

VALUE (MeV)

EVTS

DOCUMENT ID

TECN

COMMENT

**86.19 ± 0.22 OUR EVALUATION**

Treating systematic errors as correlated

**86.40 ± 0.18 OUR AVERAGE**

86.04 ± 0.06 ± 0.27

ARTUSO

05

CLEO

 $\Upsilon(3S) \rightarrow \gamma X$ 

86 ± 1

101

CRAWFORD

92B

CLE2

 $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$ 

86.7 ± 0.4

10319

<sup>3</sup> HEINTZ

92

CSB2

 $e^+ e^- \rightarrow \gamma X$ 

86.9 ± 0.4

157

<sup>4</sup> HEINTZ

92

CSB2

 $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$ 

86.4 ± 0.1 ± 0.4

30741

MORRISON

91

CLE2

 $e^+ e^- \rightarrow \gamma X$ <sup>3</sup> A systematic uncertainty on the energy scale of 0.9% not included. Supersedes NARAIN 91.<sup>4</sup> A systematic uncertainty on the energy scale of 0.9% not included. Supersedes HEINTZ 91.

NODE=M081DM

NODE=M081DM

→ UNCHECKED ←

OCCUR=2

NODE=M081DM;LINKAGE=A

NODE=M081DM;LINKAGE=B

 $\chi_{b2}(2P)$  DECAY MODES

NODE=M081215;NODE=M081

| Mode                                              | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|---------------------------------------------------|--------------------------------|------------------|
| $\Gamma_1 \quad \omega \Upsilon(1S)$              | $(1.10^{+0.34}_{-0.30}) \%$    |                  |
| $\Gamma_2 \quad \gamma \Upsilon(2S)$              | $(8.9 \pm 1.2) \%$             |                  |
| $\Gamma_3 \quad \gamma \Upsilon(1S)$              | $(6.6 \pm 0.8) \%$             |                  |
| $\Gamma_4 \quad \pi \pi \chi_{b2}(1P)$            | $(5.1 \pm 0.9) \times 10^{-3}$ |                  |
| $\Gamma_5 \quad D^0 X$                            | $< 2.4 \%$                     | 90%              |
| $\Gamma_6 \quad \pi^+ \pi^- K^+ K^- \pi^0$        | $< 1.1 \times 10^{-4}$         | 90%              |
| $\Gamma_7 \quad 2\pi^+ \pi^- K^- K_S^0$           | $< 9 \times 10^{-5}$           | 90%              |
| $\Gamma_8 \quad 2\pi^+ \pi^- K^- K_S^0 2\pi^0$    | $< 7 \times 10^{-4}$           | 90%              |
| $\Gamma_9 \quad 2\pi^+ 2\pi^- 2\pi^0$             | $(3.9 \pm 1.6) \times 10^{-4}$ |                  |
| $\Gamma_{10} \quad 2\pi^+ 2\pi^- K^+ K^-$         | $(9 \pm 4) \times 10^{-5}$     |                  |
| $\Gamma_{11} \quad 2\pi^+ 2\pi^- K^+ K^- \pi^0$   | $(2.4 \pm 1.1) \times 10^{-4}$ |                  |
| $\Gamma_{12} \quad 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$  | $(4.7 \pm 2.3) \times 10^{-4}$ |                  |
| $\Gamma_{13} \quad 3\pi^+ 2\pi^- K^- K_S^0 \pi^0$ | $< 4 \times 10^{-4}$           | 90%              |
| $\Gamma_{14} \quad 3\pi^+ 3\pi^-$                 | $(9 \pm 4) \times 10^{-5}$     |                  |
| $\Gamma_{15} \quad 3\pi^+ 3\pi^- 2\pi^0$          | $(1.2 \pm 0.4) \times 10^{-3}$ |                  |
| $\Gamma_{16} \quad 3\pi^+ 3\pi^- K^+ K^-$         | $(1.4 \pm 0.7) \times 10^{-4}$ |                  |
| $\Gamma_{17} \quad 3\pi^+ 3\pi^- K^+ K^- \pi^0$   | $(4.2 \pm 1.7) \times 10^{-4}$ |                  |
| $\Gamma_{18} \quad 4\pi^+ 4\pi^-$                 | $(9 \pm 5) \times 10^{-5}$     |                  |
| $\Gamma_{19} \quad 4\pi^+ 4\pi^- 2\pi^0$          | $(1.3 \pm 0.5) \times 10^{-3}$ |                  |

DESIG=3

DESIG=2

DESIG=1

DESIG=4

DESIG=5

DESIG=6

DESIG=7

DESIG=8

DESIG=9

DESIG=10

DESIG=11

DESIG=12

DESIG=13

DESIG=14

DESIG=15

DESIG=16

DESIG=17

DESIG=18

DESIG=19

$\chi_{b2}(2P)$  BRANCHING RATIOS

NODE=M081220

 $\Gamma(\omega \Upsilon(1S))/\Gamma_{\text{total}}$  $\Gamma_1/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**1.10<sup>+0.32+0.11</sup><sub>-0.28-0.10</sub>** 20.1<sup>+5.8</sup><sub>-5.1</sub> <sup>5</sup> CRONIN-HEN..04 CLE3  $\Upsilon(3S) \rightarrow \gamma \omega \Upsilon(1S)$

NODE=M081R3  
NODE=M081R3

<sup>5</sup> Using  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (11.4 \pm 0.8)\%$  and  $B(\Upsilon(1S) \rightarrow \ell^+ \ell^-) = 2$   
 $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = 2 (2.48 \pm 0.06)\%$ .

NODE=M081R3;LINKAGE=CR

 $\Gamma(\gamma \Upsilon(2S))/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.089 $\pm$ 0.012 OUR AVERAGE**

0.085 $\pm$ 0.010 $\pm$ 0.010 6,7,8 LEES 14M BABR  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$

0.084 $\pm$ 0.011 $\pm$ 0.010 2.5k <sup>9</sup> LEES 11J BABR  $\Upsilon(3S) \rightarrow X \gamma$

0.096 $\pm$ 0.022 $\pm$ 0.012 7,10 CRAWFORD 92B CLE2  $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$

0.106 $\pm$ 0.016 $\pm$ 0.013 7,11 HEINTZ 92 CSB2  $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$

NODE=M081R2  
NODE=M081R2

<sup>6</sup> LEES 14M quotes  $\Gamma(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(2S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))/\Gamma_{\text{total}}$   
 $= (1.12 \pm 0.13)\%$  combining the results from samples of  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$  with and without converted photons.

NODE=M081R2;LINKAGE=D

<sup>7</sup> Assuming  $B(\Upsilon(2S) \rightarrow \mu^+ \mu^-) = (1.93 \pm 0.17)\%$ .

<sup>8</sup> LEES 14M reports  $[\Gamma(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))]$   
 $= (1.12 \pm 0.13) \times 10^{-2}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) =$   
 $(13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M081R2;LINKAGE=E  
NODE=M081R2;LINKAGE=F

<sup>9</sup> LEES 11J reports  $[\Gamma(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(2S))/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))]$   
 $= (1.1 \pm 0.1 \pm 0.1) \times 10^{-2}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) =$   
 $(13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M081R2;LINKAGE=LE

<sup>10</sup> CRAWFORD 92B quotes  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P)) \times B(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(2S)) \times 2$   
 $B(\Upsilon(2S) \rightarrow \ell^+ \ell^-) = (4.98 \pm 0.94 \pm 0.62) 10^{-4}$ .

NODE=M081R2;LINKAGE=B

<sup>11</sup> Recalculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) \times B(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(2S)) =$   
 $(1.90 \pm 0.23 \pm 0.18) \%$  using  $B(\Upsilon(2S) \rightarrow \mu^+ \mu^-) = (1.44 \pm 0.10)\%$ .  
 Supersedes HEINTZ 91.

NODE=M081R2;LINKAGE=C

 $\Gamma(\gamma \Upsilon(1S))/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

**0.066 $\pm$ 0.008 OUR AVERAGE**

0.061 $\pm$ 0.004 $\pm$ 0.007 12,13,14 LEES 14M BABR  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$

0.070 $\pm$ 0.004 $\pm$ 0.008 11k <sup>15</sup> LEES 11J BABR  $\Upsilon(3S) \rightarrow X \gamma$

0.077 $\pm$ 0.018 $\pm$ 0.009 13,16 CRAWFORD 92B CLE2  $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$

0.061 $\pm$ 0.009 $\pm$ 0.007 13,17 HEINTZ 92 CSB2  $e^+ e^- \rightarrow \ell^+ \ell^- \gamma \gamma$

NODE=M081R1  
NODE=M081R1

<sup>12</sup> LEES 14M quotes  $\Gamma(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))/\Gamma_{\text{total}}$   
 $= (8.03 \pm 0.50) \times 10^{-3}$  combining the results from samples of  $\Upsilon(3S) \rightarrow \gamma \gamma \mu^+ \mu^-$  with and without converted photons.

NODE=M081R1;LINKAGE=D

<sup>13</sup> Assuming  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\%$ .

<sup>14</sup> LEES 14M reports  $[\Gamma(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))]$   
 $= (8.03 \pm 0.50) \times 10^{-3}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) =$   
 $(13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M081R1;LINKAGE=E  
NODE=M081R1;LINKAGE=F

<sup>15</sup> LEES 11J reports  $[\Gamma(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))]$   
 $= (9.2 \pm 0.3 \pm 0.4) \times 10^{-3}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) =$   
 $(13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M081R1;LINKAGE=LE

<sup>16</sup> CRAWFORD 92B quotes  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) \times B(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(1S)) \times 2$   
 $B(\Upsilon(1S) \rightarrow \ell^+ \ell^-) = (5.03 \pm 0.94 \pm 0.63) 10^{-4}$ .

NODE=M081R1;LINKAGE=B

<sup>17</sup> Recalculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) \times B(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(1S)) =$   
 $(0.77 \pm 0.11 \pm 0.05)\%$  using  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.57 \pm 0.05)\%$ .  
 Supersedes HEINTZ 91.

NODE=M081R1;LINKAGE=C

 $\Gamma(\pi \pi \chi_{b2}(1P))/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**5.1 $\pm$ 0.9 OUR AVERAGE**

4.9 $\pm$ 0.7 $\pm$ 0.6 17k <sup>18</sup> LEES 11C BABR  $e^+ e^- \rightarrow \pi^+ \pi^- X$

6.0 $\pm$ 1.6 $\pm$ 1.4 <sup>19</sup> CAWLFIELD 06 CLE3  $\Upsilon(3S) \rightarrow 2(\gamma \pi \ell)$

NODE=M081R4  
NODE=M081R4

<sup>18</sup>  $(0.64 \pm 0.05 \pm 0.08) \times 10^{-3}$ . We derive the value assuming  $B(\Upsilon(3S) \rightarrow \chi_{b2}(2P)X) = B(\Upsilon(3S) \rightarrow \chi_{b2}(2P)\gamma) = (13.1 \pm 1.6) \times 10^{-2}$ .

<sup>19</sup> CAWLFIELD 06 quote  $\Gamma(\chi_{b2}(2P) \rightarrow \pi\pi\chi_b(1P)) = 0.83 \pm 0.22 \pm 0.08 \pm 0.19$  keV assuming l-spin conservation, no D-wave contribution,  $\Gamma(\chi_{b1}(2P)) = 96 \pm 16$  keV, and  $\Gamma(\chi_{b2}(2P)) = 138 \pm 19$  keV.

### $\Gamma(D^0 X)/\Gamma_{\text{total}}$ $\Gamma_5/\Gamma$

| VALUE                                      | CL% | DOCUMENT ID  | TECN    | COMMENT                                 |
|--------------------------------------------|-----|--------------|---------|-----------------------------------------|
| <b><math>&lt;2.4 \times 10^{-2}</math></b> | 90  | 20,21 BRIERE | 08 CLEO | $\Upsilon(3S) \rightarrow \gamma D^0 X$ |

<sup>20</sup> For  $p_{D^0} > 2.5$  GeV/c.

<sup>21</sup> The authors also present their result as  $(0.2 \pm 1.4 \pm 0.1) \times 10^{-2}$ .

NODE=M081R4;LINKAGE=LE

NODE=M081R4;LINKAGE=CA

NODE=M081R01  
NODE=M081R01

NODE=M081R01;LINKAGE=BR  
NODE=M081R01;LINKAGE=RI

### $\Gamma(\pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$ $\Gamma_6/\Gamma$

| VALUE (units $10^{-4}$ )    | CL% | DOCUMENT ID | TECN     | COMMENT                                                     |
|-----------------------------|-----|-------------|----------|-------------------------------------------------------------|
| <b><math>&lt;1.1</math></b> | 90  | 22 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma \pi^+ \pi^- K^+ K^- \pi^0$ |

<sup>22</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(2P) \rightarrow \pi^+ \pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] < 14 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = 13.1 \times 10^{-2}$ .

NODE=M081R02  
NODE=M081R02

NODE=M081R02;LINKAGE=AS

### $\Gamma(2\pi^+ \pi^- K^- K_S^0)/\Gamma_{\text{total}}$ $\Gamma_7/\Gamma$

| VALUE (units $10^{-4}$ )    | CL% | DOCUMENT ID | TECN     | COMMENT                                                  |
|-----------------------------|-----|-------------|----------|----------------------------------------------------------|
| <b><math>&lt;0.9</math></b> | 90  | 23 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+ \pi^- K^- K_S^0$ |

<sup>23</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(2P) \rightarrow 2\pi^+ \pi^- K^- K_S^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] < 12 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = 13.1 \times 10^{-2}$ .

NODE=M081R03  
NODE=M081R03

NODE=M081R03;LINKAGE=AS

### $\Gamma(2\pi^+ \pi^- K^- K_S^0 2\pi^0)/\Gamma_{\text{total}}$ $\Gamma_8/\Gamma$

| VALUE (units $10^{-4}$ )  | CL% | DOCUMENT ID | TECN     | COMMENT                                                   |
|---------------------------|-----|-------------|----------|-----------------------------------------------------------|
| <b><math>&lt;7</math></b> | 90  | 24 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+ \pi^- K^- 2\pi^0$ |

<sup>24</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(2P) \rightarrow 2\pi^+ \pi^- K^- K_S^0 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] < 87 \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = 13.1 \times 10^{-2}$ .

NODE=M081R04  
NODE=M081R04

NODE=M081R04;LINKAGE=AS

### $\Gamma(2\pi^+ 2\pi^- 2\pi^0)/\Gamma_{\text{total}}$ $\Gamma_9/\Gamma$

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID | TECN     | COMMENT                                                |
|-----------------------------------------|------|-------------|----------|--------------------------------------------------------|
| <b><math>3.9 \pm 1.6 \pm 0.5</math></b> | 23   | 25 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+ 2\pi^- 2\pi^0$ |

<sup>25</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(2P) \rightarrow 2\pi^+ 2\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] = (51 \pm 16 \pm 13) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M081R05  
NODE=M081R05

NODE=M081R05;LINKAGE=AS

### $\Gamma(2\pi^+ 2\pi^- K^+ K^-)/\Gamma_{\text{total}}$ $\Gamma_{10}/\Gamma$

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID | TECN     | COMMENT                                                 |
|-----------------------------------------|------|-------------|----------|---------------------------------------------------------|
| <b><math>0.9 \pm 0.4 \pm 0.1</math></b> | 11   | 26 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^-$ |

<sup>26</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(2P) \rightarrow 2\pi^+ 2\pi^- K^+ K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] = (12 \pm 4 \pm 3) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M081R06  
NODE=M081R06

NODE=M081R06;LINKAGE=AS

### $\Gamma(2\pi^+ 2\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$ $\Gamma_{11}/\Gamma$

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID | TECN     | COMMENT                                                       |
|-----------------------------------------|------|-------------|----------|---------------------------------------------------------------|
| <b><math>2.4 \pm 1.0 \pm 0.3</math></b> | 16   | 27 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^- \pi^0$ |

<sup>27</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(2P) \rightarrow 2\pi^+ 2\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] = (32 \pm 11 \pm 8) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M081R07  
NODE=M081R07

NODE=M081R07;LINKAGE=AS

### $\Gamma(2\pi^+ 2\pi^- K^+ K^- 2\pi^0)/\Gamma_{\text{total}}$ $\Gamma_{12}/\Gamma$

| VALUE (units $10^{-4}$ )                | EVTS | DOCUMENT ID | TECN     | COMMENT                                                        |
|-----------------------------------------|------|-------------|----------|----------------------------------------------------------------|
| <b><math>4.7 \pm 2.2 \pm 0.6</math></b> | 14   | 28 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 2\pi^+ 2\pi^- K^+ K^- 2\pi^0$ |

<sup>28</sup> ASNER 08A reports  $[\Gamma(\chi_{b2}(2P) \rightarrow 2\pi^+ 2\pi^- K^+ K^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] = (62 \pm 23 \pm 17) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M081R08  
NODE=M081R08

NODE=M081R08;LINKAGE=AS

$\Gamma(3\pi^+ 2\pi^- K^- K_S^0 \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                  | CL% | DOCUMENT ID | TECN     | COMMENT                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------|----------|-----------------------------------------------------------------|
| <b>&lt;4</b>                                                                                                                                                                                                                                                                                              | 90  | 29 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 2\pi^- K^- K_S^0 \pi^0$ |
| 29 ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \rightarrow 3\pi^+ 2\pi^- K^- K_S^0 \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] < 58 \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = 13.1 \times 10^{-2}$ . |     |             |          |                                                                 |

NODE=M081R09  
 NODE=M081R09

NODE=M081R09;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{14}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                              | EVTS | DOCUMENT ID | TECN     | COMMENT                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|-------------------------------------------------|
| <b>0.9±0.4±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                    | 14   | 30 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^-$ |
| 30 ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \rightarrow 3\pi^+ 3\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] = (12 \pm 4 \pm 3) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                 |

NODE=M081R10  
 NODE=M081R10

NODE=M081R10;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{15}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                        | EVTS | DOCUMENT ID | TECN     | COMMENT                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|--------------------------------------------------------|
| <b>12±4±1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | 45   | 31 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^- 2\pi^0$ |
| 31 ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \rightarrow 3\pi^+ 3\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] = (159 \pm 33 \pm 43) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                        |

NODE=M081R11  
 NODE=M081R11

NODE=M081R11;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}$  $\Gamma_{16}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                      | EVTS | DOCUMENT ID | TECN     | COMMENT                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|---------------------------------------------------------|
| <b>1.4±0.7±0.2</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | 12   | 32 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^-$ |
| 32 ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \rightarrow 3\pi^+ 3\pi^- K^+ K^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] = (19 \pm 7 \pm 5) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                         |

NODE=M081R12  
 NODE=M081R12

NODE=M081R12;LINKAGE=AS

 $\Gamma(3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                              | EVTS | DOCUMENT ID | TECN     | COMMENT                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|---------------------------------------------------------------|
| <b>4.2±1.7±0.5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    | 16   | 33 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 3\pi^+ 3\pi^- K^+ K^- \pi^0$ |
| 33 ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \rightarrow 3\pi^+ 3\pi^- K^+ K^- \pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] = (55 \pm 16 \pm 15) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                               |

NODE=M081R13  
 NODE=M081R13

NODE=M081R13;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                              | EVTS | DOCUMENT ID | TECN     | COMMENT                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|-------------------------------------------------|
| <b>0.9±0.4±0.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                    | 9    | 34 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 4\pi^+ 4\pi^-$ |
| 34 ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \rightarrow 4\pi^+ 4\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] = (12 \pm 5 \pm 3) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                 |

NODE=M081R14  
 NODE=M081R14

NODE=M081R14;LINKAGE=AS

 $\Gamma(4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ 

| VALUE (units $10^{-4}$ )                                                                                                                                                                                                                                                                                                                                                                                                                        | EVTS | DOCUMENT ID | TECN     | COMMENT                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|----------|--------------------------------------------------------|
| <b>13±5±2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | 27   | 35 ASNER    | 08A CLEO | $\Upsilon(3S) \rightarrow \gamma 4\pi^+ 4\pi^- 2\pi^0$ |
| 35 ASNER 08A reports $[\Gamma(\chi_{b2}(2P) \rightarrow 4\pi^+ 4\pi^- 2\pi^0)/\Gamma_{\text{total}}] \times [B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] = (165 \pm 46 \pm 50) \times 10^{-6}$ which we divide by our best value $B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) = (13.1 \pm 1.6) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |             |          |                                                        |

NODE=M081R15  
 NODE=M081R15

NODE=M081R15;LINKAGE=AS

 $\chi_{b2}(2P)$  Cross-Particle Branching Ratios

NODE=M081230

$$\Gamma(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(1S))/\Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))/\Gamma_{\text{total}}$$

$$\Gamma_3/\Gamma \times \Gamma_{20}^{\Upsilon(3S)}/\Gamma \Upsilon(3S)$$

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                            |
|--------------------------|------|-------------|----------|------------------------------------|
| <b>9.2±0.3±0.4</b>       | 11k  | LEES        | 11J BABR | $\Upsilon(3S) \rightarrow X\gamma$ |

NODE=M081B01  
 NODE=M081B01

$$\Gamma(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(2S)) / \Gamma_{\text{total}} \times \Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) / \Gamma_{\text{total}}$$

$$\Gamma_2 / \Gamma \times \Gamma_{20}^{\Upsilon(3S)} / \Gamma \Upsilon(3S)$$

| VALUE (units $10^{-2}$ ) | EVTs | DOCUMENT ID | TECN     | COMMENT                            |
|--------------------------|------|-------------|----------|------------------------------------|
| <b>1.1±0.1±0.1</b>       | 2.5k | LEES        | 11J BABR | $\Upsilon(3S) \rightarrow X\gamma$ |

NODE=M081B02  
NODE=M081B02

$$B(\chi_{b2}(2P) \rightarrow \chi_{b2}(1P)\pi^+\pi^-) \times B(\Upsilon(3S) \rightarrow \chi_{b2}(2P)X)$$

| VALUE (units $10^{-3}$ ) | EVTs | DOCUMENT ID | TECN     | COMMENT                          |
|--------------------------|------|-------------|----------|----------------------------------|
| <b>0.64±0.05±0.08</b>    | 17k  | LEES        | 11C BABR | $e^+e^- \rightarrow \pi^+\pi^-X$ |

NODE=M081R16  
NODE=M081R16

$$B(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) \times B(\Upsilon(1S) \rightarrow \ell^+\ell^-)$$

| VALUE (units $10^{-4}$ )     | EVTs | DOCUMENT ID | TECN | COMMENT |
|------------------------------|------|-------------|------|---------|
| <b>2.02±0.18 OUR AVERAGE</b> |      |             |      |         |

|                                                  |    |             |          |                                                     |
|--------------------------------------------------|----|-------------|----------|-----------------------------------------------------|
| 1.95 <sup>+0.22+0.10</sup> <sub>-0.21-0.16</sub> |    | 36 LEES     | 14M BABR | $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$   |
| 2.52±0.47±0.32                                   | 48 | 37 CRAWFORD | 92B CLE2 | $\Upsilon(3S) \rightarrow \gamma\gamma\ell^+\ell^-$ |
| 1.98±0.28±0.12                                   |    | 38 HEINTZ   | 92 CSB2  | $\Upsilon(3S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

36 From a sample of  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  with converted photons.  
 37 CRAWFORD 92B quotes  $2 \times B(\Upsilon(3S) \rightarrow \gamma\chi_{bJ}(2P)) B(\chi_{bJ}(2P) \rightarrow \gamma\Upsilon(nS))$   
 $B(\Upsilon(nS) \rightarrow \ell^+\ell^-)$ .  
 38 Calculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b2}(2P)) \times B(\chi_{b2}(2P) \rightarrow \gamma\Upsilon(1S)) = (0.77 \pm 0.11 \pm 0.05)\%$  using  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.57 \pm 0.05)\%$ .

NODE=M081A01  
NODE=M081A01

NODE=M081A01;LINKAGE=A  
NODE=M081A01;LINKAGE=C

NODE=M081A01;LINKAGE=B

$$[B(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] / [B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(1S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$$

| VALUE (%)       | DOCUMENT ID | TECN     | COMMENT                                           |
|-----------------|-------------|----------|---------------------------------------------------|
| <b>66.6±3.0</b> | 39 LEES     | 14M BABR | $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$ |

39 From a sample of  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  events without converted photons.

NODE=M081A00  
NODE=M081A00

NODE=M081A00;LINKAGE=A

$$B(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P)) \times B(\Upsilon(2S) \rightarrow \ell^+\ell^-)$$

| VALUE (units $10^{-4}$ )     | EVTs | DOCUMENT ID | TECN | COMMENT |
|------------------------------|------|-------------|------|---------|
| <b>2.74±0.29 OUR AVERAGE</b> |      |             |      |         |

|                                                  |    |             |          |                                                     |
|--------------------------------------------------|----|-------------|----------|-----------------------------------------------------|
| 3.22 <sup>+0.58+0.16</sup> <sub>-0.53-0.71</sub> |    | 40 LEES     | 14M BABR | $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$   |
| 2.49±0.47±0.31                                   | 53 | 41 CRAWFORD | 92B CLE2 | $\Upsilon(3S) \rightarrow \gamma\gamma\ell^+\ell^-$ |
| 2.74±0.33±0.18                                   |    | 42 HEINTZ   | 92 CSB2  | $\Upsilon(3S) \rightarrow \gamma\gamma\ell^+\ell^-$ |

40 From a sample of  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  with converted photons.  
 41 CRAWFORD 92B quotes  $2 \times B(\Upsilon(3S) \rightarrow \gamma\chi_{bJ}(2P)) B(\chi_{bJ}(2P) \rightarrow \gamma\Upsilon(nS))$   
 $B(\Upsilon(nS) \rightarrow \ell^+\ell^-)$ .  
 42 Calculated by us. HEINTZ 92 quotes  $B(\Upsilon(3S) \rightarrow \gamma\chi_{b2}(2P)) \times B(\chi_{b2}(2P) \rightarrow \gamma\Upsilon(2S)) = (1.90 \pm 0.23 \pm 0.18)\%$  using  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.44 \pm 0.10)\%$ .

NODE=M081A02  
NODE=M081A02

NODE=M081A02;LINKAGE=A  
NODE=M081A02;LINKAGE=C

NODE=M081A02;LINKAGE=B

$$[B(\chi_{b2}(2P) \rightarrow \gamma \Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(2P))] / [B(\chi_{b1}(2P) \rightarrow \gamma \Upsilon(2S)) \times B(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(2P))]$$

| VALUE (%)       | DOCUMENT ID | TECN     | COMMENT                                           |
|-----------------|-------------|----------|---------------------------------------------------|
| <b>46.9±2.0</b> | 43 LEES     | 14M BABR | $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$ |

43 From a sample of  $\Upsilon(3S) \rightarrow \gamma\gamma\mu^+\mu^-$  without converted photons.

NODE=M081A03  
NODE=M081A03

NODE=M081A03;LINKAGE=A

## $\chi_{b2}(2P)$ REFERENCES

|                 |      |               |                                  |                   |
|-----------------|------|---------------|----------------------------------|-------------------|
| AAIJ            | 14BG | JHEP 1410 088 | R. Aaij <i>et al.</i>            | (LHCb Collab.)    |
| LEES            | 14M  | PR D90 112010 | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   |
| LEES            | 11C  | PR D84 011104 | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   |
| LEES            | 11J  | PR D84 072002 | J.P. Lees <i>et al.</i>          | (BABAR Collab.)   |
| ASNER           | 08A  | PR D78 091103 | D.M. Asner <i>et al.</i>         | (CLEO Collab.)    |
| BRIERE          | 08   | PR D78 092007 | R.A. Briere <i>et al.</i>        | (CLEO Collab.)    |
| CRAWFIELD       | 06   | PR D73 012003 | C. Cawfield <i>et al.</i>        | (CLEO Collab.)    |
| ARTUSO          | 05   | PRL 94 032001 | M. Artuso <i>et al.</i>          | (CLEO Collab.)    |
| CRONIN-HENNESSY | 04   | PRL 92 222002 | D. Cronin-Hennessy <i>et al.</i> | (CLEO Collab.)    |
| CRAWFORD        | 92B  | PL B294 139   | G. Crawford <i>et al.</i>        | (CLEO Collab.)    |
| HEINTZ          | 92   | PR D46 1928   | U. Heintz <i>et al.</i>          | (CUSB II Collab.) |
| HEINTZ          | 91   | PRL 66 1563   | U. Heintz <i>et al.</i>          | (CUSB Collab.)    |
| MORRISON        | 91   | PRL 67 1696   | R.J. Morrison <i>et al.</i>      | (CLEO Collab.)    |
| NARAIN          | 91   | PRL 66 3113   | M. Narain <i>et al.</i>          | (CUSB Collab.)    |

NODE=M081

REFID=56199  
REFID=56343  
REFID=16775  
REFID=53936  
REFID=52574  
REFID=52577  
REFID=50997  
REFID=50454  
REFID=49766  
REFID=43177  
REFID=43604  
REFID=41580  
REFID=41634  
REFID=41586

$\Upsilon(3S)$ 

$$J^G(J^{PC}) = 0^-(1^{--})$$

NODE=M048

 **$\Upsilon(3S)$  MASS**

NODE=M048M

| VALUE (MeV)                                                                   | DOCUMENT ID               | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------|---------------------------|----------|-------------------------------------|
| <b>10355.2±0.5</b>                                                            | <sup>1</sup> ARTAMONOV 00 | MD1      | $e^+e^- \rightarrow \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                           |          |                                     |
| 10355.3±0.5                                                                   | <sup>2,3</sup> BARU       | 86B REDE | $e^+e^- \rightarrow \text{hadrons}$ |
| <sup>1</sup> Reanalysis of BARU 86B using new electron mass (COHEN 87).       |                           |          |                                     |
| <sup>2</sup> Reanalysis of ARTAMONOV 84.                                      |                           |          |                                     |
| <sup>3</sup> Superseded by ARTAMONOV 00.                                      |                           |          |                                     |

NODE=M048M

NODE=M048M;LINKAGE=AR  
 NODE=M048M;LINKAGE=C  
 NODE=M048M;LINKAGE=RZ

 **$m\Upsilon(3S) - m\Upsilon(2S)$** 

NODE=M048DM2

| VALUE (MeV)             | DOCUMENT ID | TECN     | COMMENT                          |
|-------------------------|-------------|----------|----------------------------------|
| <b>331.50±0.02±0.13</b> | LEES        | 11C BABR | $e^+e^- \rightarrow \pi^+\pi^-X$ |

NODE=M048DM2

 **$\Upsilon(3S)$  WIDTH**

NODE=M048W

| VALUE (keV)                      | DOCUMENT ID                                                     | COMMENT |
|----------------------------------|-----------------------------------------------------------------|---------|
| <b>20.32±1.85 OUR EVALUATION</b> | See the Note on "Width Determinations of the $\Upsilon$ States" |         |

NODE=M048W  
 → UNCHECKED ←

 **$\Upsilon(3S)$  DECAY MODES**

NODE=M048215;NODE=M048

| Mode                                                           | Fraction ( $\Gamma_i/\Gamma$ )   | Scale factor/<br>Confidence level |
|----------------------------------------------------------------|----------------------------------|-----------------------------------|
| $\Gamma_1$ $\Upsilon(2S)\text{anything}$                       | (10.6 ± 0.8 ) %                  |                                   |
| $\Gamma_2$ $\Upsilon(2S)\pi^+\pi^-$                            | ( 2.82± 0.18) %                  | S=1.6                             |
| $\Gamma_3$ $\Upsilon(2S)\pi^0\pi^0$                            | ( 1.85± 0.14) %                  |                                   |
| $\Gamma_4$ $\Upsilon(2S)\gamma\gamma$                          | ( 5.0 ± 0.7 ) %                  |                                   |
| $\Gamma_5$ $\Upsilon(2S)\pi^0$                                 | < 5.1 × 10 <sup>-4</sup>         | CL=90%                            |
| $\Gamma_6$ $\Upsilon(1S)\pi^+\pi^-$                            | ( 4.37± 0.08) %                  |                                   |
| $\Gamma_7$ $\Upsilon(1S)\pi^0\pi^0$                            | ( 2.20± 0.13) %                  |                                   |
| $\Gamma_8$ $\Upsilon(1S)\eta$                                  | < 1 × 10 <sup>-4</sup>           | CL=90%                            |
| $\Gamma_9$ $\Upsilon(1S)\pi^0$                                 | < 7 × 10 <sup>-5</sup>           | CL=90%                            |
| $\Gamma_{10}$ $h_b(1P)\pi^0$                                   | < 1.2 × 10 <sup>-3</sup>         | CL=90%                            |
| $\Gamma_{11}$ $h_b(1P)\pi^0 \rightarrow \gamma\eta_b(1S)\pi^0$ | ( 4.3 ± 1.4 ) × 10 <sup>-4</sup> |                                   |
| $\Gamma_{12}$ $h_b(1P)\pi^+\pi^-$                              | < 1.2 × 10 <sup>-4</sup>         | CL=90%                            |
| $\Gamma_{13}$ $\tau^+\tau^-$                                   | ( 2.29± 0.30) %                  |                                   |
| $\Gamma_{14}$ $\mu^+\mu^-$                                     | ( 2.18± 0.21) %                  | S=2.1                             |
| $\Gamma_{15}$ $e^+e^-$                                         | ( 2.18± 0.20) %                  |                                   |
| $\Gamma_{16}$ hadrons                                          | (93 ± 12 ) %                     |                                   |
| $\Gamma_{17}$ $ggg$                                            | (35.7 ± 2.6 ) %                  |                                   |
| $\Gamma_{18}$ $\gamma g g$                                     | ( 9.7 ± 1.8 ) × 10 <sup>-3</sup> |                                   |
| $\Gamma_{19}$ $^2H$ anything                                   | ( 2.33± 0.33) × 10 <sup>-5</sup> |                                   |

DESIG=8

DESIG=4

DESIG=10

DESIG=12

DESIG=107

DESIG=3

DESIG=11

DESIG=9

DESIG=106

DESIG=112

DESIG=113

DESIG=114

DESIG=16

DESIG=1

DESIG=2

DESIG=101

DESIG=109

DESIG=110

DESIG=117

**Radiative decays**

NODE=M048;CLUMP=B

|                                                                     |                                  |        |
|---------------------------------------------------------------------|----------------------------------|--------|
| $\Gamma_{20}$ $\gamma\chi_{b2}(2P)$                                 | (13.1 ± 1.6 ) %                  | S=3.4  |
| $\Gamma_{21}$ $\gamma\chi_{b1}(2P)$                                 | (12.6 ± 1.2 ) %                  | S=2.4  |
| $\Gamma_{22}$ $\gamma\chi_{b0}(2P)$                                 | ( 5.9 ± 0.6 ) %                  | S=1.4  |
| $\Gamma_{23}$ $\gamma\chi_{b2}(1P)$                                 | (10.0 ± 1.0 ) × 10 <sup>-3</sup> | S=1.7  |
| $\Gamma_{24}$ $\gamma\chi_{b1}(1P)$                                 | ( 9 ± 5 ) × 10 <sup>-4</sup>     | S=1.8  |
| $\Gamma_{25}$ $\gamma\chi_{b0}(1P)$                                 | ( 2.7 ± 0.4 ) × 10 <sup>-3</sup> |        |
| $\Gamma_{26}$ $\gamma\eta_b(2S)$                                    | < 6.2 × 10 <sup>-4</sup>         | CL=90% |
| $\Gamma_{27}$ $\gamma\eta_b(1S)$                                    | ( 5.1 ± 0.7 ) × 10 <sup>-4</sup> |        |
| $\Gamma_{28}$ $\gamma A^0 \rightarrow \gamma \text{hadrons}$        | < 8 × 10 <sup>-5</sup>           | CL=90% |
| $\Gamma_{29}$ $\gamma X \rightarrow \gamma + \geq 4 \text{ prongs}$ | [a] < 2.2 × 10 <sup>-4</sup>     | CL=95% |
| $\Gamma_{30}$ $\gamma a_1^0 \rightarrow \gamma \mu^+\mu^-$          | < 5.5 × 10 <sup>-6</sup>         | CL=90% |
| $\Gamma_{31}$ $\gamma a_1^0 \rightarrow \gamma \tau^+\tau^-$        | [b] < 1.6 × 10 <sup>-4</sup>     | CL=90% |

DESIG=115

DESIG=102

DESIG=116

DESIG=108

**Lepton Family number (LF) violating modes**

|               |                       |    |       |                  |        |
|---------------|-----------------------|----|-------|------------------|--------|
| $\Gamma_{32}$ | $e^{\pm}\tau^{\mp}$   | LF | < 4.2 | $\times 10^{-6}$ | CL=90% |
| $\Gamma_{33}$ | $\mu^{\pm}\tau^{\mp}$ | LF | < 3.1 | $\times 10^{-6}$ | CL=90% |

NODE=M048;CLUMP=C

DESIG=111

DESIG=105

[a]  $1.5 \text{ GeV} < m_X < 5.0 \text{ GeV}$ 

LINKAGE=C48

[b] For  $m_{\tau^+\tau^-}$  in the ranges 4.03–9.52 and 9.61–10.10 GeV.

LINKAGE=MRG

 **$\Upsilon(3S) \Gamma(i) \Gamma(e^+ e^-) / \Gamma(\text{total})$** 

NODE=M048218

 **$\Gamma(\text{hadrons}) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$**  **$\Gamma_{16} \Gamma_{15} / \Gamma$** 

| VALUE (keV)                      | DOCUMENT ID        | TECN | COMMENT                                        |
|----------------------------------|--------------------|------|------------------------------------------------|
| <b>0.414 ± 0.007 OUR AVERAGE</b> |                    |      |                                                |
| 0.413 ± 0.004 ± 0.006            | ROSNER             | 06   | CLEO $10.4 e^+ e^- \rightarrow \text{hadrons}$ |
| 0.45 ± 0.03 ± 0.03               | <sup>4</sup> GILES | 84B  | CLEO $e^+ e^- \rightarrow \text{hadrons}$      |

NODE=M048G2

NODE=M048G2

<sup>4</sup> Radiative corrections reevaluated by BUCHMUELLER 88 following KURAEV 85.

NODE=M048G2;LINKAGE=R

 **$\Gamma(\Upsilon(1S)\pi^+\pi^-) \times \Gamma(e^+ e^-) / \Gamma_{\text{total}}$**  **$\Gamma_6 \Gamma_{15} / \Gamma$** 

| VALUE (eV)                 | EVTS | DOCUMENT ID         | TECN      | COMMENT                                                |
|----------------------------|------|---------------------|-----------|--------------------------------------------------------|
| <b>18.46 ± 0.27 ± 0.77</b> | 6.4k | <sup>5</sup> AUBERT | 08BP BABR | $e^+ e^- \rightarrow \gamma \pi^+ \pi^- \ell^+ \ell^-$ |

NODE=M048G01

NODE=M048G01

<sup>5</sup> Using  $B(\Upsilon(1S) \rightarrow e^+ e^-) = (2.38 \pm 0.11)\%$  and  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\%$ .

NODE=M048G01;LINKAGE=AU

 **$\Upsilon(3S)$  PARTIAL WIDTHS**

NODE=M048220

 **$\Gamma(e^+ e^-)$**  **$\Gamma_{15}$** 

| VALUE (keV)                         | DOCUMENT ID |
|-------------------------------------|-------------|
| <b>0.443 ± 0.008 OUR EVALUATION</b> |             |

NODE=M048W2

NODE=M048W2

→ UNCHECKED ←

 **$\Upsilon(3S)$  BRANCHING RATIOS**

NODE=M048225

 **$\Gamma(\Upsilon(2S) \text{ anything}) / \Gamma_{\text{total}}$**  **$\Gamma_1 / \Gamma$** 

| VALUE                            | EVTS | DOCUMENT ID             | TECN     | COMMENT                                                             |
|----------------------------------|------|-------------------------|----------|---------------------------------------------------------------------|
| <b>0.106 ± 0.008 OUR AVERAGE</b> |      |                         |          |                                                                     |
| 0.1023 ± 0.0105                  | 4625 | <sup>6,7,8</sup> BUTLER | 94B CLE2 | $e^+ e^- \rightarrow \ell^+ \ell^- X$                               |
| 0.111 ± 0.012                    | 4891 | <sup>7,8,9</sup> BROCK  | 91 CLEO  | $e^+ e^- \rightarrow \pi^+ \pi^- X,$<br>$\pi^+ \pi^- \ell^+ \ell^-$ |

NODE=M048R8

NODE=M048R8

<sup>6</sup> Using  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\gamma\gamma) = (0.038 \pm 0.007)\%$ , and  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^0\pi^0) = (1/2)B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-)$ .

NODE=M048R;LINKAGE=A

<sup>7</sup> Using  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.06)\%$ . With the assumption of  $e\mu$  universality.

NODE=M048R;LINKAGE=B

<sup>8</sup> Using  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-) = (18.5 \pm 0.8)\%$ .

NODE=M048R;LINKAGE=D

<sup>9</sup> Using  $B(\Upsilon(2S) \rightarrow \mu^+ \mu^-) = (1.31 \pm 0.21)\%$ ,  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\gamma\gamma) \times 2B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (0.188 \pm 0.035)\%$ , and  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^0\pi^0) \times 2B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (0.436 \pm 0.056)\%$ . With the assumption of  $e\mu$  universality.

NODE=M048R;LINKAGE=C

 **$\Gamma(\Upsilon(2S)\pi^+\pi^-) / \Gamma_{\text{total}}$**  **$\Gamma_2 / \Gamma$** 

| VALUE (units $10^{-2}$ )       | EVTS | DOCUMENT ID             | TECN      | COMMENT                                                             |
|--------------------------------|------|-------------------------|-----------|---------------------------------------------------------------------|
| <b>2.82 ± 0.18 OUR AVERAGE</b> |      |                         |           | Error includes scale factor of 1.6. See the ideogram below.         |
| 3.00 ± 0.02 ± 0.14             | 543k | LEES                    | 11C BABR  | $e^+ e^- \rightarrow \pi^+ \pi^- X$                                 |
| 2.40 ± 0.10 ± 0.26             | 800  | <sup>10</sup> AUBERT    | 08BP BABR | $e^+ e^- \rightarrow \gamma \pi^+ \pi^- e^+ e^-$                    |
| 3.12 ± 0.49                    | 980  | <sup>11,12</sup> BUTLER | 94B CLE2  | $e^+ e^- \rightarrow \pi^+ \pi^- \ell^+ \ell^-$                     |
| 2.13 ± 0.38                    | 974  | <sup>13</sup> BROCK     | 91 CLEO   | $e^+ e^- \rightarrow \pi^+ \pi^- X,$<br>$\pi^+ \pi^- \ell^+ \ell^-$ |

NODE=M048R4

NODE=M048R4

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                    |     |                  |         |                                                      |
|--------------------|-----|------------------|---------|------------------------------------------------------|
| 4.82 ± 0.65 ± 0.53 | 138 | <sup>13</sup> WU | 93 CUSB | $\Upsilon(3S) \rightarrow \pi^+ \pi^- \ell^+ \ell^-$ |
| 3.1 ± 2.0          | 5   | MAGERAS          | 82 CUSB | $\Upsilon(3S) \rightarrow \pi^+ \pi^- \ell^+ \ell^-$ |

<sup>10</sup> Using  $B(\Upsilon(1S) \rightarrow e^+ e^-) = (2.38 \pm 0.11)\%$ ,  $B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (2.48 \pm 0.05)\%$ , and  $\Gamma_{ee}(\Upsilon(3S)) = 0.443 \pm 0.008 \text{ keV}$ .

NODE=M048R4;LINKAGE=AU

<sup>11</sup> From the exclusive mode.

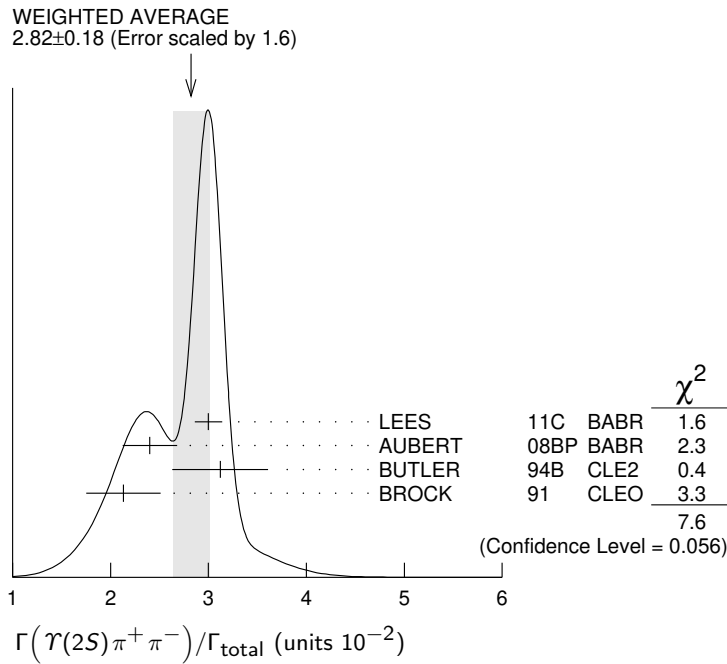
NODE=M048R;LINKAGE=M

<sup>12</sup> Using  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\gamma\gamma) = (0.038 \pm 0.007)\%$ , and  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^0\pi^0) = (1/2)B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^+\pi^-)$ .

NODE=M048R4;LINKAGE=A

<sup>13</sup> Using  $B(\Upsilon(2S) \rightarrow \mu^+ \mu^-) = (1.31 \pm 0.21)\%$ ,  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\gamma\gamma) \times 2B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (0.188 \pm 0.035)\%$ , and  $B(\Upsilon(2S) \rightarrow \Upsilon(1S)\pi^0\pi^0) \times 2B(\Upsilon(1S) \rightarrow \mu^+ \mu^-) = (0.436 \pm 0.056)\%$ . With the assumption of  $e\mu$  universality.

NODE=M048R4;LINKAGE=C



### $\Gamma(\Upsilon(2S)\pi^0\pi^0)/\Gamma_{\text{total}}$ $\Gamma_3/\Gamma$

| VALUE (units 10 <sup>-2</sup> )                                                                                                    | EVTS | DOCUMENT ID             | TECN     | COMMENT                                     |
|------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------|----------|---------------------------------------------|
| <b>1.85±0.14 OUR AVERAGE</b>                                                                                                       |      |                         |          |                                             |
| 1.82±0.09±0.12                                                                                                                     | 4391 | <sup>14</sup> BHARI     | 09 CLEO  | $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$ |
| 2.16±0.39                                                                                                                          |      | <sup>15,16</sup> BUTLER | 94B CLE2 | $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$ |
| 1.7 ±0.5 ±0.2                                                                                                                      | 10   | <sup>17</sup> HEINTZ    | 92 CSB2  | $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$ |
| <sup>14</sup> Authors assume $B(\Upsilon(1S) \rightarrow e^+e^-) + B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = 4.06\%$ .              |      |                         |          |                                             |
| <sup>15</sup> $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.31 \pm 0.21)\%$ and assuming $e\mu$ universality.                       |      |                         |          |                                             |
| <sup>16</sup> From the exclusive mode.                                                                                             |      |                         |          |                                             |
| <sup>17</sup> $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.44 \pm 0.10)\%$ and assuming $e\mu$ universality. Supersedes HEINTZ 91. |      |                         |          |                                             |

NODE=M048R10  
NODE=M048R10

NODE=M048R10;LINKAGE=BH  
NODE=M048R;LINKAGE=K  
NODE=M048R10;LINKAGE=M  
NODE=M048R;LINKAGE=G

### $\Gamma(\Upsilon(2S)\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_4/\Gamma$

| VALUE                | DOCUMENT ID          | TECN     | COMMENT                                  |
|----------------------|----------------------|----------|------------------------------------------|
| <b>0.0502±0.0069</b> | <sup>18</sup> BUTLER | 94B CLE2 | $e^+e^- \rightarrow \ell^+\ell^-2\gamma$ |

<sup>18</sup> From the exclusive mode.

NODE=M048R12  
NODE=M048R12

NODE=M048R12;LINKAGE=M

### $\Gamma(\Upsilon(2S)\pi^0)/\Gamma_{\text{total}}$ $\Gamma_5/\Gamma$

| VALUE (units 10 <sup>-3</sup> ) | CL% | DOCUMENT ID      | TECN     | COMMENT                                       |
|---------------------------------|-----|------------------|----------|-----------------------------------------------|
| <b>&lt;0.51</b>                 | 90  | <sup>19</sup> HE | 08A CLEO | $e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$ |

<sup>19</sup> Authors assume  $B(\Upsilon(2S) \rightarrow e^+e^-) + B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = 4.06\%$ .

NODE=M048R25  
NODE=M048R25

NODE=M048R25;LINKAGE=HE

### $\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$ $\Gamma_6/\Gamma$

Abbreviation MM in the COMMENT field below stands for missing mass.

| VALUE (units 10 <sup>-2</sup> ) | EVTS  | DOCUMENT ID          | TECN      | COMMENT                                                       |
|---------------------------------|-------|----------------------|-----------|---------------------------------------------------------------|
| <b>4.37±0.08 OUR AVERAGE</b>    |       |                      |           |                                                               |
| 4.32±0.07±0.13                  | 90k   | <sup>20</sup> LEES   | 11L BABR  | $\Upsilon(3S) \rightarrow \pi^+\pi^-\ell^+\ell^-$             |
| 4.46±0.01±0.13                  | 190k  | <sup>21</sup> BHARI  | 09 CLEO   | $e^+e^- \rightarrow \pi^+\pi^- \text{MM}$                     |
| 4.17±0.06±0.19                  | 6.4k  | <sup>22</sup> AUBERT | 08BP BABR | $10.58 e^+e^- \rightarrow \gamma\pi^+\pi^-\ell^+\ell^-$       |
| 4.52±0.35                       | 11830 | <sup>23</sup> BUTLER | 94B CLE2  | $e^+e^- \rightarrow \pi^+\pi^-X,$<br>$\pi^+\pi^-\ell^+\ell^-$ |
| 4.46±0.34±0.50                  | 451   | <sup>23</sup> WU     | 93 CUSB   | $\Upsilon(3S) \rightarrow \pi^+\pi^-\ell^+\ell^-$             |
| 4.46±0.30                       | 11221 | <sup>23</sup> BROCK  | 91 CLEO   | $e^+e^- \rightarrow \pi^+\pi^-X,$<br>$\pi^+\pi^-\ell^+\ell^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |    |         |         |                                                   |
|----------|----|---------|---------|---------------------------------------------------|
| 4.9 ±1.0 | 22 | GREEN   | 82 CLEO | $\Upsilon(3S) \rightarrow \pi^+\pi^-\ell^+\ell^-$ |
| 3.9 ±1.3 | 26 | MAGERAS | 82 CUSB | $\Upsilon(3S) \rightarrow \pi^+\pi^-\ell^+\ell^-$ |

<sup>20</sup> Using  $B(\Upsilon(1S) \rightarrow e^+e^-) = (2.38 \pm 0.11)\%$  and  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ .

<sup>21</sup> A weighted average of the inclusive and exclusive results.

<sup>22</sup> Using  $B(\Upsilon(2S) \rightarrow e^+e^-) = (1.91 \pm 0.16)\%$ ,  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.93 \pm 0.17)\%$ , and  $\Gamma_{ee}(\Upsilon(3S)) = 0.443 \pm 0.008$  keV.

<sup>23</sup> Using  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.06)\%$ . With the assumption of  $e\mu$  universality.

NODE=M048R3  
NODE=M048R3  
NODE=M048R3

NODE=M048R3;LINKAGE=LE

NODE=M048R3;LINKAGE=BH  
NODE=M048R3;LINKAGE=AU

NODE=M048R3;LINKAGE=B



$\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$  $\Gamma_2/\Gamma_6$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |     |                      |           |                                                   |
|-----------------------|-----|----------------------|-----------|---------------------------------------------------|
| 0.577 ± 0.026 ± 0.060 | 800 | <sup>24</sup> AUBERT | 08BP BABR | $e^+e^- \rightarrow \gamma\pi^+\pi^-\ell^+\ell^-$ |
|-----------------------|-----|----------------------|-----------|---------------------------------------------------|

<sup>24</sup> Using  $B(\Upsilon(1S) \rightarrow e^+e^-) = (2.38 \pm 0.11)\%$ ,  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ ,  $B(\Upsilon(2S) \rightarrow e^+e^-) = (1.91 \pm 0.16)\%$ , and  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.93 \pm 0.17)\%$ . Not independent of other values reported by AUBERT 08BP.

NODE=M048R28  
NODE=M048R28

NODE=M048R28;LINKAGE=AU

 $\Gamma(\Upsilon(1S)\pi^0\pi^0)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.20 ± 0.13 OUR AVERAGE**

|                    |      |                      |          |                                             |
|--------------------|------|----------------------|----------|---------------------------------------------|
| 2.24 ± 0.09 ± 0.11 | 6584 | <sup>25</sup> BHARI  | 09 CLEO  | $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$ |
| 1.99 ± 0.34        | 56   | <sup>26</sup> BUTLER | 94B CLE2 | $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$ |
| 2.2 ± 0.4 ± 0.3    | 33   | <sup>27</sup> HEINTZ | 92 CSB2  | $e^+e^- \rightarrow \pi^0\pi^0\ell^+\ell^-$ |

<sup>25</sup> Authors assume  $B(\Upsilon(1S) \rightarrow e^+e^-) + B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = 4.96\%$ .

<sup>26</sup> Using  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.06)\%$  and assuming  $e\mu$  universality.

<sup>27</sup> Using  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.57 \pm 0.07)\%$  and assuming  $e\mu$  universality. Supersedes HEINTZ 91.

NODE=M048R11  
NODE=M048R11

NODE=M048R11;LINKAGE=BH  
NODE=M048R11;LINKAGE=B  
NODE=M048R;LINKAGE=I

 $\Gamma(\Upsilon(1S)\pi^0\pi^0)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$  $\Gamma_7/\Gamma_6$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |                     |         |                                   |
|---------------|---------------------|---------|-----------------------------------|
| 0.501 ± 0.043 | <sup>28</sup> BHARI | 09 CLEO | $e^+e^- \rightarrow \Upsilon(3S)$ |
|---------------|---------------------|---------|-----------------------------------|

<sup>28</sup> Not independent of other values reported by BHARI 09.

NODE=M048R26  
NODE=M048R26

NODE=M048R26;LINKAGE=BH

 $\Gamma(\Upsilon(1S)\eta)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|      |    |                    |          |                                                                   |
|------|----|--------------------|----------|-------------------------------------------------------------------|
| <0.1 | 90 | <sup>29</sup> LEES | 11L BABR | $\Upsilon(3S) \rightarrow (\pi^+\pi^-)(\gamma\gamma)\ell^+\ell^-$ |
|------|----|--------------------|----------|-------------------------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                         |           |                                                        |
|------|----|-------------------------|-----------|--------------------------------------------------------|
| <0.8 | 90 | <sup>29,30</sup> AUBERT | 08BP BABR | $e^+e^- \rightarrow \gamma\pi^+\pi^-\pi^0\ell^+\ell^-$ |
|------|----|-------------------------|-----------|--------------------------------------------------------|

|       |    |                  |          |                                       |
|-------|----|------------------|----------|---------------------------------------|
| <0.18 | 90 | <sup>31</sup> HE | 08A CLEO | $e^+e^- \rightarrow \ell^+\ell^-\eta$ |
|-------|----|------------------|----------|---------------------------------------|

|      |    |       |         |                                       |
|------|----|-------|---------|---------------------------------------|
| <2.2 | 90 | BROCK | 91 CLEO | $e^+e^- \rightarrow \ell^+\ell^-\eta$ |
|------|----|-------|---------|---------------------------------------|

<sup>29</sup> Using  $B(\Upsilon(1S) \rightarrow e^+e^-) = (2.38 \pm 0.11)\%$ ,  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ .

<sup>30</sup> Using  $\Gamma_{ee}(\Upsilon(3S)) = 0.443 \pm 0.008$  keV.

<sup>31</sup> Authors assume  $B(\Upsilon(1S) \rightarrow e^+e^-) + B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = 4.96\%$ .

NODE=M048R9  
NODE=M048R9

NODE=M048R9;LINKAGE=LE  
NODE=M048R9;LINKAGE=AU  
NODE=M048R9;LINKAGE=HE

 $\Gamma(\Upsilon(1S)\eta)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$  $\Gamma_8/\Gamma_6$ 

| VALUE (units $10^{-2}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|       |    |                    |          |                                                                   |
|-------|----|--------------------|----------|-------------------------------------------------------------------|
| <0.23 | 90 | <sup>32</sup> LEES | 11L BABR | $\Upsilon(3S) \rightarrow (\pi^+\pi^-)(\gamma\gamma)\ell^+\ell^-$ |
|-------|----|--------------------|----------|-------------------------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                      |           |                                                          |
|------|----|----------------------|-----------|----------------------------------------------------------|
| <1.9 | 90 | <sup>33</sup> AUBERT | 08BP BABR | $e^+e^- \rightarrow \gamma\pi^+\pi^-(\pi^0)\ell^+\ell^-$ |
|------|----|----------------------|-----------|----------------------------------------------------------|

<sup>32</sup> Not independent of other values reported by LEES 11L.

<sup>33</sup> Not independent of other values reported by AUBERT 08BP.

NODE=M048R27  
NODE=M048R27

NODE=M048R27;LINKAGE=LE  
NODE=M048R27;LINKAGE=AU

 $\Gamma(\Upsilon(1S)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

| VALUE (units $10^{-3}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

|       |    |                  |          |                                               |
|-------|----|------------------|----------|-----------------------------------------------|
| <0.07 | 90 | <sup>34</sup> HE | 08A CLEO | $e^+e^- \rightarrow \ell^+\ell^-\gamma\gamma$ |
|-------|----|------------------|----------|-----------------------------------------------|

<sup>34</sup> Authors assume  $B(\Upsilon(1S) \rightarrow e^+e^-) + B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = 4.96\%$ .

NODE=M048R24  
NODE=M048R24

NODE=M048R24;LINKAGE=HE

 $\Gamma(h_b(1P)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

|                         |    |                  |         |                                           |
|-------------------------|----|------------------|---------|-------------------------------------------|
| <1.2 × 10 <sup>-3</sup> | 90 | <sup>35</sup> GE | 11 CLEO | $\Upsilon(3S) \rightarrow \pi^0$ anything |
|-------------------------|----|------------------|---------|-------------------------------------------|

<sup>35</sup> Assuming  $M(h_b(1P)) = 9900$  MeV and  $\Gamma(h_b(1P)) = 0$  MeV, and allowing  $B(h_b(1P) \rightarrow \gamma\eta_b(1S))$  to vary from 0–100%.

NODE=M048R03  
NODE=M048R03

NODE=M048R03;LINKAGE=GE

 $\Gamma(h_b(1P)\pi^0 \rightarrow \gamma\eta_b(1S)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE (units $10^{-4}$ ) | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-------------|------|---------|
|--------------------------|-------------|------|---------|

|                 |      |          |                                              |
|-----------------|------|----------|----------------------------------------------|
| 4.3 ± 1.1 ± 0.9 | LEES | 11K BABR | $\Upsilon(3S) \rightarrow \eta_b\gamma\pi^0$ |
|-----------------|------|----------|----------------------------------------------|

NODE=M048R33  
NODE=M048R33

$\Gamma(h_b(1P)\pi^+\pi^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-4}$ )                                                      | CL% | DOCUMENT ID          | TECN     | COMMENT                           |
|-------------------------------------------------------------------------------|-----|----------------------|----------|-----------------------------------|
| < 1.2                                                                         | 90  | <sup>36</sup> LEES   | 11C BABR | $e^+e^- \rightarrow \pi^+\pi^- X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                      |          |                                   |
| <18                                                                           |     | <sup>36</sup> BUTLER | 94B CLE2 | $e^+e^- \rightarrow \pi^+\pi^- X$ |
| <15                                                                           |     | <sup>36</sup> BROCK  | 91 CLEO  | $e^+e^- \rightarrow \pi^+\pi^- X$ |
| <sup>36</sup> For $M(h_b(1P)) = 9900$ MeV.                                    |     |                      |          |                                   |

NODE=M048R34  
 NODE=M048R34

NODE=M048R34;LINKAGE=MH

 $\Gamma(\tau^+\tau^-)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-2}$ )                                                                                                                                                                                                                                                                                                                                                                                        | EVTS | DOCUMENT ID             | TECN | COMMENT                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------|------|------------------------------------------------------------|
| <b>2.29±0.21±0.22</b>                                                                                                                                                                                                                                                                                                                                                                                           | 15k  | <sup>37</sup> BESSON 07 | CLEO | $e^+e^- \rightarrow \Upsilon(3S) \rightarrow \tau^+\tau^-$ |
| <sup>37</sup> BESSON 07 reports $[\Gamma(\Upsilon(3S) \rightarrow \tau^+\tau^-)/\Gamma_{\text{total}}] / [B(\Upsilon(3S) \rightarrow \mu^+\mu^-)] = 1.05 \pm 0.08 \pm 0.05$ which we multiply by our best value $B(\Upsilon(3S) \rightarrow \mu^+\mu^-) = (2.18 \pm 0.21) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |      |                         |      |                                                            |

NODE=M048R18  
 NODE=M048R18

NODE=M048R18;LINKAGE=BE

 $\Gamma(\tau^+\tau^-)/\Gamma(\mu^+\mu^-)$ 

| VALUE                                                            | EVTS | DOCUMENT ID | TECN     | COMMENT                           |
|------------------------------------------------------------------|------|-------------|----------|-----------------------------------|
| <b>0.968±0.016 OUR AVERAGE</b><br>[1.05 ± 0.09 OUR 2020 AVERAGE] |      |             |          |                                   |
| 0.966±0.008±0.014                                                | 2.2M | LEES        | 20E BABR | $e^+e^- \rightarrow \Upsilon(3S)$ |
| 1.05 ± 0.08 ± 0.05                                               | 15k  | BESSON      | 07 CLEO  | $e^+e^- \rightarrow \Upsilon(3S)$ |

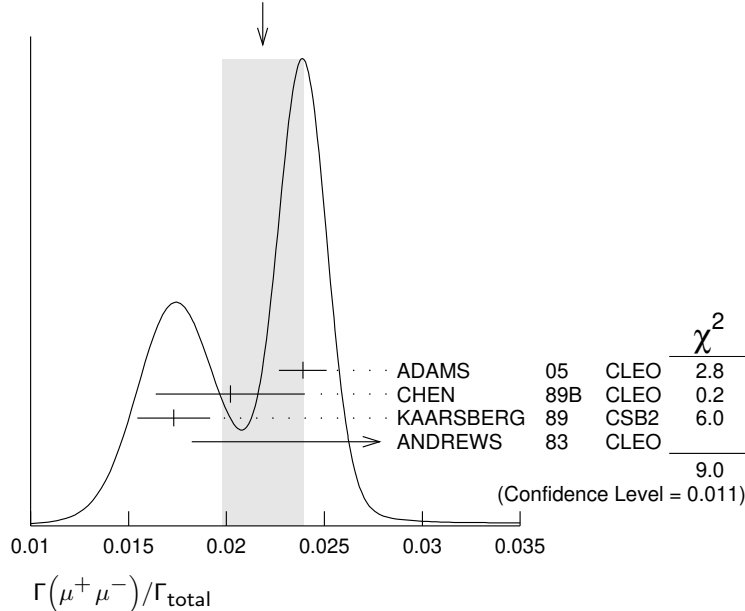
NODE=M048R19  
 NODE=M048R19  
 NEW

 $\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$ 

| VALUE                            | EVTS | DOCUMENT ID | TECN     | COMMENT                                                     |
|----------------------------------|------|-------------|----------|-------------------------------------------------------------|
| <b>0.0218±0.0021 OUR AVERAGE</b> |      |             |          | Error includes scale factor of 2.1. See the ideogram below. |
| 0.0239±0.0007±0.0010             | 81k  | ADAMS       | 05 CLEO  | $e^+e^- \rightarrow \mu^+\mu^-$                             |
| 0.0202±0.0019±0.0033             |      | CHEN        | 89B CLEO | $e^+e^- \rightarrow \mu^+\mu^-$                             |
| 0.0173±0.0015±0.0011             |      | KAARSBERG   | 89 CSB2  | $e^+e^- \rightarrow \mu^+\mu^-$                             |
| 0.033 ± 0.013 ± 0.007            | 1096 | ANDREWS     | 83 CLEO  | $e^+e^- \rightarrow \mu^+\mu^-$                             |

NODE=M048R1  
 NODE=M048R1

WEIGHTED AVERAGE  
 0.0218±0.0021 (Error scaled by 2.1)

 $\Gamma(ggg)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID              | TECN | COMMENT                                   |
|--------------------------|------|--------------------------|------|-------------------------------------------|
| <b>35.7±2.6</b>          | 3M   | <sup>38</sup> BESSON 06A | CLEO | $\Upsilon(3S) \rightarrow \text{hadrons}$ |

NODE=M048R30  
 NODE=M048R30

NODE=M048R30;LINKAGE=BE

<sup>38</sup> Calculated using BESSON 06A value of  $\Gamma(\gamma gg)/\Gamma(ggg) = (2.72 \pm 0.06 \pm 0.32 \pm 0.37)\%$  and the PDG 08 values of  $B(\Upsilon(2S) + \text{anything}) = (10.6 \pm 0.8)\%$ ,  $B(\pi^+\pi^-\Upsilon(1S)) = (4.40 \pm 0.10)\%$ ,  $B(\pi^0\pi^0\Upsilon(1S)) = (2.20 \pm 0.13)\%$ ,  $B(\gamma\chi_{b2}(2P)) = (13.1 \pm 1.6)\%$ ,  $B(\gamma\chi_{b1}(2P)) = (12.6 \pm 1.2)\%$ ,  $B(\gamma\chi_{b0}(2P)) = (5.9 \pm 0.6)\%$ ,  $B(\gamma\chi_{b0}(1P)) = (0.30 \pm 0.11)\%$ ,  $B(\mu^+\mu^-) = (2.18 \pm 0.21)\%$ , and  $R_{\text{hadrons}} = 3.51$ . The statistical error is negligible and the systematic error is partially correlated with  $\Gamma(\gamma gg)/\Gamma_{\text{total}}$  BESSON 06A value.

$\Gamma(\gamma g g)/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID          | TECN     | COMMENT                                            |
|--------------------------|------|----------------------|----------|----------------------------------------------------|
| <b>0.97±0.18</b>         | 60k  | <sup>39</sup> BESSON | 06A CLEO | $\Upsilon(3S) \rightarrow \gamma + \text{hadrons}$ |

<sup>39</sup> Calculated using BESSON 06A values of  $\Gamma(\gamma g g)/\Gamma(g g g) = (2.72 \pm 0.06 \pm 0.32 \pm 0.37)\%$  and  $\Gamma(g g g)/\Gamma_{\text{total}}$ . The statistical error is negligible and the systematic error is partially correlated with  $\Gamma(g g g)/\Gamma_{\text{total}}$  BESSON 06A value.

 $\Gamma_{18}/\Gamma$ 

NODE=M048R31  
NODE=M048R31

NODE=M048R31;LINKAGE=BE

 $\Gamma(\gamma g g)/\Gamma(g g g)$ 

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN     | COMMENT                                              |
|--------------------------|------|-------------|----------|------------------------------------------------------|
| <b>2.72±0.06±0.49</b>    | 3M   | BESSON      | 06A CLEO | $\Upsilon(3S) \rightarrow (\gamma +) \text{hadrons}$ |

 $\Gamma_{18}/\Gamma_{17}$ 

NODE=M048R32  
NODE=M048R32

 $\Gamma(\overline{2H} \text{ anything})/\Gamma_{\text{total}}$ 

| VALUE (units $10^{-5}$ )                         | DOCUMENT ID | TECN     | COMMENT                              |
|--------------------------------------------------|-------------|----------|--------------------------------------|
| <b>2.33±0.15<sup>+0.31</sup><sub>-0.28</sub></b> | LEES        | 14G BABR | $e^+e^- \rightarrow \overline{2H} X$ |

 $\Gamma_{19}/\Gamma$ 

NODE=M048R00  
NODE=M048R00

 $\Gamma(\gamma \chi_{b2}(2P))/\Gamma_{\text{total}}$ 

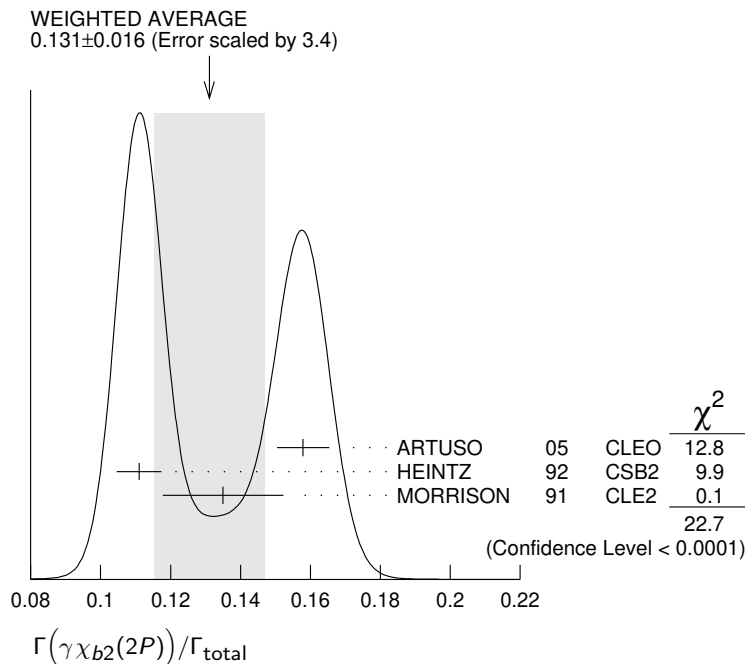
| VALUE                            | EVTS  | DOCUMENT ID                                                 | TECN    | COMMENT                       |
|----------------------------------|-------|-------------------------------------------------------------|---------|-------------------------------|
| <b>0.131 ± 0.016 OUR AVERAGE</b> |       | Error includes scale factor of 3.4. See the ideogram below. |         |                               |
| 0.1579 ± 0.0017 ± 0.0073         | 568k  | ARTUSO                                                      | 05 CLEO | $e^+e^- \rightarrow \gamma X$ |
| 0.111 ± 0.005 ± 0.004            | 10319 | <sup>40</sup> HEINTZ                                        | 92 CSB2 | $e^+e^- \rightarrow \gamma X$ |
| 0.135 ± 0.003 ± 0.017            | 30741 | MORRISON                                                    | 91 CLE2 | $e^+e^- \rightarrow \gamma X$ |

 $\Gamma_{20}/\Gamma$ 

NODE=M048R5  
NODE=M048R5

<sup>40</sup> Supersedes NARAIN 91.

NODE=M048R;LINKAGE=H

 $\Gamma(\gamma \chi_{b1}(2P))/\Gamma_{\text{total}}$ 

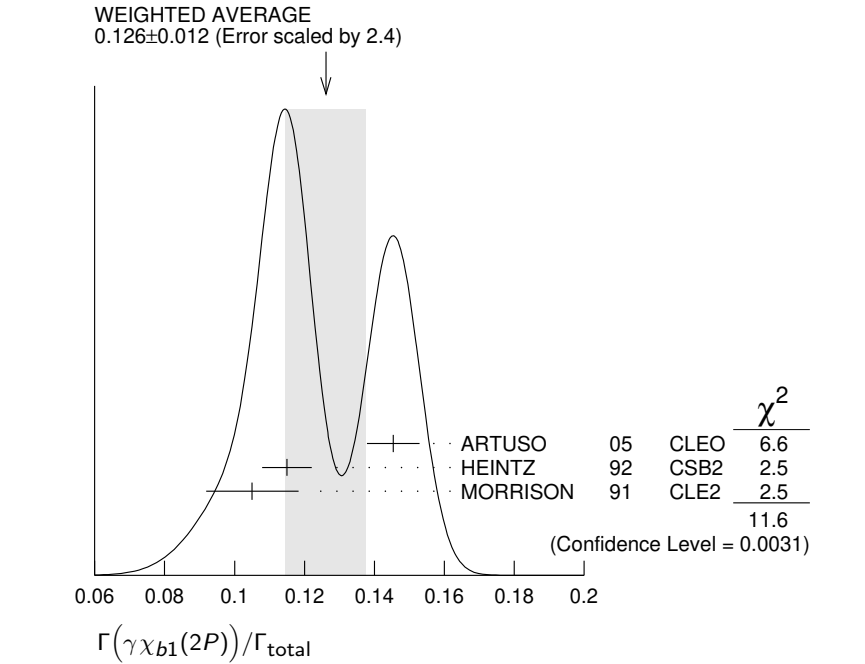
| VALUE                                             | EVTS  | DOCUMENT ID                                                 | TECN    | COMMENT                       |
|---------------------------------------------------|-------|-------------------------------------------------------------|---------|-------------------------------|
| <b>0.126 ± 0.012 OUR AVERAGE</b>                  |       | Error includes scale factor of 2.4. See the ideogram below. |         |                               |
| 0.1454 ± 0.0018 ± 0.0073                          | 537k  | ARTUSO                                                      | 05 CLEO | $e^+e^- \rightarrow \gamma X$ |
| 0.115 ± 0.005 ± 0.005                             | 11147 | <sup>41</sup> HEINTZ                                        | 92 CSB2 | $e^+e^- \rightarrow \gamma X$ |
| 0.105 <sup>+0.003</sup> <sub>-0.002</sub> ± 0.013 | 25759 | MORRISON                                                    | 91 CLE2 | $e^+e^- \rightarrow \gamma X$ |

 $\Gamma_{21}/\Gamma$ 

NODE=M048R6  
NODE=M048R6

<sup>41</sup> Supersedes NARAIN 91.

NODE=M048R6;LINKAGE=H

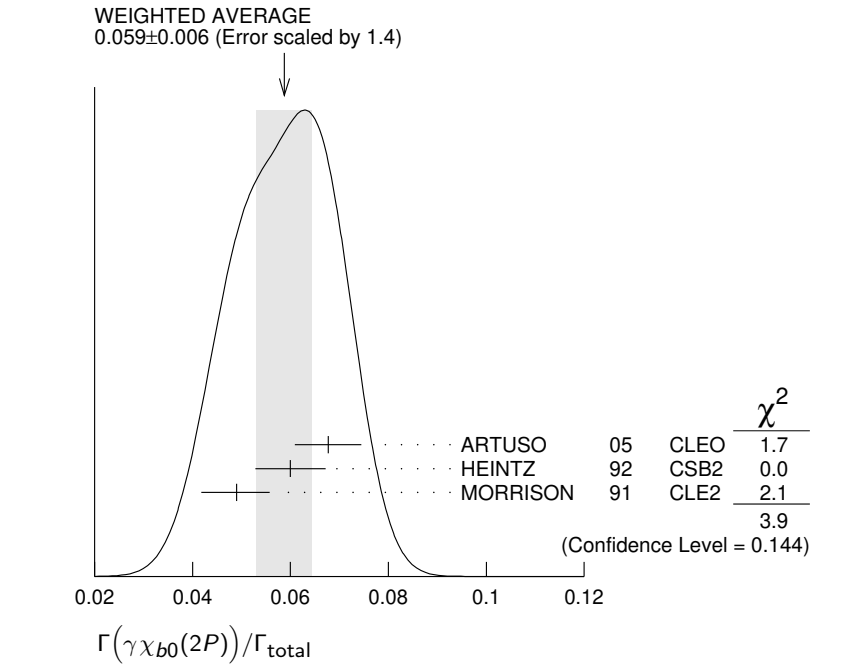


| $\Gamma(\gamma\chi_{b0}(2P))/\Gamma_{\text{total}}$ |      |             |      |         | $\Gamma_{22}/\Gamma$                                        |  |
|-----------------------------------------------------|------|-------------|------|---------|-------------------------------------------------------------|--|
| VALUE                                               | EVTS | DOCUMENT ID | TECN | COMMENT |                                                             |  |
| <b>0.059 ± 0.006 OUR AVERAGE</b>                    |      |             |      |         | Error includes scale factor of 1.4. See the ideogram below. |  |
| 0.0677 ± 0.0020 ± 0.0065                            | 225k | ARTUSO      | 05   | CLEO    | $e^+e^- \rightarrow \gamma X$                               |  |
| 0.060 ± 0.004 ± 0.006                               | 4959 | 42 HEINTZ   | 92   | CSB2    | $e^+e^- \rightarrow \gamma X$                               |  |
| 0.049 $^{+0.003}_{-0.004}$ ± 0.006                  | 9903 | MORRISON    | 91   | CLE2    | $e^+e^- \rightarrow \gamma X$                               |  |

<sup>42</sup>Supersedes NARAIN 91.

NODE=M048R7  
NODE=M048R7

NODE=M048R7;LINKAGE=H



| $\Gamma(\gamma\chi_{b2}(1P))/\Gamma_{\text{total}}$ |      |                |             |      | $\Gamma_{23}/\Gamma$                          |  |
|-----------------------------------------------------|------|----------------|-------------|------|-----------------------------------------------|--|
| VALUE (units $10^{-3}$ )                            | CL%  | EVTS           | DOCUMENT ID | TECN | COMMENT                                       |  |
| <b>10.0 ± 1.0 OUR AVERAGE</b>                       |      |                |             |      | Error includes scale factor of 1.7.           |  |
| 8.0 ± 1.3 ± 0.4                                     | 126  | 43,44 KORNICER | 11          | CLEO | $e^+e^- \rightarrow \gamma\gamma\ell^+\ell^-$ |  |
| 10.5 ± 0.3 $^{+0.7}_{-0.6}$                         | 9.7k | LEES           | 11J         | BABR | $\Upsilon(3S) \rightarrow X\gamma$            |  |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                      |     |      |                                                    |
|------|----|----------------------|-----|------|----------------------------------------------------|
| <19  | 90 | <sup>45</sup> ASNER  | 08A | CLEO | $\Upsilon(3S) \rightarrow \gamma + \text{hadrons}$ |
| seen |    | <sup>46</sup> HEINTZ | 92  | CSB2 | $e^+e^- \rightarrow \gamma\gamma\ell^+\ell^-$      |

NODE=M048R21  
NODE=M048R21

<sup>43</sup> Assuming  $B(\Upsilon(1S) \rightarrow \ell^+ \ell^-) = (2.48 \pm 0.05)\%$ .

<sup>44</sup> KORNICER 11 reports  $[\Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(1P))/\Gamma_{\text{total}}] \times [B(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S))]$   
 $= (1.435 \pm 0.162 \pm 0.169) \times 10^{-3}$  which we divide by our best value  $B(\chi_{b2}(1P) \rightarrow \gamma \Upsilon(1S)) = (18.0 \pm 1.0) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>45</sup> ASNER 08A reports  $[\Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b2}(1P))/\Gamma_{\text{total}}] / [B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P))]$   
 $< 27.1 \times 10^{-2}$  which we multiply by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b2}(1P)) = 7.15 \times 10^{-2}$ .

<sup>46</sup> HEINTZ 92, while unable to distinguish between different  $J$  states, measures  $\sum_J B(\Upsilon(3S) \rightarrow \gamma \chi_{bJ}) \times B(\chi_{bJ} \rightarrow \gamma \Upsilon(1S)) = (1.7 \pm 0.4 \pm 0.6) \times 10^{-3}$  for  $J = 0, 1, 2$  using inclusive  $\Upsilon(1S)$  decays and  $(1.2^{+0.4}_{-0.3} \pm 0.09) \times 10^{-3}$  for  $J = 1, 2$  using  $\Upsilon(1S) \rightarrow \ell^+ \ell^-$ .

NODE=M048R21;LINKAGE=KA

NODE=M048R21;LINKAGE=KR

NODE=M048R21;LINKAGE=AS

NODE=M048R21;LINKAGE=HE

### $\Gamma(\gamma \chi_{b1}(1P))/\Gamma_{\text{total}}$

$\Gamma_{24}/\Gamma$

| VALUE (units $10^{-3}$ )                                       | CL% | EVTs | DOCUMENT ID               | TECN     | COMMENT                                           |
|----------------------------------------------------------------|-----|------|---------------------------|----------|---------------------------------------------------|
| <b>0.9±0.5 OUR AVERAGE</b> Error includes scale factor of 1.8. |     |      |                           |          |                                                   |
| $1.5 \pm 0.4 \pm 0.1$                                          |     | 50   | <sup>47,48</sup> KORNICER | 11 CLEO  | $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$ |
| $0.5 \pm 0.3^{+0.2}_{-0.1}$                                    |     |      | LEES                      | 11J BABR | $\Upsilon(3S) \rightarrow X \gamma$               |

NODE=M048R22  
NODE=M048R22

• • • We do not use the following data for averages, fits, limits, etc. • • •

$< 1.7$  90 <sup>49</sup> ASNER 08A CLEO  $\Upsilon(3S) \rightarrow \gamma + \text{hadrons}$   
 seen <sup>50</sup> HEINTZ 92 CSB2  $e^+ e^- \rightarrow \gamma \gamma \ell^+ \ell^-$

<sup>47</sup> Assuming  $B(\Upsilon(1S) \rightarrow \ell^+ \ell^-) = (2.48 \pm 0.05)\%$ .

<sup>48</sup> KORNICER 11 reports  $[\Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(1P))/\Gamma_{\text{total}}] \times [B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S))]$   
 $= (5.38 \pm 1.20 \pm 0.95) \times 10^{-4}$  which we divide by our best value  $B(\chi_{b1}(1P) \rightarrow \gamma \Upsilon(1S)) = (35.2 \pm 2.0) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M048R22;LINKAGE=KA

NODE=M048R22;LINKAGE=KR

<sup>49</sup> ASNER 08A reports  $[\Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b1}(1P))/\Gamma_{\text{total}}] / [B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P))]$   
 $< 2.5 \times 10^{-2}$  which we multiply by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b1}(1P)) = 6.9 \times 10^{-2}$ .

NODE=M048R22;LINKAGE=AS

<sup>50</sup> HEINTZ 92, while unable to distinguish between different  $J$  states, measures  $\sum_J B(\Upsilon(3S) \rightarrow \gamma \chi_{bJ}) \times B(\chi_{bJ} \rightarrow \gamma \Upsilon(1S)) = (1.7 \pm 0.4 \pm 0.6) \times 10^{-3}$  for  $J = 0, 1, 2$  using inclusive  $\Upsilon(1S)$  decays and  $(1.2^{+0.4}_{-0.3} \pm 0.09) \times 10^{-3}$  for  $J = 1, 2$  using  $\Upsilon(1S) \rightarrow \ell^+ \ell^-$ .

NODE=M048R22;LINKAGE=HE

### $\Gamma(\gamma \chi_{b0}(1P))/\Gamma_{\text{total}}$

$\Gamma_{25}/\Gamma$

| VALUE (units $10^{-2}$ )     | CL% | EVTs | DOCUMENT ID | TECN     | COMMENT                             |
|------------------------------|-----|------|-------------|----------|-------------------------------------|
| <b>0.27±0.04 OUR AVERAGE</b> |     |      |             |          |                                     |
| $0.27 \pm 0.04 \pm 0.02$     |     | 2.3k | LEES        | 11J BABR | $\Upsilon(3S) \rightarrow X \gamma$ |
| $0.30 \pm 0.04 \pm 0.10$     |     | 8.7k | ARTUSO      | 05 CLEO  | $e^+ e^- \rightarrow \gamma X$      |

NODE=M048R15  
NODE=M048R15

• • • We do not use the following data for averages, fits, limits, etc. • • •

$< 0.8$  90 <sup>51</sup> ASNER 08A CLEO  $\Upsilon(3S) \rightarrow \gamma + \text{hadrons}$

<sup>51</sup> ASNER 08A reports  $[\Gamma(\Upsilon(3S) \rightarrow \gamma \chi_{b0}(1P))/\Gamma_{\text{total}}] / [B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P))]$   
 $< 21.9 \times 10^{-2}$  which we multiply by our best value  $B(\Upsilon(2S) \rightarrow \gamma \chi_{b0}(1P)) = 3.8 \times 10^{-2}$ .

NODE=M048R15;LINKAGE=AS

### $\Gamma(\gamma \eta_b(2S))/\Gamma_{\text{total}}$

$\Gamma_{26}/\Gamma$

| VALUE (units $10^{-4}$ )                                                      | CL% | DOCUMENT ID | TECN | COMMENT                             |
|-------------------------------------------------------------------------------|-----|-------------|------|-------------------------------------|
| <b>&lt; 6.2</b> 90 ARTUSO 05 CLEO $e^+ e^- \rightarrow \gamma X$              |     |             |      |                                     |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |             |      |                                     |
| $< 19$ 90 LEES 11J BABR                                                       |     |             |      | $\Upsilon(3S) \rightarrow X \gamma$ |

NODE=M048R16  
NODE=M048R16

### $\Gamma(\gamma \eta_b(1S))/\Gamma_{\text{total}}$

$\Gamma_{27}/\Gamma$

| VALUE (units $10^{-4}$ )                                                      | CL% | EVTs           | DOCUMENT ID             | TECN      | COMMENT                             |
|-------------------------------------------------------------------------------|-----|----------------|-------------------------|-----------|-------------------------------------|
| <b>5.1±0.7 OUR AVERAGE</b>                                                    |     |                |                         |           |                                     |
| $7.1 \pm 1.8 \pm 1.3$                                                         |     | $2.3 \pm 0.5k$ | <sup>52</sup> BONVICINI | 10 CLEO   | $\Upsilon(3S) \rightarrow \gamma X$ |
| $4.8 \pm 0.5 \pm 0.6$                                                         |     | $19 \pm 3k$    | <sup>52</sup> AUBERT    | 09AQ BABR | $\Upsilon(3S) \rightarrow \gamma X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |     |                |                         |           |                                     |
| $< 8.5$ 90 LEES 11J BABR                                                      |     |                |                         |           | $\Upsilon(3S) \rightarrow X \gamma$ |
| $4.8 \pm 0.5 \pm 1.2$                                                         |     | $19 \pm 3k$    | <sup>52,53</sup> AUBERT | 08V BABR  | $\Upsilon(3S) \rightarrow \gamma X$ |
| $< 4.3$ 90 <sup>54</sup> ARTUSO 05 CLEO                                       |     |                |                         |           | $e^+ e^- \rightarrow \gamma X$      |

NODE=M048R17  
NODE=M048R17

<sup>52</sup> Assuming  $\Gamma_{\eta_b(1S)} = 10 \text{ MeV}$ .

<sup>53</sup> Systematic error re-evaluated by AUBERT 09AQ.

<sup>54</sup> Superseded by BONVICINI 10.

NODE=M048R17;LINKAGE=BO

NODE=M048R17;LINKAGE=AU

NODE=M048R17;LINKAGE=SU

$\Gamma(\gamma A^0 \rightarrow \gamma \text{hadrons})/\Gamma_{\text{total}}$   
 (0.3 GeV <  $m_{A^0}$  < 7 GeV)
 $\Gamma_{28}/\Gamma$ 

NODE=M048R02

NODE=M048R02  
NODE=M048R02

| VALUE                | CL% | DOCUMENT ID        | TECN     | COMMENT                                          |
|----------------------|-----|--------------------|----------|--------------------------------------------------|
| $< 8 \times 10^{-5}$ | 90  | <sup>55</sup> LEES | 11H BABR | $\Upsilon(3S) \rightarrow \gamma \text{hadrons}$ |

<sup>55</sup> For a narrow scalar or pseudoscalar  $A^0$ , excluding known resonances, with mass in the range 0.3–7 GeV. Measured 90% CL limits as a function of  $m_{A^0}$  range from  $1 \times 10^{-6}$  to  $8 \times 10^{-5}$ .

NODE=M048R02;LINKAGE=LE

 $\Gamma(\gamma X \rightarrow \gamma + \geq 4 \text{ prongs})/\Gamma_{\text{total}}$   
 (1.5 GeV <  $m_X$  < 5.0 GeV)
 $\Gamma_{29}/\Gamma$ 

NODE=M048R20

NODE=M048R20  
NODE=M048R20

| VALUE (units $10^{-4}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                       |
|--------------------------|-----|-------------|----------|-------------------------------|
| $< 2.2$                  | 95  | ROSNER      | 07A CLEO | $e^+e^- \rightarrow \gamma X$ |

 $\Gamma(\gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{30}/\Gamma$ NODE=M048R04  
NODE=M048R04

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID          | TECN     | COMMENT                                                          |
|--------------------------|-----|----------------------|----------|------------------------------------------------------------------|
| $< 5.5$                  | 90  | <sup>56</sup> AUBERT | 09Z BABR | $e^+e^- \rightarrow \gamma a_1^0 \rightarrow \gamma \mu^+ \mu^-$ |

<sup>56</sup> For a narrow scalar or pseudoscalar  $a_1^0$  with mass in the range 212–9300 MeV, excluding  $J/\psi$  and  $\psi(2S)$ . Measured 90% CL limits as a function of  $m_{a_1^0}$  range from 0.27–5.5  $\times 10^{-6}$ .

NODE=M048R04;LINKAGE=AU

 $\Gamma(\gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-)/\Gamma_{\text{total}}$ 
 $\Gamma_{31}/\Gamma$ NODE=M048R29  
NODE=M048R29

| VALUE                  | CL% | DOCUMENT ID          | TECN     | COMMENT                                                            |
|------------------------|-----|----------------------|----------|--------------------------------------------------------------------|
| $< 1.6 \times 10^{-4}$ | 90  | <sup>57</sup> AUBERT | 09P BABR | $e^+e^- \rightarrow \gamma a_1^0 \rightarrow \gamma \tau^+ \tau^-$ |

<sup>57</sup> For a narrow scalar or pseudoscalar  $a_1^0$  with  $M(\tau^+ \tau^-)$  in the ranges 4.03–9.52 and 9.61–10.10 GeV. Measured 90% CL limits as a function of  $M(\tau^+ \tau^-)$  range from  $1.5$ – $16 \times 10^{-5}$ .

NODE=M048R29;LINKAGE=AU

## LEPTON FAMILY NUMBER (LF) VIOLATING MODES

NODE=M048230

 $\Gamma(e^\pm \tau^\mp)/\Gamma_{\text{total}}$ 
 $\Gamma_{32}/\Gamma$ NODE=M048R01  
NODE=M048R01

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                             |
|--------------------------|-----|-------------|----------|-------------------------------------|
| $< 4.2$                  | 90  | LEES        | 10B BABR | $e^+e^- \rightarrow e^\pm \tau^\mp$ |

 $\Gamma(\mu^\pm \tau^\mp)/\Gamma_{\text{total}}$ 
 $\Gamma_{33}/\Gamma$ NODE=M048R23  
NODE=M048R23

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID | TECN     | COMMENT                               |
|--------------------------|-----|-------------|----------|---------------------------------------|
| $< 3.1$                  | 90  | LEES        | 10B BABR | $e^+e^- \rightarrow \mu^\pm \tau^\mp$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|          |    |      |          |                                       |
|----------|----|------|----------|---------------------------------------|
| $< 20.3$ | 95 | LOVE | 08A CLEO | $e^+e^- \rightarrow \mu^\pm \tau^\mp$ |
|----------|----|------|----------|---------------------------------------|

 $\Upsilon(3S)$  REFERENCES

NODE=M048

|           |      |                |                            |                 |             |
|-----------|------|----------------|----------------------------|-----------------|-------------|
| LEES      | 20E  | PRL 125 241801 | J.P. Lees <i>et al.</i>    | (BABAR Collab.) | REFID=60700 |
| LEES      | 14G  | PR D89 111102  | J.P. Lees <i>et al.</i>    | (BABAR Collab.) | REFID=55939 |
| GE        | 11   | PR D84 032008  | J.Y. Ge <i>et al.</i>      | (CLEO Collab.)  | REFID=53960 |
| KORNICER  | 11   | PR D83 054003  | M. Kornicer <i>et al.</i>  | (CLEO Collab.)  | REFID=16769 |
| LEES      | 11C  | PR D84 011104  | J.P. Lees <i>et al.</i>    | (BABAR Collab.) | REFID=16775 |
| LEES      | 11H  | PRL 107 221803 | J.P. Lees <i>et al.</i>    | (BABAR Collab.) | REFID=53877 |
| LEES      | 11J  | PR D84 072002  | J.P. Lees <i>et al.</i>    | (BABAR Collab.) | REFID=53936 |
| LEES      | 11K  | PR D84 091101  | J.P. Lees <i>et al.</i>    | (BABAR Collab.) | REFID=53937 |
| LEES      | 11L  | PR D84 092003  | J.P. Lees <i>et al.</i>    | (BABAR Collab.) | REFID=53938 |
| BONVICINI | 10   | PR D81 031104  | G. Bonvicini <i>et al.</i> | (CLEO Collab.)  | REFID=53231 |
| LEES      | 10B  | PRL 104 151802 | J.P. Lees <i>et al.</i>    | (BABAR Collab.) | REFID=53355 |
| AUBERT    | 09AQ | PRL 103 161801 | B. Aubert <i>et al.</i>    | (BABAR Collab.) | REFID=53106 |
| AUBERT    | 09P  | PRL 103 181801 | B. Aubert <i>et al.</i>    | (BABAR Collab.) | REFID=53062 |
| AUBERT    | 09Z  | PRL 103 081803 | B. Aubert <i>et al.</i>    | (BABAR Collab.) | REFID=52930 |
| BHARI     | 09   | PR D79 011103  | S.R. Bhari <i>et al.</i>   | (CLEO Collab.)  | REFID=52662 |
| ASNER     | 08A  | PR D78 091103  | D.M. Asner <i>et al.</i>   | (CLEO Collab.)  | REFID=52574 |
| AUBERT    | 08BP | PR D78 112002  | B. Aubert <i>et al.</i>    | (BABAR Collab.) | REFID=52660 |
| AUBERT    | 08V  | PRL 101 071801 | B. Aubert <i>et al.</i>    | (BABAR Collab.) | REFID=52262 |
| HE        | 08A  | PRL 101 192001 | Q. He <i>et al.</i>        | (CLEO Collab.)  | REFID=52587 |
| LOVE      | 08A  | PRL 101 201601 | W. Love <i>et al.</i>      | (CLEO Collab.)  | REFID=52592 |
| PDG       | 08   | PL B667 1      | C. Amsler <i>et al.</i>    | (PDG Collab.)   | REFID=52166 |
| BESSION   | 07   | PRL 98 052002  | D. Besson <i>et al.</i>    | (CLEO Collab.)  | REFID=51620 |
| ROSNER    | 07A  | PR D76 117102  | J.L. Rosner <i>et al.</i>  | (CLEO Collab.)  | REFID=52079 |
| BESSION   | 06A  | PR D74 012003  | D. Besson <i>et al.</i>    | (CLEO Collab.)  | REFID=51147 |
| ROSNER    | 06   | PRL 96 092003  | J.L. Rosner <i>et al.</i>  | (CLEO Collab.)  | REFID=51035 |
| ADAMS     | 05   | PRL 94 012001  | G.S. Adams <i>et al.</i>   | (CLEO Collab.)  | REFID=50452 |
| ARTUSO    | 05   | PRL 94 032001  | M. Artuso <i>et al.</i>    | (CLEO Collab.)  | REFID=50454 |

|                                                             |     |                         |                              |                    |
|-------------------------------------------------------------|-----|-------------------------|------------------------------|--------------------|
| ARTAMONOV                                                   | 00  | PL B474 427             | A.S. Artamonov <i>et al.</i> |                    |
| BUTLER                                                      | 94B | PR D49 40               | F. Butler <i>et al.</i>      | (CLEO Collab.)     |
| WU                                                          | 93  | PL B301 307             | Q.W. Wu <i>et al.</i>        | (CUSB Collab.)     |
| HEINTZ                                                      | 92  | PR D46 1928             | U. Heintz <i>et al.</i>      | (CUSB II Collab.)  |
| BROCK                                                       | 91  | PR D43 1448             | I.C. Brock <i>et al.</i>     | (CLEO Collab.)     |
| HEINTZ                                                      | 91  | PRL 66 1563             | U. Heintz <i>et al.</i>      | (CUSB Collab.)     |
| MORRISON                                                    | 91  | PRL 67 1696             | R.J. Morrison <i>et al.</i>  | (CLEO Collab.)     |
| NARAIN                                                      | 91  | PRL 66 3113             | M. Narain <i>et al.</i>      | (CUSB Collab.)     |
| CHEN                                                        | 89B | PR D39 3528             | W.Y. Chen <i>et al.</i>      | (CLEO Collab.)     |
| KAARSBERG                                                   | 89  | PRL 62 2077             | T.M. Kaarsberg <i>et al.</i> | (CUSB Collab.)     |
| BUCHMUELLER                                                 | 88  | HE $e^+e^-$ Physics 412 | W. Buchmueller, S. Cooper    | (HANN, DESY, MIT)  |
| Editors: A. Ali and P. Soeding, World Scientific, Singapore |     |                         |                              |                    |
| COHEN                                                       | 87  | RMP 59 1121             | E.R. Cohen, B.N. Taylor      | (RISC, NBS)        |
| BARU                                                        | 86B | ZPHY C32 622 (erratum)  | S.E. Baru <i>et al.</i>      | (NOVO)             |
| KURAEV                                                      | 85  | SJNP 41 466             | E.A. Kuraev, V.S. Fadin      | (NOVO)             |
| Translated from YAF 41 733.                                 |     |                         |                              |                    |
| ARTAMONOV                                                   | 84  | PL 137B 272             | A.S. Artamonov <i>et al.</i> | (NOVO)             |
| GILES                                                       | 84B | PR D29 1285             | R. Giles <i>et al.</i>       | (CLEO Collab.)     |
| ANDREWS                                                     | 83  | PRL 50 807              | D.E. Andrews <i>et al.</i>   | (CLEO Collab.)     |
| GREEN                                                       | 82  | PRL 49 617              | J. Green <i>et al.</i>       | (CLEO Collab.)     |
| MAGERAS                                                     | 82  | PL 118B 453             | G. Mageras <i>et al.</i>     | (COLU, CORN, LSU+) |

REFID=47424  
REFID=43799  
REFID=43313  
REFID=43604  
REFID=41579  
REFID=41580  
REFID=41634  
REFID=41586  
REFID=40919  
REFID=40733  
REFID=40034

REFID=11616  
REFID=22338  
REFID=40033

REFID=22278  
REFID=22280  
REFID=22273  
REFID=22321  
REFID=22359

NODE=M206

$$\chi_{b1}(3P)$$

$$I^G(J^{PC}) = 0^+(1^{++})$$

Needs confirmation.

NODE=M206

Observed in the radiative decay to  $\Upsilon(1S, 2S, 3S)$ , therefore  $C = +$ .  
 $J$  needs confirmation.

### $\chi_{b1}(3P)$ MASS

NODE=M206M

| VALUE (MeV)                                                                   | EVTS | DOCUMENT ID           | TECN      | COMMENT                                     |
|-------------------------------------------------------------------------------|------|-----------------------|-----------|---------------------------------------------|
| <b>10513.42 ± 0.41 ± 0.53</b>                                                 |      | <sup>1</sup> SIRUNYAN | 18N CMS   | $pp \rightarrow \gamma \mu^+ \mu^- X$       |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                       |           |                                             |
| 10515.7 + 2.2 + 1.5<br>- 3.9 - 2.1                                            | 169  | <sup>2</sup> AAIJ     | 14BG LHCb | $pp \rightarrow \gamma \mu^+ \mu^- X$       |
| 10512.1 ± 2.1 ± 0.9                                                           | 351  | <sup>3</sup> AAIJ     | 14BG LHCb | $pp \rightarrow \gamma \mu^+ \mu^- X$       |
| 10511.3 ± 1.7 ± 2.5                                                           | 182  | <sup>4</sup> AAIJ     | 14BI LHCb | $pp \rightarrow \gamma \mu^+ \mu^- X$       |
| 10530 ± 5 ± 9                                                                 |      | <sup>5</sup> AAD      | 12A ATLS  | $pp \rightarrow \gamma \mu^+ \mu^- X$       |
| 10551 ± 14 ± 17                                                               |      | <sup>5</sup> ABAZOV   | 12Q D0    | $p\bar{p} \rightarrow \gamma \mu^+ \mu^- X$ |

NODE=M206M

<sup>1</sup> Systematic error includes an additional 0.5 MeV for the uncertainty on the  $\Upsilon(3S)$  mass. Also measures  $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.60 \pm 0.64 \pm 0.17$  MeV. A total of 372  $\chi_{b1}(3P)$  and  $\chi_{b2}(3P)$  events was observed.

<sup>2</sup> From  $\chi_{b1}(3P) \rightarrow \Upsilon(1S, 2S)\gamma$  transitions assuming  $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.5 \pm 1.5$  MeV and allowing for  $\pm 30\%$  variation in the  $\chi_{b2}(3P)$  production rate relative to that of  $\chi_{b1}(3P)$ .

<sup>3</sup> The mass of the  $\chi_{b1}(3P)$  state obtained by combining the results of AAIJ 14BG with that of AAIJ 14BI. The first uncertainty is experimental and the second attributable to the unknown mass splitting, assumed to be  $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.5 \pm 1.5$  MeV.

<sup>4</sup> From  $\chi_{b1}(3P) \rightarrow \Upsilon(3S)\gamma$  transition assuming  $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.5 \pm 1.5$  MeV.

<sup>5</sup> The mass barycenter of the merged lineshapes from the  $J = 1$  and 2 states.

NODE=M206M;LINKAGE=D

NODE=M206M;LINKAGE=A

NODE=M206M;LINKAGE=B

NODE=M206M;LINKAGE=C

NODE=M206M;LINKAGE=AA

### $\chi_{b1}(3P)$ DECAY MODES

NODE=M206215;NODE=M206

| Mode                            | Fraction ( $\Gamma_i/\Gamma$ ) |
|---------------------------------|--------------------------------|
| $\Gamma_1$ $\Upsilon(1S)\gamma$ | seen                           |
| $\Gamma_2$ $\Upsilon(2S)\gamma$ | seen                           |
| $\Gamma_3$ $\Upsilon(3S)\gamma$ | seen                           |

DESIG=1

DESIG=2

DESIG=3

### $\chi_{b1}(3P)$ BRANCHING RATIOS

NODE=M206225

| $\Gamma(\Upsilon(1S)\gamma)/\Gamma_{\text{total}}$                            | VALUE | EVTS | DOCUMENT ID       | TECN      | COMMENT                                     | $\Gamma_1/\Gamma$ |
|-------------------------------------------------------------------------------|-------|------|-------------------|-----------|---------------------------------------------|-------------------|
| <b>seen</b>                                                                   |       | 169  | <sup>1</sup> AAIJ | 14BG LHCb | $pp \rightarrow \gamma \mu^+ \mu^- X$       |                   |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |       |      |                   |           |                                             |                   |
| seen                                                                          |       |      | AAD               | 12A ATLS  | $pp \rightarrow \gamma \mu^+ \mu^- X$       |                   |
| seen                                                                          |       |      | ABAZOV            | 12Q D0    | $p\bar{p} \rightarrow \gamma \mu^+ \mu^- X$ |                   |

NODE=M206R01  
NODE=M206R01

<sup>1</sup> From  $\chi_{b1}(3P) \rightarrow \Upsilon(1S, 2S)\gamma$  transitions assuming  $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.5 \pm 1.5$  MeV and allowing for  $\pm 30\%$  variation in the  $\chi_{b2}(3P)$  production rate relative to that of  $\chi_{b1}(3P)$ .

NODE=M206R01;LINKAGE=A

$\Gamma(\Upsilon(2S)\gamma)/\Gamma_{\text{total}}$ 
 $\Gamma_2/\Gamma$ 

| VALUE                                                                         | EVTS | DOCUMENT ID       | TECN      | COMMENT                               |
|-------------------------------------------------------------------------------|------|-------------------|-----------|---------------------------------------|
| seen                                                                          | 169  | <sup>1</sup> AAIJ | 14BG LHCb | $pp \rightarrow \gamma \mu^+ \mu^- X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |      |                   |           |                                       |
| seen                                                                          |      | AAD               | 12A ATLAS | $pp \rightarrow \gamma \mu^+ \mu^- X$ |

<sup>1</sup> From  $\chi_{b1}(3P) \rightarrow \Upsilon(1S, 2S)\gamma$  transitions assuming  $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.5 \pm 1.5$  MeV and allowing for  $\pm 30\%$  variation in the  $\chi_{b2}(3P)$  production rate relative to that of  $\chi_{b1}(3P)$ .

NODE=M206R02  
NODE=M206R02

NODE=M206R02;LINKAGE=A

 $\Gamma(\Upsilon(3S)\gamma)/\Gamma_{\text{total}}$ 
 $\Gamma_3/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID | TECN      | COMMENT                               |
|-------|------|-------------|-----------|---------------------------------------|
| seen  |      | SIRUNYAN    | 18N CMS   | $pp \rightarrow \gamma \mu^+ \mu^- X$ |
| seen  | 182  | AAIJ        | 14BI LHCb | $pp \rightarrow \gamma \mu^+ \mu^- X$ |

NODE=M206R03  
NODE=M206R03

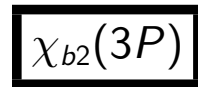
### $\chi_{b1}(3P)$ REFERENCES

|          |      |                |                             |                 |
|----------|------|----------------|-----------------------------|-----------------|
| SIRUNYAN | 18N  | PRL 121 092002 | A.M. Sirunyan <i>et al.</i> | (CMS Collab.)   |
| AAIJ     | 14BG | JHEP 1410 088  | R. Aaij <i>et al.</i>       | (LHCb Collab.)  |
| AAIJ     | 14BI | EPJ C74 3092   | R. Aaij <i>et al.</i>       | (LHCb Collab.)  |
| AAD      | 12A  | PRL 108 152001 | G. Aad <i>et al.</i>        | (ATLAS Collab.) |
| ABAZOV   | 12Q  | PR D86 031103  | V.M. Abazov <i>et al.</i>   | (D0 Collab.)    |

NODE=M206

REFID=58873  
REFID=56199  
REFID=56235  
REFID=54037  
REFID=54264

NODE=M238



$$J^{PC} = 0^{+}(2^{++})$$

Needs confirmation.

NODE=M238

Observed in the radiative decay to  $\Upsilon(3S)$ , therefore  $C = +$ .  $J$  needs confirmation.

### $\chi_{b2}(3P)$ MASS

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN      | COMMENT                               |
|-------------------------------------------------------------------------------|-----------------------|-----------|---------------------------------------|
| <b><math>10524.02 \pm 0.57 \pm 0.53</math></b>                                | <sup>1</sup> SIRUNYAN | 18N CMS   | $pp \rightarrow \gamma \mu^+ \mu^- X$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |           |                                       |
| 10530 $\pm 5$ $\pm 9$                                                         | <sup>2</sup> AAD      | 12A ATLAS | $pp \rightarrow \gamma \mu^+ \mu^- X$ |

<sup>1</sup> Systematic error includes an additional 0.5 MeV for the uncertainty on the  $\Upsilon(3S)$  mass. Also measures  $m_{\chi_{b2}(3P)} - m_{\chi_{b1}(3P)} = 10.60 \pm 0.64 \pm 0.17$  MeV. A total of 372  $\chi_{b1}(3P)$  and  $\chi_{b2}(3P)$  events was observed.

<sup>2</sup> The mass barycenter of the merged lineshapes from the  $J = 1$  and 2 states.

NODE=M238M

NODE=M238M

NODE=M238M;LINKAGE=A

NODE=M238M;LINKAGE=AA

### $\chi_{b2}(3P)$ DECAY MODES

| Mode                   | Fraction ( $\Gamma_i/\Gamma$ ) |
|------------------------|--------------------------------|
| $\Upsilon_1(3S)\gamma$ | seen                           |

NODE=M238215;NODE=M238

DESIG=1

### $\chi_{b2}(3P)$ BRANCHING RATIOS

 $\Gamma(\Upsilon(3S)\gamma)/\Gamma_{\text{total}}$ 
 $\Gamma_1/\Gamma$ 

| VALUE | DOCUMENT ID | TECN    | COMMENT                               |
|-------|-------------|---------|---------------------------------------|
| seen  | SIRUNYAN    | 18N CMS | $pp \rightarrow \gamma \mu^+ \mu^- X$ |

NODE=M238225

NODE=M238R01  
NODE=M238R01

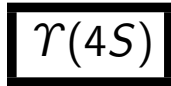
### $\chi_{b2}(3P)$ REFERENCES

|          |     |                |                             |                 |
|----------|-----|----------------|-----------------------------|-----------------|
| SIRUNYAN | 18N | PRL 121 092002 | A.M. Sirunyan <i>et al.</i> | (CMS Collab.)   |
| AAD      | 12A | PRL 108 152001 | G. Aad <i>et al.</i>        | (ATLAS Collab.) |

NODE=M238

REFID=58873  
REFID=54037





$$I^G(J^{PC}) = 0^-(1^{--})$$

also known as  $\Upsilon(10580)$

NODE=M047

### $\Upsilon(4S)$ MASS

NODE=M047M

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------|-----------------------|----------|-------------------------------------|
| <b>10579.4±1.2 OUR AVERAGE</b>                                                |                       |          |                                     |
| 10579.3±0.4±1.2                                                               | AUBERT                | 05Q BABR | $e^+e^- \rightarrow \text{hadrons}$ |
| 10580.0±3.5                                                                   | <sup>1</sup> BEBEK    | 87 CLEO  | $e^+e^- \rightarrow \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |          |                                     |
| 10577.4±1.0                                                                   | <sup>2</sup> LOVELOCK | 85 CUSB  | $e^+e^- \rightarrow \text{hadrons}$ |
| <sup>1</sup> Reanalysis of BESSON 85.                                         |                       |          |                                     |
| <sup>2</sup> No systematic error given.                                       |                       |          |                                     |

NODE=M047M

NODE=M047M;LINKAGE=C  
NODE=M047M;LINKAGE=B

### $\Upsilon(4S)$ WIDTH

NODE=M047W

| VALUE (MeV)                                                                   | DOCUMENT ID | TECN     | COMMENT                             |
|-------------------------------------------------------------------------------|-------------|----------|-------------------------------------|
| <b>20.5±2.5 OUR AVERAGE</b>                                                   |             |          |                                     |
| 20.7±1.6±2.5                                                                  | AUBERT      | 05Q BABR | $e^+e^- \rightarrow \text{hadrons}$ |
| 20 ±2 ±4                                                                      | BESSON      | 85 CLEO  | $e^+e^- \rightarrow \text{hadrons}$ |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |             |          |                                     |
| 25 ±2.5                                                                       | LOVELOCK    | 85 CUSB  | $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M047W

### $\Upsilon(4S)$ DECAY MODES

NODE=M047215;NODE=M047

| Mode                                                  | Fraction ( $\Gamma_i/\Gamma$ ) | Confidence level |
|-------------------------------------------------------|--------------------------------|------------------|
| $\Gamma_1$ $B\bar{B}$                                 | > 96 %                         | 95%              |
| $\Gamma_2$ $B^+B^-$                                   | (51.4 ±0.6) %                  |                  |
| $\Gamma_3$ $D^+_S \text{ anything} + \text{c.c.}$     | (17.8 ±2.6) %                  |                  |
| $\Gamma_4$ $B^0\bar{B}^0$                             | (48.6 ±0.6) %                  |                  |
| $\Gamma_5$ $J/\psi K^0_S + (J/\psi, \eta_c) K^0_S$    | < 4 × 10 <sup>-7</sup>         | 90%              |
| $\Gamma_6$ non- $B\bar{B}$                            | < 4 %                          | 95%              |
| $\Gamma_7$ $e^+e^-$                                   | (1.57±0.08) × 10 <sup>-5</sup> |                  |
| $\Gamma_8$ $\rho^+\rho^-$                             | < 5.7 × 10 <sup>-6</sup>       | 90%              |
| $\Gamma_9$ $K^*(892)^0 \bar{K}^0$                     | < 2.0 × 10 <sup>-6</sup>       | 90%              |
| $\Gamma_{10}$ $J/\psi(1S) \text{ anything}$           | < 1.9 × 10 <sup>-4</sup>       | 95%              |
| $\Gamma_{11}$ $D^{*+} \text{ anything} + \text{c.c.}$ | < 7.4 %                        | 90%              |
| $\Gamma_{12}$ $\phi \text{ anything}$                 | (7.1 ±0.6) %                   |                  |
| $\Gamma_{13}$ $\phi\eta$                              | < 1.8 × 10 <sup>-6</sup>       | 90%              |
| $\Gamma_{14}$ $\phi\eta'$                             | < 4.3 × 10 <sup>-6</sup>       | 90%              |
| $\Gamma_{15}$ $\rho\eta$                              | < 1.3 × 10 <sup>-6</sup>       | 90%              |
| $\Gamma_{16}$ $\rho\eta'$                             | < 2.5 × 10 <sup>-6</sup>       | 90%              |
| $\Gamma_{17}$ $\Upsilon(1S) \text{ anything}$         | < 4 × 10 <sup>-3</sup>         | 90%              |
| $\Gamma_{18}$ $\Upsilon(1S)\pi^+\pi^-$                | (8.2 ±0.4) × 10 <sup>-5</sup>  |                  |
| $\Gamma_{19}$ $\Upsilon(1S)\eta$                      | (1.81±0.18) × 10 <sup>-4</sup> |                  |
| $\Gamma_{20}$ $\Upsilon(1S)\eta'$                     | (3.4 ±0.9) × 10 <sup>-5</sup>  |                  |
| $\Gamma_{21}$ $\Upsilon(2S)\pi^+\pi^-$                | (8.2 ±0.8) × 10 <sup>-5</sup>  |                  |
| $\Gamma_{22}$ $h_b(1P)\pi^+\pi^-$                     | not seen                       |                  |
| $\Gamma_{23}$ $h_b(1P)\eta$                           | (2.18±0.21) × 10 <sup>-3</sup> |                  |
| $\Gamma_{24}$ $\eta_b(1S)\omega$                      | < 1.8 × 10 <sup>-4</sup>       | 90%              |
| $\Gamma_{25}$ $^2H \text{ anything}$                  | < 1.3 × 10 <sup>-5</sup>       | 90%              |

DESIG=8;OUR EST;→ UNCHECKED ←  
DESIG=10  
DESIG=12  
DESIG=11  
DESIG=15  
DESIG=6  
DESIG=1  
DESIG=16  
DESIG=22  
DESIG=2  
DESIG=3  
DESIG=4  
DESIG=13  
DESIG=18  
DESIG=19  
DESIG=20  
DESIG=5  
DESIG=7  
DESIG=17  
DESIG=26  
DESIG=9  
DESIG=21  
DESIG=23  
DESIG=27  
DESIG=14

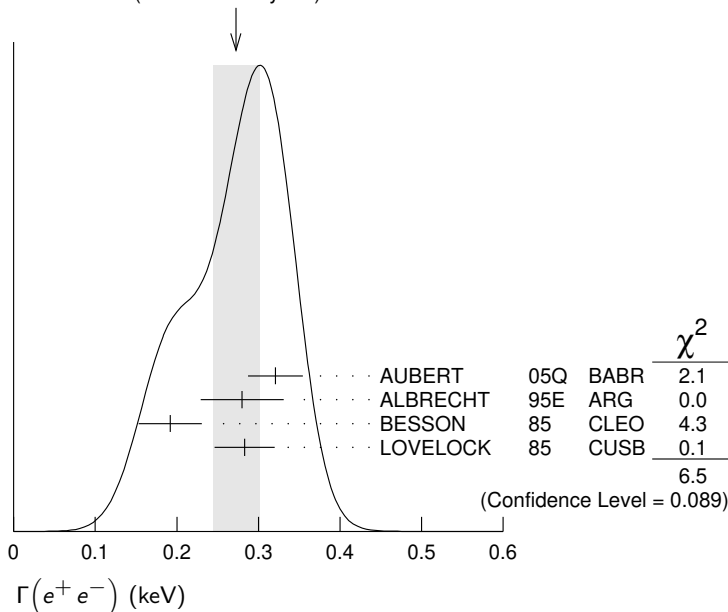
### Double Radiative Decays

|                                                                                    |                          |     |
|------------------------------------------------------------------------------------|--------------------------|-----|
| $\Gamma_{26}$ $\gamma\gamma \Upsilon(D) \rightarrow \gamma\gamma\eta \Upsilon(1S)$ | < 2.3 × 10 <sup>-5</sup> | 90% |
|------------------------------------------------------------------------------------|--------------------------|-----|

NODE=M047;CLUMP=B  
DESIG=24

$\Upsilon(4S)$  PARTIAL WIDTHS $\Gamma(e^+e^-)$  $\Gamma_7$ 

| VALUE (keV)                    | DOCUMENT ID                                                 | TECN | COMMENT                                  |
|--------------------------------|-------------------------------------------------------------|------|------------------------------------------|
| <b>0.272±0.029 OUR AVERAGE</b> | Error includes scale factor of 1.5. See the ideogram below. |      |                                          |
| 0.321±0.017±0.029              | AUBERT                                                      | 05Q  | BABR $e^+e^- \rightarrow \text{hadrons}$ |
| 0.28 ±0.05 ±0.01               | <sup>1</sup> ALBRECHT                                       | 95E  | ARG $e^+e^- \rightarrow \text{hadrons}$  |
| 0.192±0.007±0.038              | BESSON                                                      | 85   | CLEO $e^+e^- \rightarrow \text{hadrons}$ |
| 0.283±0.037                    | LOVELOCK                                                    | 85   | CUSB $e^+e^- \rightarrow \text{hadrons}$ |

<sup>1</sup> Using LEYAOUANC 77 parametrization of  $\Gamma(s)$ .WEIGHTED AVERAGE  
0.272±0.029 (Error scaled by 1.5)

NODE=M047220

NODE=M047W1  
NODE=M047W1

NODE=M047W1;LINKAGE=A

 $\Upsilon(4S)$  BRANCHING RATIOS $B\bar{B}$  DECAYS

The ratio of branching fraction to charged and neutral B mesons is often derived assuming isospin invariance in the decays, and relies on the knowledge of the  $B^+/B^0$  lifetime ratio. "OUR EVALUATION" is obtained based on averages of rescaled data listed below. The average and rescaling were performed by the Heavy Flavor Averaging Group (HFLAV) and are described at <https://hflav.web.cern.ch/>. The averaging/rescaling procedure takes into account the common dependence of the measurement on the value of the lifetime ratio.

NODE=M047230

NODE=M047BBD

NODE=M047BBD

 $\Gamma(B^+B^-)/\Gamma_{\text{total}}$  $\Gamma_2/\Gamma$ 

| VALUE                             | DOCUMENT ID                                         |
|-----------------------------------|-----------------------------------------------------|
| <b>0.514±0.006 OUR EVALUATION</b> | Assuming $B(\Upsilon(4S) \rightarrow B\bar{B}) = 1$ |

NODE=M047R11  
NODE=M047R11  
→ UNCHECKED ← $\Gamma(D_s^+ \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ 

| VALUE                                                                                                                                                                                                                                                                                                                                                                                                                                  | DOCUMENT ID         | TECN | COMMENT                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------|---------------------------------|
| <b>0.178±0.021±0.016</b>                                                                                                                                                                                                                                                                                                                                                                                                               | <sup>1</sup> ARTUSO | 05B  | CLE3 $e^+e^- \rightarrow D_s X$ |
| <sup>1</sup> ARTUSO 05B reports $[\Gamma(\Upsilon(4S) \rightarrow D_s^+ \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi\pi^+)] = (8.0 \pm 0.2 \pm 0.9) \times 10^{-3}$ which we divide by our best value $B(D_s^+ \rightarrow \phi\pi^+) = (4.5 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value. |                     |      |                                 |

NODE=M047R13  
NODE=M047R13

NODE=M047R13;LINKAGE=AR

 $\Gamma(B^0\bar{B}^0)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

| VALUE                                                                                                                                             | DOCUMENT ID                                         | TECN | COMMENT                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------|----------------------------------------------------------------------|
| <b>0.486±0.006 OUR EVALUATION</b>                                                                                                                 | Assuming $B(\Upsilon(4S) \rightarrow B\bar{B}) = 1$ |      |                                                                      |
| • • • We do not use the following data for averages, fits, limits, etc. • • •                                                                     |                                                     |      |                                                                      |
| 0.487±0.010±0.008                                                                                                                                 | <sup>1</sup> AUBERT,B                               | 05H  | BABR $\Upsilon(4S) \rightarrow \bar{B}B \rightarrow D^*\ell\nu_\ell$ |
| <sup>1</sup> Direct measurement. This value is averaged with the value extracted from the $\Gamma(B^+B^-)$ / $\Gamma(B^0\bar{B}^0)$ measurements. |                                                     |      |                                                                      |

NODE=M047R12  
NODE=M047R12  
→ UNCHECKED ←

NODE=M047R12;LINKAGE=AU

$\Gamma(B^+ B^-)/\Gamma(B^0 \bar{B}^0)$  $\Gamma_2/\Gamma_4$ 

| VALUE                               | DOCUMENT ID               | TECN | COMMENT                                                          |
|-------------------------------------|---------------------------|------|------------------------------------------------------------------|
| <b>1.058 ± 0.024 OUR EVALUATION</b> |                           |      |                                                                  |
| 1.006 ± 0.036 ± 0.031               | <sup>1</sup> AUBERT 04F   | BABR | $\Upsilon(4S) \rightarrow B\bar{B} \rightarrow J/\psi K$         |
| 1.01 ± 0.03 ± 0.09                  | <sup>1</sup> HASTINGS 03  | BELL | $\Upsilon(4S) \rightarrow B\bar{B} \rightarrow \text{dileptons}$ |
| 1.058 ± 0.084 ± 0.136               | <sup>2</sup> ATHAR 02     | CLEO | $\Upsilon(4S) \rightarrow B\bar{B} \rightarrow D^* \ell \nu$     |
| 1.10 ± 0.06 ± 0.05                  | <sup>3</sup> AUBERT 02    | BABR | $\Upsilon(4S) \rightarrow B\bar{B} \rightarrow (c\bar{c}) K^*$   |
| 1.04 ± 0.07 ± 0.04                  | <sup>4</sup> ALEXANDER 01 | CLEO | $\Upsilon(4S) \rightarrow B\bar{B} \rightarrow J/\psi K^*$       |

<sup>1</sup> HASTINGS 03 and AUBERT 04F assume  $\tau(B^+)/\tau(B^0) = 1.083 \pm 0.017$ .<sup>2</sup> ATHAR 02 assumes  $\tau(B^+)/\tau(B^0) = 1.074 \pm 0.028$ . Supersedes BARISH 95.<sup>3</sup> AUBERT 02 assumes  $\tau(B^+)/\tau(B^0) = 1.062 \pm 0.029$ .<sup>4</sup> ALEXANDER 01 assumes  $\tau(B^+)/\tau(B^0) = 1.066 \pm 0.024$ .

NODE=M047R10  
 NODE=M047R10  
 → UNCHECKED ←

NODE=M047R10;LINKAGE=F  
 NODE=M047R10;LINKAGE=D  
 NODE=M047R10;LINKAGE=E  
 NODE=M047R10;LINKAGE=C

 $[\Gamma(J/\psi K_S^0) + \Gamma((J/\psi, \eta_c) K_S^0)]/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ 

Forbidden by CP invariance.

| VALUE (units 10 <sup>-7</sup> ) | CL% | DOCUMENT ID             | TECN | COMMENT                                  |
|---------------------------------|-----|-------------------------|------|------------------------------------------|
| <b>&lt;4</b>                    | 90  | <sup>1</sup> TAJIMA 07A | BELL | $\Upsilon(4S) \rightarrow B^0 \bar{B}^0$ |

<sup>1</sup>  $\Upsilon(4S)$  with CP = +1 decays to the final state with CP = -1.

NODE=M047R16  
 NODE=M047R16  
 NODE=M047R16

NODE=M047R16;LINKAGE=TA

NODE=M047NBB

**non- $B\bar{B}$  DECAYS** $\Gamma(\text{non-}B\bar{B})/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT   |
|-----------------|-----|-------------|------|-----------|
| <b>&lt;0.04</b> | 95  | BARISH 96B  | CLEO | $e^+ e^-$ |

NODE=M047R6  
 NODE=M047R6

 $\Gamma(e^+ e^-)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

| VALUE (units 10 <sup>-5</sup> ) | DOCUMENT ID               | TECN | COMMENT                              |
|---------------------------------|---------------------------|------|--------------------------------------|
| <b>1.57 ± 0.08 OUR AVERAGE</b>  |                           |      |                                      |
| 1.55 ± 0.04 ± 0.07              | AUBERT 05Q                | BABR | $e^+ e^- \rightarrow \text{hadrons}$ |
| 2.77 ± 0.50 ± 0.49              | <sup>1</sup> ALBRECHT 95E | ARG  | $e^+ e^- \rightarrow \text{hadrons}$ |

<sup>1</sup> Using LEYAQUANC 77 parametrization of  $\Gamma(s)$ .

NODE=M047R5  
 NODE=M047R5

NODE=M047R5;LINKAGE=A

 $\Gamma(\rho^+ \rho^-)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                                  |
|----------------------------------|-----|-------------|------|------------------------------------------|
| <b>&lt;5.7 × 10<sup>-6</sup></b> | 90  | AUBERT 08B0 | BABR | $e^+ e^- \rightarrow \pi^+ \pi^- 2\pi^0$ |

NODE=M047R17  
 NODE=M047R17

 $\Gamma(K^*(892)^0 \bar{K}^0)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

| VALUE                            | CL% | DOCUMENT ID | TECN | COMMENT                                    |
|----------------------------------|-----|-------------|------|--------------------------------------------|
| <b>&lt;2.0 × 10<sup>-6</sup></b> | 90  | SHEN 13A    | BELL | $e^+ e^- \rightarrow K^*(892)^0 \bar{K}^0$ |

NODE=M047R02  
 NODE=M047R02

 $\Gamma(J/\psi(1S) \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{10}/\Gamma$ 

| VALUE (units 10 <sup>-4</sup> ) | CL% | DOCUMENT ID          | TECN | COMMENT                                                    |
|---------------------------------|-----|----------------------|------|------------------------------------------------------------|
| <b>&lt;1.9</b>                  | 95  | <sup>1</sup> ABE 02D | BELL | $e^+ e^- \rightarrow J/\psi X \rightarrow \ell^+ \ell^- X$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                         |      |                                                            |
|------|----|-------------------------|------|------------------------------------------------------------|
| <4.7 | 90 | <sup>1</sup> AUBERT 01c | BABR | $e^+ e^- \rightarrow J/\psi X \rightarrow \ell^+ \ell^- X$ |
|------|----|-------------------------|------|------------------------------------------------------------|

<sup>1</sup> Uses  $B(J/\psi \rightarrow e^+ e^-) = 0.0593 \pm 0.0010$  and  $B(J/\psi \rightarrow \mu^+ \mu^-) = 0.0588 \pm 0.0010$ .

NODE=M047R1  
 NODE=M047R1

NODE=M047R;LINKAGE=AC

 $\Gamma(D^{*+} \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$  $\Gamma_{11}/\Gamma$ 

| VALUE            | CL% | DOCUMENT ID                | TECN | COMMENT   |
|------------------|-----|----------------------------|------|-----------|
| <b>&lt;0.074</b> | 90  | <sup>1</sup> ALEXANDER 90C | CLEO | $e^+ e^-$ |

<sup>1</sup> For  $x > 0.473$ .

NODE=M047R2  
 NODE=M047R2

NODE=M047R2;LINKAGE=A

 $\Gamma(\phi \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{12}/\Gamma$ 

| VALUE (units 10 <sup>-2</sup> ) | CL% | DOCUMENT ID | TECN | COMMENT                           |
|---------------------------------|-----|-------------|------|-----------------------------------|
| <b>7.1 ± 0.1 ± 0.6</b>          |     | HUANG 07    | CLEO | $\Upsilon(4S) \rightarrow \phi X$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|       |    |                            |      |           |
|-------|----|----------------------------|------|-----------|
| <0.23 | 90 | <sup>1</sup> ALEXANDER 90C | CLEO | $e^+ e^-$ |
|-------|----|----------------------------|------|-----------|

<sup>1</sup> For  $x > 0.52$ .

NODE=M047R3  
 NODE=M047R3

NODE=M047R3;LINKAGE=A

 $\Gamma(\phi \eta)/\Gamma_{\text{total}}$  $\Gamma_{13}/\Gamma$ 

| VALUE (units 10 <sup>-6</sup> ) | CL% | DOCUMENT ID            | TECN | COMMENT                         |
|---------------------------------|-----|------------------------|------|---------------------------------|
| <b>&lt;1.8</b>                  | 90  | <sup>1</sup> BELOUS 09 | BELL | $e^+ e^- \rightarrow \phi \eta$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |                |      |                                 |
|------|----|----------------|------|---------------------------------|
| <2.5 | 90 | AUBERT, BE 06F | BABR | $e^+ e^- \rightarrow \phi \eta$ |
|------|----|----------------|------|---------------------------------|

<sup>1</sup> Using all intermediate branching fraction values from PDG 08.

NODE=M047R14  
 NODE=M047R14

NODE=M047R14;LINKAGE=BE

### $\Gamma(\phi\eta')/\Gamma_{\text{total}}$ $\Gamma_{14}/\Gamma$

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN    | COMMENT                        |
|--------------------------|-----|---------------------|---------|--------------------------------|
| <b>&lt;4.3</b>           | 90  | <sup>1</sup> BELOUS | 09 BELL | $e^+e^- \rightarrow \phi\eta'$ |

<sup>1</sup> Using all intermedite branching fraction values from PDG 08.

NODE=M047R21  
NODE=M047R21

NODE=M047R21;LINKAGE=BE

### $\Gamma(\rho\eta)/\Gamma_{\text{total}}$ $\Gamma_{15}/\Gamma$

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN    | COMMENT                       |
|--------------------------|-----|---------------------|---------|-------------------------------|
| <b>&lt;1.3</b>           | 90  | <sup>1</sup> BELOUS | 09 BELL | $e^+e^- \rightarrow \rho\eta$ |

<sup>1</sup> Using all intermedite branching fraction values from PDG 08.

NODE=M047R22  
NODE=M047R22

NODE=M047R22;LINKAGE=BE

### $\Gamma(\rho\eta')/\Gamma_{\text{total}}$ $\Gamma_{16}/\Gamma$

| VALUE (units $10^{-6}$ ) | CL% | DOCUMENT ID         | TECN    | COMMENT                        |
|--------------------------|-----|---------------------|---------|--------------------------------|
| <b>&lt;2.5</b>           | 90  | <sup>1</sup> BELOUS | 09 BELL | $e^+e^- \rightarrow \rho\eta'$ |

<sup>1</sup> Using all intermedite branching fraction values from PDG 08.

NODE=M047R23  
NODE=M047R23

NODE=M047R23;LINKAGE=BE

### $\Gamma(\Upsilon(1S) \text{ anything})/\Gamma_{\text{total}}$ $\Gamma_{17}/\Gamma$

| VALUE            | CL% | DOCUMENT ID | TECN     | COMMENT  |
|------------------|-----|-------------|----------|----------|
| <b>&lt;0.004</b> | 90  | ALEXANDER   | 90C CLEO | $e^+e^-$ |

NODE=M047R4  
NODE=M047R4

### $\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$ $\Gamma_{18}/\Gamma$

| VALUE (units $10^{-5}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

|                              |          |     |                      |           |                                                   |
|------------------------------|----------|-----|----------------------|-----------|---------------------------------------------------|
| <b>8.2 ± 0.4 OUR AVERAGE</b> |          |     |                      |           |                                                   |
| 8.2 ± 0.5 ± 0.4              |          | 515 | GUIDO                | 17 BELL   | $\Upsilon(4S) \rightarrow \pi^+\pi^-\mu^+\mu^-$   |
| 8.5 ± 1.3 ± 0.2              | 113 ± 16 |     | <sup>1</sup> SOKOLOV | 09 BELL   | $e^+e^- \rightarrow \pi^+\pi^-\mu^+\mu^-$         |
| 8.00 ± 0.64 ± 0.27           | 430      |     | <sup>2</sup> AUBERT  | 08BP BABR | $\Upsilon(4S) \rightarrow \pi^+\pi^-\ell^+\ell^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                  |          |  |                        |          |                                           |
|------------------|----------|--|------------------------|----------|-------------------------------------------|
| 17.8 ± 4.0 ± 0.3 |          |  | <sup>3,4</sup> SOKOLOV | 07 BELL  | $e^+e^- \rightarrow \pi^+\pi^-\mu^+\mu^-$ |
| 9.0 ± 1.5 ± 0.2  | 167 ± 19 |  | <sup>5</sup> AUBERT    | 06R BABR | $e^+e^- \rightarrow \pi^+\pi^-\mu^+\mu^-$ |
| <12              | 90       |  | GLENN                  | 99 CLE2  | $e^+e^-$                                  |

<sup>1</sup> SOKOLOV 09 reports  $[\Gamma(\Upsilon(4S) \rightarrow \Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(1S) \rightarrow \mu^+\mu^-)] = (0.211 \pm 0.030 \pm 0.014) \times 10^{-5}$  which we divide by our best value  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>2</sup> Using  $B(\Upsilon(1S) \rightarrow e^+e^-) = (2.38 \pm 0.11)\%$  and  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ .

<sup>3</sup> SOKOLOV 07 reports  $[\Gamma(\Upsilon(4S) \rightarrow \Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(1S) \rightarrow \mu^+\mu^-)] = (4.42 \pm 0.81 \pm 0.56) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

<sup>4</sup> According to the authors, systematic errors were underestimated.

<sup>5</sup> Superseded by AUBERT 08BP. AUBERT 06R reports  $[\Gamma(\Upsilon(4S) \rightarrow \Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(1S) \rightarrow \mu^+\mu^-)] = (2.23 \pm 0.25 \pm 0.27) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M047R7  
NODE=M047R7

NODE=M047R7;LINKAGE=SK

NODE=M047R7;LINKAGE=UB

NODE=M047R7;LINKAGE=SO

NODE=M047R7;LINKAGE=US  
NODE=M047R7;LINKAGE=AU

### $\Gamma(\Upsilon(1S)\eta)/\Gamma_{\text{total}}$ $\Gamma_{19}/\Gamma$

| VALUE (units $10^{-4}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

|                                |    |    |                     |           |                                                        |
|--------------------------------|----|----|---------------------|-----------|--------------------------------------------------------|
| <b>1.81 ± 0.18 OUR AVERAGE</b> |    |    |                     |           |                                                        |
| 1.70 ± 0.23 ± 0.08             |    | 49 | GUIDO               | 17 BELL   | $\Upsilon(4S) \rightarrow \pi^+\pi^-\pi^0\mu^+\mu^-$   |
| 1.96 ± 0.26 ± 0.09             | 56 |    | <sup>1</sup> AUBERT | 08BP BABR | $\Upsilon(4S) \rightarrow \pi^+\pi^-\pi^0\ell^+\ell^-$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |    |  |                      |         |                                                  |
|------|----|--|----------------------|---------|--------------------------------------------------|
| <2.7 | 90 |  | <sup>2</sup> TAMPONI | 15 BELL | $e^+e^- \rightarrow \gamma\eta + \text{hadrons}$ |
|------|----|--|----------------------|---------|--------------------------------------------------|

<sup>1</sup> Using  $B(\Upsilon(1S) \rightarrow e^+e^-) = (2.38 \pm 0.11)\%$  and  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ .

<sup>2</sup> Using  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20)\%$ .

NODE=M047R18  
NODE=M047R18

NODE=M047R18;LINKAGE=UB

NODE=M047R18;LINKAGE=A

### $\Gamma(\Upsilon(1S)\eta')/\Gamma_{\text{total}}$ $\Gamma_{20}/\Gamma$

| VALUE (units $10^{-5}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

|                           |  |    |       |         |                                                                     |
|---------------------------|--|----|-------|---------|---------------------------------------------------------------------|
| <b>3.43 ± 0.88 ± 0.21</b> |  | 27 | GUIDO | 18 BELL | $\Upsilon(4S) \rightarrow (\rho^0\gamma, \pi^+\pi^-\eta)\mu^+\mu^-$ |
|---------------------------|--|----|-------|---------|---------------------------------------------------------------------|

NODE=M047R03  
NODE=M047R03

$\Gamma(\Upsilon(1S)\eta)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$  $\Gamma_{19}/\Gamma_{18}$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |    |                     |           |                                                          |
|--------------------------|----|---------------------|-----------|----------------------------------------------------------|
| $2.41 \pm 0.40 \pm 0.12$ | 56 | <sup>1</sup> AUBERT | 08BP BABR | $\Upsilon(4S) \rightarrow \pi^+\pi^-(\pi^0)\ell^+\ell^-$ |
|--------------------------|----|---------------------|-----------|----------------------------------------------------------|

<sup>1</sup> Not independent of other values reported by AUBERT 08BP.NODE=M047R19  
NODE=M047R19

NODE=M047R19;LINKAGE=UB

 $\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|------|-------------|------|---------|
|--------------------------|-----|------|-------------|------|---------|

**8.2 $\pm$ 0.8 OUR AVERAGE**

|                       |  |     |       |         |                                                 |
|-----------------------|--|-----|-------|---------|-------------------------------------------------|
| $7.9 \pm 1.0 \pm 0.4$ |  | 181 | GUIDO | 17 BELL | $\Upsilon(4S) \rightarrow \pi^+\pi^-\mu^+\mu^-$ |
|-----------------------|--|-----|-------|---------|-------------------------------------------------|

|                       |  |     |                     |           |                                                   |
|-----------------------|--|-----|---------------------|-----------|---------------------------------------------------|
| $8.6 \pm 1.1 \pm 0.7$ |  | 220 | <sup>1</sup> AUBERT | 08BP BABR | $\Upsilon(4S) \rightarrow \pi^+\pi^-\ell^+\ell^-$ |
|-----------------------|--|-----|---------------------|-----------|---------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                       |  |             |                     |          |                                           |
|-----------------------|--|-------------|---------------------|----------|-------------------------------------------|
| $8.8 \pm 1.7 \pm 0.8$ |  | 97 $\pm$ 15 | <sup>2</sup> AUBERT | 06R BABR | $e^+e^- \rightarrow \pi^+\pi^-\mu^+\mu^-$ |
|-----------------------|--|-------------|---------------------|----------|-------------------------------------------|

 $<3.9$ 

90

GLENN

99

CLE2

 $e^+e^-$ <sup>1</sup> Using  $B(\Upsilon(2S) \rightarrow e^+e^-) = (1.91 \pm 0.16)\%$  and  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.93 \pm 0.17)\%$ .<sup>2</sup> Superseded by AUBERT 08BP. AUBERT 06R reports  $[\Gamma(\Upsilon(4S) \rightarrow \Upsilon(2S)\pi^+\pi^-)/\Gamma_{\text{total}}] \times [B(\Upsilon(2S) \rightarrow \mu^+\mu^-)] = (1.69 \pm 0.26 \pm 0.20) \times 10^{-6}$  which we divide by our best value  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.93 \pm 0.17) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.NODE=M047R9  
NODE=M047R9

NODE=M047R9;LINKAGE=UB

NODE=M047R9;LINKAGE=AU

 $\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma(\Upsilon(1S)\pi^+\pi^-)$  $\Gamma_{21}/\Gamma_{18}$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |     |                     |           |                                                   |
|--------------------------|-----|---------------------|-----------|---------------------------------------------------|
| $1.16 \pm 0.16 \pm 0.14$ | 220 | <sup>1</sup> AUBERT | 08BP BABR | $\Upsilon(4S) \rightarrow \pi^+\pi^-\ell^+\ell^-$ |
|--------------------------|-----|---------------------|-----------|---------------------------------------------------|

<sup>1</sup> Using  $B(\Upsilon(1S) \rightarrow e^+e^-) = (2.38 \pm 0.11)\%$ ,  $B(\Upsilon(1S) \rightarrow \mu^+\mu^-) = (2.48 \pm 0.05)\%$ ,  $B(\Upsilon(2S) \rightarrow e^+e^-) = (1.91 \pm 0.16)\%$ , and  $B(\Upsilon(2S) \rightarrow \mu^+\mu^-) = (1.93 \pm 0.17)\%$ . Not independent of other values reported by AUBERT 08BP.NODE=M047R20  
NODE=M047R20

NODE=M047R20;LINKAGE=UB

 $\Gamma(h_b(1P)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{22}/\Gamma$ 

| VALUE | EVTS | DOCUMENT ID | TECN | COMMENT |
|-------|------|-------------|------|---------|
|-------|------|-------------|------|---------|

not seen (35<sup>+32</sup><sub>-26</sub>)k <sup>1</sup> ADACHI 12 BELL 10.58  $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$ <sup>1</sup> From the upper limit on the ratio of  $\sigma(e^+e^- \rightarrow h_b(1P)\pi^+\pi^-)$  at the  $\Upsilon(4S)$  to that at the  $\Upsilon(5S)$  of 0.27.NODE=M047R01  
NODE=M047R01

NODE=M047R01;LINKAGE=AD

 $\Gamma(h_b(1P)\eta)/\Gamma_{\text{total}}$  $\Gamma_{23}/\Gamma$ 

| VALUE (units $10^{-3}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

**2.18 $\pm$ 0.11 $\pm$ 0.18** 112k <sup>1</sup> TAMPONI 15 BELL  $e^+e^- \rightarrow h_b(1P)\eta$ <sup>1</sup> Using  $B(\eta \rightarrow 2\gamma) = (39.41 \pm 0.20)\%$ .NODE=M047R00  
NODE=M047R00

NODE=M047R00;LINKAGE=A

 $\Gamma(h_b(1S)\omega)/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

 $<1.8 \times 10^{-4}$  90 OSKIN 20 BELL  $e^+e^- \rightarrow \omega X$ NODE=M047R04  
NODE=M047R04 $\Gamma(h_b(1S)\omega)/\Gamma(h_b(1P)\eta)$  $\Gamma_{24}/\Gamma_{23}$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

 $<8.4 \times 10^{-2}$  90 <sup>1</sup> OSKIN 20 BELL  $e^+e^- \rightarrow \omega X$ <sup>1</sup> Using  $B(\Upsilon(4S) \rightarrow h_b(1P)\eta) = (2.18 \pm 0.11 \pm 0.18) \times 10^{-3}$  from TAMPONI 15.NODE=M047R05  
NODE=M047R05

NODE=M047R05;LINKAGE=A

 $\Gamma(\overline{2H} \text{ anything})/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

| VALUE (units $10^{-5}$ ) | CL% | DOCUMENT ID | TECN | COMMENT |
|--------------------------|-----|-------------|------|---------|
|--------------------------|-----|-------------|------|---------|

 $<1.3$  90 ASNER 07 CLEO  $e^+e^- \rightarrow \overline{d}X$ NODE=M047R15  
NODE=M047R15

## Double Radiative Decays

NODE=M047240

 $\Gamma(\gamma\gamma\Upsilon(D) \rightarrow \gamma\gamma\eta\Upsilon(1S))/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ 

| VALUE | CL% | DOCUMENT ID | TECN | COMMENT |
|-------|-----|-------------|------|---------|
|-------|-----|-------------|------|---------|

 $<2.3 \times 10^{-5}$  90 GUIDO 17 BELL  $\Upsilon(4S) \rightarrow \gamma\gamma\pi^+\pi^-\pi^0\mu^+\mu^-$ NODE=M047R24  
NODE=M047R24

**$\Upsilon(4S)$  REFERENCES**

|           |      |                |                               |                 |
|-----------|------|----------------|-------------------------------|-----------------|
| OSKIN     | 20   | PR D102 092011 | P. Oskin <i>et al.</i>        | (BELLE Collab.) |
| GUIDO     | 18   | PRL 121 062001 | E. Guido <i>et al.</i>        | (BELLE Collab.) |
| GUIDO     | 17   | PR D96 052005  | E. Guido <i>et al.</i>        | (BELLE Collab.) |
| TAMPONI   | 15   | PRL 115 142001 | U. Tamponi <i>et al.</i>      | (BELLE Collab.) |
| SHEN      | 13A  | PR D88 052019  | C.P. Shen <i>et al.</i>       | (BELLE Collab.) |
| ADACHI    | 12   | PRL 108 032001 | I. Adachi <i>et al.</i>       | (BELLE Collab.) |
| BELOUS    | 09   | PL B681 400    | K. Belous <i>et al.</i>       | (BELLE Collab.) |
| SOKOLOV   | 09   | PR D79 051103  | A. Sokolov <i>et al.</i>      | (BELLE Collab.) |
| AUBERT    | 08BO | PR D78 071103  | B. Aubert <i>et al.</i>       | (BABAR Collab.) |
| AUBERT    | 08BP | PR D78 112002  | B. Aubert <i>et al.</i>       | (BABAR Collab.) |
| PDG       | 08   | PL B667 1      | C. Amsler <i>et al.</i>       | (PDG Collab.)   |
| ASNER     | 07   | PR D75 012009  | D.M. Asner <i>et al.</i>      | (CLEO Collab.)  |
| HUANG     | 07   | PR D75 012002  | G.S. Huang <i>et al.</i>      | (CLEO Collab.)  |
| SOKOLOV   | 07   | PR D75 071103  | A. Sokolov <i>et al.</i>      | (BELLE Collab.) |
| TAJIMA    | 07A  | PRL 99 211601  | O. Tajima <i>et al.</i>       | (BELLE Collab.) |
| AUBERT    | 06R  | PRL 96 232001  | B. Aubert <i>et al.</i>       | (BABAR Collab.) |
| AUBERT,BE | 06F  | PR D74 111103  | B. Aubert <i>et al.</i>       | (BABAR Collab.) |
| ARTUSO    | 05B  | PRL 95 261801  | M. Artuso <i>et al.</i>       | (CLEO Collab.)  |
| AUBERT    | 05Q  | PR D72 032005  | B. Aubert <i>et al.</i>       | (BABAR Collab.) |
| AUBERT,B  | 05H  | PRL 95 042001  | B. Aubert <i>et al.</i>       | (BABAR Collab.) |
| AUBERT    | 04F  | PR D69 071101  | B. Aubert <i>et al.</i>       |                 |
| HASTINGS  | 03   | PR D67 052004  | N.C. Hastings <i>et al.</i>   | (BELLE Collab.) |
| ABE       | 02D  | PRL 88 052001  | K. Abe <i>et al.</i>          | (BELLE Collab.) |
| ATHAR     | 02   | PR D66 052003  | S.B. Athar <i>et al.</i>      | (CLEO Collab.)  |
| AUBERT    | 02   | PR D65 032001  | B. Aubert <i>et al.</i>       | (BABAR Collab.) |
| ALEXANDER | 01   | PRL 86 2737    | J.P. Alexander <i>et al.</i>  | (CLEO Collab.)  |
| AUBERT    | 01C  | PRL 87 162002  | B. Aubert <i>et al.</i>       | (BABAR Collab.) |
| GLENN     | 99   | PR D59 052003  | S. Glenn <i>et al.</i>        |                 |
| BARISH    | 96B  | PRL 76 1570    | B.C. Barish <i>et al.</i>     | (CLEO Collab.)  |
| ALBRECHT  | 95E  | ZPHY C65 619   | H. Albrecht <i>et al.</i>     | (ARGUS Collab.) |
| BARISH    | 95   | PR D51 1014    | B.C. Barish <i>et al.</i>     | (CLEO Collab.)  |
| ALEXANDER | 90C  | PRL 64 2226    | J. Alexander <i>et al.</i>    | (CLEO Collab.)  |
| BEBEK     | 87   | PR D36 1289    | C. Bebek <i>et al.</i>        | (CLEO Collab.)  |
| BESSON    | 85   | PRL 54 381     | D. Besson <i>et al.</i>       | (CLEO Collab.)  |
| LOVELOCK  | 85   | PRL 54 377     | D.M.J. Lovelock <i>et al.</i> | (CUSB Collab.)  |
| LEYAOUANC | 77   | PL B71 397     | A. Le Yaouanc <i>et al.</i>   | (ORSAY)         |

NODE=M047

REFID=60735  
 REFID=58860  
 REFID=58218  
 REFID=56996  
 REFID=55591  
 REFID=53962  
 REFID=53107  
 REFID=52760  
 REFID=52659  
 REFID=52660  
 REFID=52166  
 REFID=51617  
 REFID=51624  
 REFID=51715  
 REFID=52066  
 REFID=51143  
 REFID=51563  
 REFID=50992  
 REFID=50774  
 REFID=50777  
 REFID=49748  
 REFID=49209  
 REFID=48557  
 REFID=48832  
 REFID=48514  
 REFID=48316  
 REFID=48346  
 REFID=46890  
 REFID=44693  
 REFID=44372  
 REFID=44139  
 REFID=41346  
 REFID=40270  
 REFID=22368  
 REFID=22369  
 REFID=44695

 **$Z_b(10610)$** 

$$I^G(J^{PC}) = 1^+(1^{+-})$$

was  $X(10610)$ 

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

NODE=M207

NODE=M207

Observed by BONDAR 12 in  $\Upsilon(5S)$  decays to  $\Upsilon(nS)\pi^+\pi^-$  ( $n = 1, 2, 3$ ) and  $h_b(mP)\pi^+\pi^-$  ( $m = 1, 2$ ).  $J^P = 1^+$  is favored from angular analyses.

 **$Z_b(10610)^\pm$  MASS**

NODE=M207M

| VALUE (MeV)                                                                   | DOCUMENT ID          | TECN | COMMENT                                          |
|-------------------------------------------------------------------------------|----------------------|------|--------------------------------------------------|
| <b><math>10607.2 \pm 2.0</math></b>                                           | <sup>1</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow \text{hadrons}$         |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                      |      |                                                  |
| $10608.5 \pm 3.4^{+3.7}_{-1.4}$                                               | <sup>2</sup> GARMASH | 15   | BELL $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |
| $10608.1 \pm 1.2^{+1.5}_{-0.2}$                                               | <sup>2</sup> GARMASH | 15   | BELL $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ |
| $10607.4 \pm 1.5^{+0.8}_{-0.2}$                                               | <sup>2</sup> GARMASH | 15   | BELL $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ |
| $10611 \pm 4 \pm 3$                                                           | <sup>3</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |
| $10609 \pm 2 \pm 3$                                                           | <sup>3</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ |
| $10608 \pm 2 \pm 3$                                                           | <sup>3</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ |
| $10605 \pm 2 \pm 3^{+3}_{-1}$                                                 | <sup>3</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$      |
| $10599 \pm 6 \pm 5^{+5}_{-4}$                                                 | <sup>3</sup> BONDAR  | 12   | BELL $e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$      |

NODE=M207M

<sup>1</sup> Average of the BONDAR 12 measurements in separate channels.

<sup>2</sup> Correlated with the corresponding result from BONDAR 12.

<sup>3</sup> Superseded by the average measurement of BONDAR 12.

NODE=M207M;LINKAGE=BO  
 NODE=M207M;LINKAGE=A  
 NODE=M207M;LINKAGE=BN

**$Z_b(10610)^0$  MASS**

| VALUE (MeV)                                                                                                                                                                                    | DOCUMENT ID              | TECN | COMMENT                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|------|----------------------------------------------------------|
| <b><math>10609 \pm 4 \pm 4</math></b>                                                                                                                                                          | <sup>1</sup> KROKOVNY 13 | BELL | $e^+e^- \rightarrow \Upsilon(2S)/\Upsilon(3S)\pi^0\pi^0$ |
| <sup>1</sup> From a simultaneous fit to the KROKOVNY 13 Dalitz analysis of $e^+e^- \rightarrow \Upsilon(2S)/\Upsilon(3S)\pi^0\pi^0$ decays with fixed width $\Gamma(Z_b(10610)^0) = 18.4$ MeV. |                          |      |                                                          |

NODE=M207M0

NODE=M207M0

NODE=M207M0;LINKAGE=A

 **$Z_b(10610)^\pm$  WIDTH**

| VALUE (MeV)                                                                   | DOCUMENT ID             | TECN | COMMENT                                     |
|-------------------------------------------------------------------------------|-------------------------|------|---------------------------------------------|
| <b><math>18.4 \pm 2.4</math></b>                                              | <sup>1</sup> BONDAR 12  | BELL | $e^+e^- \rightarrow \text{hadrons}$         |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                         |      |                                             |
| $18.5 \pm 5.3^{+6.1}_{-2.3}$                                                  | <sup>2</sup> GARMASH 15 | BELL | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |
| $20.8 \pm 2.5^{+0.3}_{-2.1}$                                                  | <sup>2</sup> GARMASH 15 | BELL | $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ |
| $18.7 \pm 3.4^{+2.5}_{-1.3}$                                                  | <sup>2</sup> GARMASH 15 | BELL | $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ |
| $22.3 \pm 7.7^{+3.0}_{-4.0}$                                                  | <sup>3</sup> BONDAR 12  | BELL | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |
| $24.2 \pm 3.1^{+2.0}_{-3.0}$                                                  | <sup>3</sup> BONDAR 12  | BELL | $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ |
| $17.6 \pm 3.0 \pm 3.0$                                                        | <sup>3</sup> BONDAR 12  | BELL | $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ |
| $11.4^{+4.5+2.1}_{-3.9-1.2}$                                                  | <sup>3</sup> BONDAR 12  | BELL | $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$      |
| $13^{+10}_{-8}{}^{+9}_{-7}$                                                   | <sup>3</sup> BONDAR 12  | BELL | $e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$      |

NODE=M207W

NODE=M207W

OCCUR=2

OCCUR=3

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=5

OCCUR=6

<sup>1</sup> Average of the BONDAR 12 measurements in separate channels.<sup>2</sup> Correlated with the corresponding result from BONDAR 12.<sup>3</sup> Superseded by the average measurement of BONDAR 12.

NODE=M207W;LINKAGE=BO

NODE=M207W;LINKAGE=A

NODE=M207W;LINKAGE=BN

 **$Z_b(10610)$  DECAY MODES**

| Mode                                                  | Fraction ( $\Gamma_i/\Gamma$ )       |
|-------------------------------------------------------|--------------------------------------|
| $\Gamma_1 \quad \Upsilon(1S)\pi^+$                    | $(5.4^{+1.9}_{-1.5}) \times 10^{-3}$ |
| $\Gamma_2 \quad \Upsilon(1S)\pi^0$                    | not seen                             |
| $\Gamma_3 \quad \Upsilon(2S)\pi^+$                    | $(3.6^{+1.1}_{-0.8}) \%$             |
| $\Gamma_4 \quad \Upsilon(2S)\pi^0$                    | seen                                 |
| $\Gamma_5 \quad \Upsilon(3S)\pi^+$                    | $(2.1^{+0.8}_{-0.6}) \%$             |
| $\Gamma_6 \quad \Upsilon(3S)\pi^0$                    | seen                                 |
| $\Gamma_7 \quad h_b(1P)\pi^+$                         | $(3.5^{+1.2}_{-0.9}) \%$             |
| $\Gamma_8 \quad h_b(2P)\pi^+$                         | $(4.7^{+1.7}_{-1.3}) \%$             |
| $\Gamma_9 \quad B^+\bar{B}^0$                         | not seen                             |
| $\Gamma_{10} \quad B^+\bar{B}^{*0} + B^{*+}\bar{B}^0$ | $(85.6^{+2.1}_{-2.9}) \%$            |

NODE=M207215;NODE=M207

DESIG=1

DESIG=9

DESIG=2

DESIG=10

DESIG=3

DESIG=11

DESIG=4

DESIG=5

DESIG=8

DESIG=6

 **$Z_b(10610)$  BRANCHING RATIOS**

| $\Gamma(\Upsilon(1S)\pi^+)/\Gamma_{\text{total}}$                             |                      |      |         | $\Gamma_1/\Gamma$                                                   |
|-------------------------------------------------------------------------------|----------------------|------|---------|---------------------------------------------------------------------|
| VALUE (units $10^{-3}$ )                                                      | DOCUMENT ID          | TECN | COMMENT |                                                                     |
| $5.4^{+1.6+1.1}_{-1.3-0.8}$                                                   | <sup>1</sup> GARMASH | 16   | BELL    | $e^+e^- \rightarrow \pi^- B^+ \bar{B}^{*0}, \pi^- \bar{B}^0 B^{*+}$ |
| ● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ● |                      |      |         |                                                                     |
| seen                                                                          | GARMASH              | 15   | BELL    | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$                         |
| seen                                                                          | BONDAR               | 12   | BELL    | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$                         |

NODE=M207225

NODE=M207R01

NODE=M207R01

<sup>1</sup> Assuming the  $Z_b(10610)$  decay width is saturated by the channels  $\pi^+\Upsilon(1S, 2S, 3S)$ ,  $\pi^+h_b(1P, 2P)$ , and  $B^+\bar{B}^{*0} + \bar{B}^0 B^{*+}$ , and using the results from BONDAR 12 and MIZUK 16.

NODE=M207R01;LINKAGE=A

| $\Gamma(\Upsilon(1S)\pi^0)/\Gamma_{\text{total}}$ | $\Gamma_2/\Gamma$ |      |                                             |
|---------------------------------------------------|-------------------|------|---------------------------------------------|
| VALUE                                             | DOCUMENT ID       | TECN | COMMENT                                     |
| not seen                                          | KROKOVNY 13       | BELL | $e^+e^- \rightarrow \Upsilon(1S)\pi^0\pi^0$ |

NODE=M207R09

NODE=M207R09

$\Gamma(\Upsilon(2S)\pi^+)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ VALUE (units  $10^{-2}$ )

DOCUMENT ID TECN COMMENT

 $3.62^{+0.76+0.79}_{-0.59-0.53}$ <sup>1</sup> GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^+ \bar{B}^{*0}, \pi^- \bar{B}^0 B^{*+}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

seen

GARMASH 15 BELL  $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ 

seen

BONDAR 12 BELL  $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ <sup>1</sup> Assuming the  $Z_b(10610)$  decay width is saturated by the channels  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^+ \bar{B}^{*0} + \bar{B}^0 B^{*+}$ , and using the results from BONDAR 12 and MIZUK 16.NODE=M207R02  
NODE=M207R02

NODE=M207R02;LINKAGE=A

 $\Gamma(\Upsilon(2S)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ 

VALUE

DOCUMENT ID TECN COMMENT

seen

<sup>1</sup> KROKOVNY 13 BELL  $e^+e^- \rightarrow \Upsilon(2S)\pi^0\pi^0$ <sup>1</sup> Combined significance in  $e^+e^- \rightarrow \Upsilon(2S)/\Upsilon(3S)\pi^0\pi^0$ , including systematics, of  $6.5\sigma$ .NODE=M207R10  
NODE=M207R10

NODE=M207R10;LINKAGE=A

 $\Gamma(\Upsilon(3S)\pi^+)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ VALUE (units  $10^{-2}$ )

DOCUMENT ID TECN COMMENT

 $2.15^{+0.55+0.60}_{-0.42-0.43}$ <sup>1</sup> GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^+ \bar{B}^{*0}, \pi^- \bar{B}^0 B^{*+}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

seen

GARMASH 15 BELL  $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ 

seen

BONDAR 12 BELL  $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ <sup>1</sup> Assuming the  $Z_b(10610)$  decay width is saturated by the channels  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^+ \bar{B}^{*0} + \bar{B}^0 B^{*+}$ , and using the results from BONDAR 12 and MIZUK 16.NODE=M207R03  
NODE=M207R03

NODE=M207R03;LINKAGE=A

 $\Gamma(\Upsilon(3S)\pi^0)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

VALUE

DOCUMENT ID TECN COMMENT

seen

<sup>1</sup> KROKOVNY 13 BELL  $e^+e^- \rightarrow \Upsilon(3S)\pi^0\pi^0$ <sup>1</sup> Combined significance in  $e^+e^- \rightarrow \Upsilon(2S)/\Upsilon(3S)\pi^0\pi^0$ , including systematics, of  $6.5\sigma$ .NODE=M207R11  
NODE=M207R11

NODE=M207R11;LINKAGE=A

 $\Gamma(h_b(1P)\pi^+)/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ VALUE (units  $10^{-2}$ )

DOCUMENT ID TECN COMMENT

 $3.45^{+0.87+0.86}_{-0.71-0.63}$ <sup>1</sup> GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^+ \bar{B}^{*0}, \pi^- \bar{B}^0 B^{*+}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

possibly seen

<sup>2</sup> MIZUK 16 BELL  $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$ 

seen

<sup>3</sup> BONDAR 12 BELL  $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$ <sup>1</sup> Assuming the  $Z_b(10610)$  decay width is saturated by the channels  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^+ \bar{B}^{*0} + \bar{B}^0 B^{*+}$ , and using the results from BONDAR 12 and MIZUK 16.<sup>2</sup> Using  $e^+e^-$  energies near the  $\Upsilon(11020)$ .<sup>3</sup> Using  $e^+e^-$  energies near the  $\Upsilon(10860)$ .NODE=M207R04  
NODE=M207R04

NODE=M207R04;LINKAGE=C

NODE=M207R04;LINKAGE=A  
NODE=M207R04;LINKAGE=B $\Gamma(h_b(2P)\pi^+)/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ VALUE (units  $10^{-2}$ )

DOCUMENT ID TECN COMMENT

 $4.67^{+1.24+1.18}_{-1.00-0.89}$ <sup>1</sup> GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^+ \bar{B}^{*0}, \pi^- \bar{B}^0 B^{*+}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

possibly seen

<sup>2</sup> MIZUK 16 BELL  $e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$ 

seen

<sup>3</sup> BONDAR 12 BELL  $e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$ <sup>1</sup> Assuming the  $Z_b(10610)$  decay width is saturated by the channels  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^+ \bar{B}^{*0} + \bar{B}^0 B^{*+}$ , and using the results from BONDAR 12 and MIZUK 16.<sup>2</sup> Using  $e^+e^-$  energies near the  $\Upsilon(11020)$ .<sup>3</sup> Using  $e^+e^-$  energies near the  $\Upsilon(10860)$ .NODE=M207R05  
NODE=M207R05

NODE=M207R05;LINKAGE=C

NODE=M207R05;LINKAGE=A  
NODE=M207R05;LINKAGE=B $\Gamma(B^+ \bar{B}^0)/\Gamma_{\text{total}}$  $\Gamma_9/\Gamma$ 

VALUE

DOCUMENT ID TECN COMMENT

not seen

GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^+ \bar{B}^0$ NODE=M207R08  
NODE=M207R08



$$[\Gamma(B^+ \bar{B}^{*0}) + \Gamma(B^{*+} \bar{B}^0)] / \Gamma_{\text{total}} \quad \Gamma_{10} / \Gamma$$

| VALUE (units $10^{-2}$ )     | EVTS | DOCUMENT ID          | TECN | COMMENT                                                                   |
|------------------------------|------|----------------------|------|---------------------------------------------------------------------------|
| $85.6^{+1.5+1.5}_{-2.0-2.1}$ | 357  | <sup>1</sup> GARMASH | 16   | BELL $e^+ e^- \rightarrow \pi^- B^+ \bar{B}^{*0}, \pi^- B^{*+} \bar{B}^0$ |

<sup>1</sup> Assuming the  $Z_b(10610)$  decay width is saturated by the channels  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^+ \bar{B}^{*0} + B^{*+} \bar{B}^0$ , and using the results from BONDAR 12 and MIZUK 16. Using the mass and width of the  $Z_b(10610)$  from BONDAR 12.

NODE=M207R00  
NODE=M207R00

NODE=M207R00;LINKAGE=A

$$[\Gamma(B^+ \bar{B}^{*0}) + \Gamma(B^{*+} \bar{B}^0)] / [\Gamma(\Upsilon(1S)\pi^+) + \Gamma(\Upsilon(2S)\pi^+) + \Gamma(\Upsilon(3S)\pi^+) + \Gamma(h_b(1P)\pi^+) + \Gamma(h_b(2P)\pi^+)] \quad \Gamma_{10} / (\Gamma_1 + \Gamma_3 + \Gamma_5 + \Gamma_7 + \Gamma_8)$$

| VALUE (units $10^{-2}$ ) | EVTS | DOCUMENT ID | TECN | COMMENT |
|--------------------------|------|-------------|------|---------|
|--------------------------|------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                  |     |                      |    |                                                                           |
|----------------------------------|-----|----------------------|----|---------------------------------------------------------------------------|
| $5.93^{+0.99+1.01}_{-0.69-0.73}$ | 357 | <sup>1</sup> GARMASH | 16 | BELL $e^+ e^- \rightarrow \pi^- B^+ \bar{B}^{*0}, \pi^- \bar{B}^0 B^{*+}$ |
|----------------------------------|-----|----------------------|----|---------------------------------------------------------------------------|

<sup>1</sup> Combined with the results of BONDAR 12 and MIZUK 16. Not independent from  $Z_b(10610)$  branching fractions to  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^+ \bar{B}^{*0} + \bar{B}^0 B^{*+}$ .

NODE=M207R07  
NODE=M207R07

NODE=M207R07;LINKAGE=A

### $Z_b(10610)$ REFERENCES

|          |    |                |                           |                 |
|----------|----|----------------|---------------------------|-----------------|
| GARMASH  | 16 | PRL 116 212001 | A. Garmash <i>et al.</i>  | (BELLE Collab.) |
| MIZUK    | 16 | PRL 117 142001 | R. Mizuk <i>et al.</i>    | (BELLE Collab.) |
| GARMASH  | 15 | PR D91 072003  | A. Garmash <i>et al.</i>  | (BELLE Collab.) |
| KROKOVNY | 13 | PR D88 052016  | P. Krokovny <i>et al.</i> | (BELLE Collab.) |
| BONDAR   | 12 | PRL 108 122001 | A. Bondar <i>et al.</i>   | (BELLE Collab.) |

NODE=M207

REFID=57446  
REFID=57465  
REFID=56811  
REFID=55588  
REFID=53963

**$Z_b(10650)$**

$$J^G(J^{PC}) = 1^+(1^+ -)$$

$I, G, C$  need confirmation.

was  $X(10650)^\pm$

Properties incompatible with a  $q\bar{q}$  structure (exotic state). See the review on non- $q\bar{q}$  states.

NODE=M208

NODE=M208

Observed by BONDAR 12 in  $\Upsilon(5S)$  decays to  $\Upsilon(nS)\pi^+\pi^-$  ( $n = 1, 2, 3$ ) and  $h_b(mP)\pi^+\pi^-$  ( $m = 1, 2$ ).  $J^P = 1^+$  is favored from angular analyses.

### $Z_b(10650)$ MASS

| VALUE (MeV)                         | DOCUMENT ID         | TECN | COMMENT                                   |
|-------------------------------------|---------------------|------|-------------------------------------------|
| <b><math>10652.2 \pm 1.5</math></b> | <sup>1</sup> BONDAR | 12   | BELL $e^+ e^- \rightarrow \text{hadrons}$ |

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                                 |                      |    |                                                   |
|---------------------------------|----------------------|----|---------------------------------------------------|
| $10656.7 \pm 5.0^{+1.1}_{-3.1}$ | <sup>2</sup> GARMASH | 15 | BELL $e^+ e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |
| $10650.7 \pm 1.5^{+0.5}_{-0.2}$ | <sup>2</sup> GARMASH | 15 | BELL $e^+ e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ |
| $10651.2 \pm 1.0^{+0.4}_{-0.3}$ | <sup>2</sup> GARMASH | 15 | BELL $e^+ e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ |
| $10657 \pm 6 \pm 3$             | <sup>3</sup> BONDAR  | 12 | BELL $e^+ e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |
| $10651 \pm 2 \pm 3$             | <sup>3</sup> BONDAR  | 12 | BELL $e^+ e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ |
| $10652 \pm 1 \pm 2$             | <sup>3</sup> BONDAR  | 12 | BELL $e^+ e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ |
| $10654 \pm 3^{+1}_{-2}$         | <sup>3</sup> BONDAR  | 12 | BELL $e^+ e^- \rightarrow h_b(1P)\pi^+\pi^-$      |
| $10651^{+2}_{-3}^{+3}_{-2}$     | <sup>3</sup> BONDAR  | 12 | BELL $e^+ e^- \rightarrow h_b(2P)\pi^+\pi^-$      |

<sup>1</sup> Average of the BONDAR 12 measurements in separate channels.

<sup>2</sup> Correlated with the corresponding result from BONDAR 12.

<sup>3</sup> Superseded by the average measurement of BONDAR 12.

NODE=M208M

NODE=M208M

OCCUR=2

OCCUR=3

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=5

OCCUR=6

NODE=M208M;LINKAGE=BO  
NODE=M208M;LINKAGE=A  
NODE=M208M;LINKAGE=BN

### $Z_b(10650)$ WIDTH

| VALUE (MeV)                      | DOCUMENT ID         | TECN | COMMENT                                   |
|----------------------------------|---------------------|------|-------------------------------------------|
| <b><math>11.5 \pm 2.2</math></b> | <sup>4</sup> BONDAR | 12   | BELL $e^+ e^- \rightarrow \text{hadrons}$ |

NODE=M208W

NODE=M208W

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                               |                      |    |      |                                             |         |
|-------------------------------|----------------------|----|------|---------------------------------------------|---------|
| $12.1^{+11.3+2.7}_{-4.8-0.6}$ | <sup>5</sup> GARMASH | 15 | BELL | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |         |
| $14.2 \pm 3.7^{+0.9}_{-0.4}$  | <sup>5</sup> GARMASH | 15 | BELL | $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ | OCCUR=2 |
| $9.3 \pm 2.2^{+0.3}_{-0.5}$   | <sup>5</sup> GARMASH | 15 | BELL | $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ | OCCUR=3 |
| $16.3 \pm 9.8^{+6.0}_{-2.0}$  | <sup>6</sup> BONDAR  | 12 | BELL | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ | OCCUR=2 |
| $13.3 \pm 3.3^{+4.0}_{-3.0}$  | <sup>6</sup> BONDAR  | 12 | BELL | $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ | OCCUR=3 |
| $8.4 \pm 2.0 \pm 2.0$         | <sup>6</sup> BONDAR  | 12 | BELL | $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ | OCCUR=4 |
| $20.9^{+5.4+2.1}_{-4.7-5.7}$  | <sup>6</sup> BONDAR  | 12 | BELL | $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$      | OCCUR=5 |
| $19 \pm 7^{+11}_{-7}$         | <sup>6</sup> BONDAR  | 12 | BELL | $e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$      | OCCUR=6 |

<sup>4</sup> Average of the BONDAR 12 measurements in separate channels.

<sup>5</sup> Correlated with the corresponding result from BONDAR 12.

<sup>6</sup> Superseded by the average measurement of BONDAR 12.

NODE=M208W;LINKAGE=BO  
NODE=M208W;LINKAGE=A  
NODE=M208W;LINKAGE=BN

## $Z_b(10650)^+$ DECAY MODES

$Z_b(10650)^-$  decay modes are charge conjugates of the modes below.

NODE=M208215;NODE=M208

NODE=M208

| Mode                                               | Fraction ( $\Gamma_i/\Gamma$ )       |         |
|----------------------------------------------------|--------------------------------------|---------|
| $\Gamma_1 \quad \Upsilon(1S)\pi^+$                 | $(1.7^{+0.8}_{-0.6}) \times 10^{-3}$ | DESIG=1 |
| $\Gamma_2 \quad \Upsilon(2S)\pi^+$                 | $(1.4^{+0.6}_{-0.4}) \%$             | DESIG=2 |
| $\Gamma_3 \quad \Upsilon(3S)\pi^+$                 | $(1.6^{+0.7}_{-0.5}) \%$             | DESIG=3 |
| $\Gamma_4 \quad h_b(1P)\pi^+$                      | $(8.4^{+2.9}_{-2.4}) \%$             | DESIG=4 |
| $\Gamma_5 \quad h_b(2P)\pi^+$                      | $(15 \pm 4) \%$                      | DESIG=5 |
| $\Gamma_6 \quad B^+\bar{B}^0$                      | not seen                             | DESIG=8 |
| $\Gamma_7 \quad B^+\bar{B}^{*0} + B^{*+}\bar{B}^0$ | not seen                             | DESIG=6 |
| $\Gamma_8 \quad B^{*+}\bar{B}^{*0}$                | $(74^{+4}_{-6}) \%$                  | DESIG=7 |

## $Z_b(10650)$ BRANCHING RATIOS

NODE=M208225

| $\Gamma(\Upsilon(1S)\pi^+)/\Gamma_{\text{total}}$ |                      |      |                                                    | $\Gamma_1/\Gamma$ |
|---------------------------------------------------|----------------------|------|----------------------------------------------------|-------------------|
| VALUE (units $10^{-3}$ )                          | DOCUMENT ID          | TECN | COMMENT                                            |                   |
| $1.7^{+0.7+0.3}_{-0.6-0.2}$                       | <sup>7</sup> GARMASH | 16   | BELL $e^+e^- \rightarrow \pi^- B^{*+}\bar{B}^{*0}$ |                   |

NODE=M208R01  
NODE=M208R01

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |         |    |      |                                             |  |
|------|---------|----|------|---------------------------------------------|--|
| seen | GARMASH | 15 | BELL | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |  |
| seen | BONDAR  | 12 | BELL | $e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ |  |

<sup>7</sup> Assuming the  $Z_b(10650)$  decay width is saturated by the channels  $\pi^+\Upsilon(1S, 2S, 3S)$ ,  $\pi^+h_b(1P, 2P)$ , and  $B^{*+}\bar{B}^{*0}$ , and using the results from BONDAR 12 and MIZUK 16.

NODE=M208R01;LINKAGE=A

| $\Gamma(\Upsilon(2S)\pi^+)/\Gamma_{\text{total}}$ |                      |      |                                               | $\Gamma_2/\Gamma$ |
|---------------------------------------------------|----------------------|------|-----------------------------------------------|-------------------|
| VALUE (units $10^{-2}$ )                          | DOCUMENT ID          | TECN | COMMENT                                       |                   |
| $1.39^{+0.48+0.34}_{-0.38-0.23}$                  | <sup>8</sup> GARMASH | 16   | $e^+e^- \rightarrow \pi^- B^{*+}\bar{B}^{*0}$ |                   |

NODE=M208R02  
NODE=M208R02

• • • We do not use the following data for averages, fits, limits, etc. • • •

|      |         |    |      |                                             |  |
|------|---------|----|------|---------------------------------------------|--|
| seen | GARMASH | 15 | BELL | $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ |  |
| seen | BONDAR  | 12 | BELL | $e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ |  |

<sup>8</sup> Assuming the  $Z_b(10650)$  decay width is saturated by the channels  $\pi^+\Upsilon(1S, 2S, 3S)$ ,  $\pi^+h_b(1P, 2P)$ , and  $B^{*+}\bar{B}^{*0}$ , and using the results from BONDAR 12 and MIZUK 16.

NODE=M208R02;LINKAGE=A

$\Gamma(\Upsilon(3S)\pi^+)/\Gamma_{\text{total}}$  $\Gamma_3/\Gamma$ VALUE (units  $10^{-2}$ )

DOCUMENT ID

TECN

COMMENT

 $1.63^{+0.53+0.39}_{-0.42-0.28}$ <sup>9</sup> GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^{*+} \bar{B}^{*0}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

seen

GARMASH 15 BELL  $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ 

seen

BONDAR 12 BELL  $e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ <sup>9</sup> Assuming the  $Z_b(10650)$  decay width is saturated by the channels  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^{*+} \bar{B}^{*0}$ , and using the results from BONDAR 12 and MIZUK 16.NODE=M208R03  
NODE=M208R03

NODE=M208R03;LINKAGE=A

 $\Gamma(h_b(1P)\pi^+)/\Gamma_{\text{total}}$  $\Gamma_4/\Gamma$ VALUE (units  $10^{-2}$ )

DOCUMENT ID

TECN

COMMENT

 $8.41^{+2.43+1.49}_{-2.12-1.06}$ <sup>10</sup> GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^{*+} \bar{B}^{*0}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

seen

<sup>11</sup> MIZUK 16 BELL  $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$ 

seen

<sup>12</sup> BONDAR 12 BELL  $e^+e^- \rightarrow h_b(1P)\pi^+\pi^-$ <sup>10</sup> Assuming the  $Z_b(10650)$  decay width is saturated by the channels  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^{*+} \bar{B}^{*0}$ , and using the results from BONDAR 12 and MIZUK 16.<sup>11</sup> Using  $e^+e^-$  energies near the  $\Upsilon(11020)$ .<sup>12</sup> Using  $e^+e^-$  energies near the  $\Upsilon(10860)$ .NODE=M208R04  
NODE=M208R04

NODE=M208R04;LINKAGE=C

NODE=M208R04;LINKAGE=A  
NODE=M208R04;LINKAGE=B $\Gamma(h_b(2P)\pi^+)/\Gamma_{\text{total}}$  $\Gamma_5/\Gamma$ VALUE (units  $10^{-2}$ )

DOCUMENT ID

TECN

COMMENT

 $14.7^{+3.2+2.8}_{-2.8-2.3}$ <sup>13</sup> GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^{*+} \bar{B}^{*0}$ 

• • • We do not use the following data for averages, fits, limits, etc. • • •

possibly seen

<sup>14</sup> MIZUK 16 BELL  $e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$ 

seen

<sup>15</sup> BONDAR 12 BELL  $e^+e^- \rightarrow h_b(2P)\pi^+\pi^-$ <sup>13</sup> Assuming the  $Z_b(10650)$  decay width is saturated by the channels  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^{*+} \bar{B}^{*0}$ , and using the results from BONDAR 12 and MIZUK 16.<sup>14</sup> Using  $e^+e^-$  energies near the  $\Upsilon(11020)$ .<sup>15</sup> Using  $e^+e^-$  energies near the  $\Upsilon(10860)$ .NODE=M208R05  
NODE=M208R05

NODE=M208R05;LINKAGE=C

NODE=M208R05;LINKAGE=A  
NODE=M208R05;LINKAGE=B $\Gamma(B^+ \bar{B}^0)/\Gamma_{\text{total}}$  $\Gamma_6/\Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

not seen

GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^+ \bar{B}^0$ NODE=M208R08  
NODE=M208R08 $[\Gamma(B^+ \bar{B}^{*0}) + \Gamma(B^{*+} \bar{B}^0)]/\Gamma_{\text{total}}$  $\Gamma_7/\Gamma$ 

VALUE

DOCUMENT ID

TECN

COMMENT

not seen

GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^+ \bar{B}^{*0}, \pi^- \bar{B}^0 B^{*+}$ NODE=M208R00  
NODE=M208R00 $\Gamma(B^{*+} \bar{B}^{*0})/\Gamma_{\text{total}}$  $\Gamma_8/\Gamma$ VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $73.7^{+3.4+2.7}_{-4.4-3.5}$ 161 <sup>16</sup> GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^{*+} \bar{B}^{*0}$ <sup>16</sup> Assuming the  $Z_b(10650)$  decay width is saturated by the channels  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^{*+} \bar{B}^{*0}$ , and using the results from BONDAR 12 and MIZUK 16. Using the mass and width of the  $Z_b(10650)$  from BONDAR 12.NODE=M208R06  
NODE=M208R06

NODE=M208R06;LINKAGE=A

 $\Gamma(B^{*+} \bar{B}^{*0})/[\Gamma(\Upsilon(1S)\pi^+) + \Gamma(\Upsilon(2S)\pi^+) + \Gamma(\Upsilon(3S)\pi^+) +$  $\Gamma(h_b(1P)\pi^+) + \Gamma(h_b(2P)\pi^+)]$  $\Gamma_8/(\Gamma_1+\Gamma_2+\Gamma_3+\Gamma_4+\Gamma_5)$ VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 $2.80^{+0.69+0.54}_{-0.40-0.36}$ 161 <sup>17</sup> GARMASH 16 BELL  $e^+e^- \rightarrow \pi^- B^{*+} \bar{B}^{*0}$ <sup>17</sup> Combined with the results of BONDAR 12 and MIZUK 16. Not independent from  $Z_b(10650)$  branching fractions to  $\pi^+ \Upsilon(1S, 2S, 3S)$ ,  $\pi^+ h_b(1P, 2P)$ , and  $B^{*+} \bar{B}^{*0}$ .NODE=M208R07  
NODE=M208R07

NODE=M208R07;LINKAGE=A

 **$Z_b(10650)$  REFERENCES**

NODE=M208

|         |    |                |                          |                 |
|---------|----|----------------|--------------------------|-----------------|
| GARMASH | 16 | PRL 116 212001 | A. Garmash <i>et al.</i> | (BELLE Collab.) |
| MIZUK   | 16 | PRL 117 142001 | R. Mizuk <i>et al.</i>   | (BELLE Collab.) |
| GARMASH | 15 | PR D91 072003  | A. Garmash <i>et al.</i> | (BELLE Collab.) |
| BONDAR  | 12 | PRL 108 122001 | A. Bondar <i>et al.</i>  | (BELLE Collab.) |

REFID=57446  
REFID=57465  
REFID=56811  
REFID=53963

**$\Upsilon(10753)$** 

$$J^{PC} = ?(1^{--})$$

## OMITTED FROM SUMMARY TABLE

A candidate for  $\Upsilon(3D)$  state or an exotic structure.Seen by MIZUK 19 in  $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$  ( $n=1,2,3$ ) with a significance of  $5.2\sigma$ .

NODE=M243

NODE=M243

 **$\Upsilon(10753)$  MASS**

NODE=M243M

| VALUE (MeV)                                       | DOCUMENT ID        | TECN | COMMENT                                          |
|---------------------------------------------------|--------------------|------|--------------------------------------------------|
| <b><math>10752.7 \pm 5.9^{+0.7}_{-1.1}</math></b> | <sup>1</sup> MIZUK | 19   | BELL $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$ |

NODE=M243M

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |                   |     |                               |
|---------------|-------------------|-----|-------------------------------|
| 10761 $\pm 2$ | <sup>2</sup> DONG | 20A | $e^+e^- \rightarrow b\bar{b}$ |
|---------------|-------------------|-----|-------------------------------|

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.63\text{--}11.02$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

NODE=M243M;LINKAGE=A

<sup>2</sup> From a fit to the dressed cross sections of AUBERT 09E by BaBar and SANTEL 16 by Belle above 10.68 GeV with a coherent sum of a continuum amplitude and three Breit-Wigner functions with constant widths.

NODE=M243M;LINKAGE=B

 **$\Upsilon(10753)$  WIDTH**

NODE=M243W

| VALUE (MeV)                                      | DOCUMENT ID        | TECN | COMMENT                                          |
|--------------------------------------------------|--------------------|------|--------------------------------------------------|
| <b><math>35.5^{+17.6+3.9}_{-11.3-3.3}</math></b> | <sup>1</sup> MIZUK | 19   | BELL $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$ |

NODE=M243W

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                |                   |     |                               |
|----------------|-------------------|-----|-------------------------------|
| 48.5 $\pm 3.0$ | <sup>2</sup> DONG | 20A | $e^+e^- \rightarrow b\bar{b}$ |
|----------------|-------------------|-----|-------------------------------|

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.63\text{--}11.02$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

NODE=M243W;LINKAGE=A

<sup>2</sup> From a fit to the dressed cross sections of AUBERT 09E by BaBar and SANTEL 16 by Belle above 10.68 GeV with a coherent sum of a continuum amplitude and three Breit-Wigner functions with constant widths.

NODE=M243W;LINKAGE=B

 **$\Upsilon(10753)$  DECAY MODES**

NODE=M243215;NODE=M243

| Mode       |                          |
|------------|--------------------------|
| $\Gamma_1$ | $\Upsilon(1S)\pi^+\pi^-$ |
| $\Gamma_2$ | $\Upsilon(2S)\pi^+\pi^-$ |
| $\Gamma_3$ | $\Upsilon(3S)\pi^+\pi^-$ |
| $\Gamma_4$ | $e^+e^-$                 |

DESIG=3

DESIG=4

DESIG=5

DESIG=2

 **$\Upsilon(10753) \Gamma(i)\Gamma(e^+e^-)/\Gamma(\text{total})$** 

NODE=M243225

| $\Gamma(\Upsilon(1S)\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |             |      |         | $\Gamma_1\Gamma_4/\Gamma$ |
|------------------------------------------------------------------------------|-------------|------|---------|---------------------------|
| VALUE (eV)                                                                   | DOCUMENT ID | TECN | COMMENT |                           |

NODE=M243R00

NODE=M243R00

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |                      |    |                                                  |
|-------------------|----------------------|----|--------------------------------------------------|
| 0.295 $\pm 0.175$ | <sup>1,2</sup> MIZUK | 19 | BELL $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$ |
|-------------------|----------------------|----|--------------------------------------------------|

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.63\text{--}11.02$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

NODE=M243R00;LINKAGE=A

<sup>2</sup> Reported as the range 0.12–0.47 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions.

NODE=M243R00;LINKAGE=B

| $\Gamma(\Upsilon(2S)\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ |             |      |         | $\Gamma_2\Gamma_4/\Gamma$ |
|------------------------------------------------------------------------------|-------------|------|---------|---------------------------|
| VALUE (eV)                                                                   | DOCUMENT ID | TECN | COMMENT |                           |

NODE=M243R02

NODE=M243R02

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                   |                      |    |                                                  |
|-------------------|----------------------|----|--------------------------------------------------|
| 0.875 $\pm 0.345$ | <sup>1,2</sup> MIZUK | 19 | BELL $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$ |
|-------------------|----------------------|----|--------------------------------------------------|

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.63\text{--}11.02$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

NODE=M243R02;LINKAGE=A

<sup>2</sup> Reported as the range 0.53–1.22 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions.

NODE=M243R02;LINKAGE=B

$\Gamma(\Upsilon(3S)\pi^+\pi^-) \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$ 
 $\Gamma_3\Gamma_4/\Gamma$ 

| VALUE (eV) | DOCUMENT ID | TECN | COMMENT |
|------------|-------------|------|---------|
|------------|-------------|------|---------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|               |           |    |                                                  |
|---------------|-----------|----|--------------------------------------------------|
| 0.235 ± 0.025 | 1,2 MIZUK | 19 | BELL $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$ |
|---------------|-----------|----|--------------------------------------------------|

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.63\text{--}11.02$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

<sup>2</sup> Reported as the range 0.21–0.26 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions.

NODE=M243R03  
NODE=M243R03

NODE=M243R03;LINKAGE=A

NODE=M243R03;LINKAGE=B

### $\Upsilon(10753)$ REFERENCES

|        |     |                |                          |                 |
|--------|-----|----------------|--------------------------|-----------------|
| DONG   | 20A | CP C44 083001  | X.-K. Dong <i>et al.</i> |                 |
| MIZUK  | 19  | JHEP 1910 220  | R. Mizuk <i>et al.</i>   | (BELLE Collab.) |
| SANTEL | 16  | PR D93 011101  | D. Santel <i>et al.</i>  | (BELLE Collab.) |
| AUBERT | 09E | PRL 102 012001 | B. Aubert <i>et al.</i>  | (BABAR Collab.) |

NODE=M243

REFID=60595  
REFID=60090  
REFID=57121  
REFID=52661

NODE=M092

 $\Upsilon(10860)$ 
 $I^G(J^{PC}) = 0^-(1^--)$ 

### $\Upsilon(10860)$ MASS

NODE=M092M

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|-------------|-------------|------|---------|
|-------------|-------------|------|---------|

**10885.2<sup>+2.6</sup><sub>-1.6</sub> OUR AVERAGE**

|                                               |                    |    |                                                  |
|-----------------------------------------------|--------------------|----|--------------------------------------------------|
| 10885.3 ± 1.5 <sup>+2.2</sup> <sub>-0.9</sub> | <sup>1</sup> MIZUK | 19 | BELL $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$ |
|-----------------------------------------------|--------------------|----|--------------------------------------------------|

|                                                               |                    |    |                                                 |
|---------------------------------------------------------------|--------------------|----|-------------------------------------------------|
| 10884.7 <sup>+3.6</sup> <sub>-3.4</sub> ± 8.9 <sub>-1.0</sub> | <sup>2</sup> MIZUK | 16 | BELL $e^+e^- \rightarrow h_b(1P, 2P)\pi^+\pi^-$ |
|---------------------------------------------------------------|--------------------|----|-------------------------------------------------|

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |                   |     |                               |
|-----------|-------------------|-----|-------------------------------|
| 10882 ± 1 | <sup>3</sup> DONG | 20A | $e^+e^- \rightarrow b\bar{b}$ |
|-----------|-------------------|-----|-------------------------------|

|                                               |                       |    |                                          |
|-----------------------------------------------|-----------------------|----|------------------------------------------|
| 10881.8 <sup>+1.0</sup> <sub>-1.1</sub> ± 1.2 | <sup>4,5</sup> SANTEL | 16 | BELL $e^+e^- \rightarrow \text{hadrons}$ |
|-----------------------------------------------|-----------------------|----|------------------------------------------|

|                                               |                       |    |                                                          |
|-----------------------------------------------|-----------------------|----|----------------------------------------------------------|
| 10891.1 ± 3.2 <sup>+1.2</sup> <sub>-2.0</sub> | <sup>6,7</sup> SANTEL | 16 | BELL $e^+e^- \rightarrow \Upsilon(1S, 2S, 3S)\pi^+\pi^-$ |
|-----------------------------------------------|-----------------------|----|----------------------------------------------------------|

|           |                     |    |                                          |
|-----------|---------------------|----|------------------------------------------|
| 10879 ± 3 | <sup>8,9</sup> CHEN | 10 | BELL $e^+e^- \rightarrow \text{hadrons}$ |
|-----------|---------------------|----|------------------------------------------|

|                                               |                    |    |                                                          |
|-----------------------------------------------|--------------------|----|----------------------------------------------------------|
| 10888.4 <sup>+2.7</sup> <sub>-2.6</sub> ± 1.2 | <sup>10</sup> CHEN | 10 | BELL $e^+e^- \rightarrow \Upsilon(1S, 2S, 3S)\pi^+\pi^-$ |
|-----------------------------------------------|--------------------|----|----------------------------------------------------------|

|           |                     |     |                                          |
|-----------|---------------------|-----|------------------------------------------|
| 10876 ± 2 | <sup>8</sup> AUBERT | 09E | BABR $e^+e^- \rightarrow \text{hadrons}$ |
|-----------|---------------------|-----|------------------------------------------|

|           |                      |     |                                          |
|-----------|----------------------|-----|------------------------------------------|
| 10869 ± 2 | <sup>11</sup> AUBERT | 09E | BABR $e^+e^- \rightarrow \text{hadrons}$ |
|-----------|----------------------|-----|------------------------------------------|

|               |                      |    |                                          |
|---------------|----------------------|----|------------------------------------------|
| 10868 ± 6 ± 5 | <sup>12</sup> BESSON | 85 | CLEO $e^+e^- \rightarrow \text{hadrons}$ |
|---------------|----------------------|----|------------------------------------------|

|            |                        |    |                                          |
|------------|------------------------|----|------------------------------------------|
| 10845 ± 20 | <sup>13</sup> LOVELOCK | 85 | CUSB $e^+e^- \rightarrow \text{hadrons}$ |
|------------|------------------------|----|------------------------------------------|

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

<sup>2</sup> From a simultaneous fit to the  $h_b(nP)\pi^+\pi^-$ ,  $n = 1, 2$  cross sections at 22 energy points within  $\sqrt{s} = 10.77\text{--}11.02$  GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with eight resonance parameters (a mass and width for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , a single relative phase, a single relative amplitude, and two overall normalization factors, one for each  $n$ ). The systematic error estimate is dominated by possible interference with a small nonresonant continuum amplitude.

<sup>3</sup> From a fit to the dressed cross sections of AUBERT 09E by BaBar and SANTEL 16 by Belle above 10.68 GeV with a coherent sum of a continuum amplitude and three Breit-Wigner functions with constant widths.

<sup>4</sup> From a fit to the total hadronic cross sections measured at 60 energy points within  $\sqrt{s} = 10.82\text{--}11.05$  GeV to a pair of interfering Breit-Wigner amplitudes and two floating continuum amplitudes with  $1/\sqrt{s}$  dependence, one coherent with the resonances and one incoherent, with six resonance parameters (a mass, width, and an amplitude for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , one relative phase, and one decoherence coefficient).

<sup>5</sup> Not including uncertain and potentially large systematic errors due to assumed continuum amplitude  $1/\sqrt{s}$  dependence and related interference contributions.

<sup>6</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 25 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with fourteen resonance parameters (a mass, width, and three amplitudes for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , a single universal relative phase, and three decoherence coefficients, one for each  $n$ ). Continuum contributions were measured (and therefore fixed) to be zero.

<sup>7</sup> Superseded by MIZUK 19.

<sup>8</sup> In a model where a flat non-resonant  $b\bar{b}$ -continuum is incoherently added to a second flat component interfering with two Breit-Wigner resonances. Systematic uncertainties not estimated.

<sup>9</sup> The parameters of the  $\Upsilon(11020)$  are fixed to those in AUBERT 09E.

NODE=M092M;LINKAGE=E

NODE=M092M;LINKAGE=D

NODE=M092M;LINKAGE=H

NODE=M092M;LINKAGE=A

NODE=M092M;LINKAGE=B

NODE=M092M;LINKAGE=C

NODE=M092M;LINKAGE=F

NODE=M092M;LINKAGE=AU

NODE=M092M;LINKAGE=CH

- <sup>10</sup> In a model where a flat nonresonant  $\Upsilon(1S, 2S, 3S)\pi^+\pi^-$  continuum interferes with a single Breit-Wigner resonance.
- <sup>11</sup> In a model where a non-resonant  $b\bar{b}$ -continuum represented by a threshold function at  $\sqrt{s}=2m_B$  is incoherently added to a flat component interfering with two Breit-Wigner resonances. Not independent of other AUBERT 09E results. Systematic uncertainties not estimated.
- <sup>12</sup> Assuming four Gaussians with radiative tails and a single step in  $R$ .
- <sup>13</sup> In a coupled-channel model with three resonances and a smooth step in  $R$ .

NODE=M092M;LINKAGE=CE

NODE=M092M;LINKAGE=UB

NODE=M092M;LINKAGE=BE

NODE=M092M;LINKAGE=LO

 **$\Upsilon(10860)$  WIDTH**

NODE=M092W

| VALUE (MeV)                                                                   | DOCUMENT ID            | TECN     | COMMENT                                             |
|-------------------------------------------------------------------------------|------------------------|----------|-----------------------------------------------------|
| <b>37 ± 4 OUR AVERAGE</b>                                                     |                        |          |                                                     |
| 36.6 <sup>+4.5+0.5</sup> <sub>-3.9-1.1</sub>                                  | <sup>1</sup> MIZUK     | 19 BELL  | $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$         |
| 40.6 <sup>+12.7+1.1</sup> <sub>-8.0-19.1</sub>                                | <sup>2</sup> MIZUK     | 16 BELL  | $e^+e^- \rightarrow h_b(1P, 2P)\pi^+\pi^-$          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                        |          |                                                     |
| 49.5 ± 1.5                                                                    | <sup>3</sup> DONG      | 20A      | $e^+e^- \rightarrow b\bar{b}$                       |
| 48.5 <sup>+1.9+2.0</sup> <sub>-1.8-2.8</sub>                                  | <sup>4,5</sup> SANTEL  | 16 BELL  | $e^+e^- \rightarrow$ hadrons                        |
| 53.7 <sup>+7.1+1.3</sup> <sub>-5.6-5.4</sub>                                  | <sup>6,7</sup> SANTEL  | 16 BELL  | $e^+e^- \rightarrow \Upsilon(1S, 2S, 3S)\pi^+\pi^-$ |
| 46 <sup>+9</sup> <sub>-7</sub>                                                | <sup>8,9</sup> CHEN    | 10 BELL  | $e^+e^- \rightarrow$ hadrons                        |
| 30.7 <sup>+8.3</sup> <sub>-7.0</sub> ± 3.1                                    | <sup>10</sup> CHEN     | 10 BELL  | $e^+e^- \rightarrow \Upsilon(1S, 2S, 3S)\pi^+\pi^-$ |
| 43 ± 4                                                                        | <sup>8</sup> AUBERT    | 09E BABR | $e^+e^- \rightarrow$ hadrons                        |
| 74 ± 4                                                                        | <sup>11</sup> AUBERT   | 09E BABR | $e^+e^- \rightarrow$ hadrons                        |
| 112 ± 17 ± 23                                                                 | <sup>12</sup> BESSON   | 85 CLEO  | $e^+e^- \rightarrow$ hadrons                        |
| 110 ± 15                                                                      | <sup>13</sup> LOVELOCK | 85 CUSB  | $e^+e^- \rightarrow$ hadrons                        |

NODE=M092W

OCCUR=2

OCCUR=2

OCCUR=2

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

NODE=M092W;LINKAGE=F

<sup>2</sup> From a simultaneous fit to the  $h_b(nP)\pi^+\pi^-$ ,  $n = 1, 2$  cross sections at 22 energy points within  $\sqrt{s} = 10.77\text{--}11.02$  GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with eight resonance parameters (a mass and width for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , a single relative phase, a single relative amplitude, and two overall normalization factors, one for each  $n$ ). The systematic error estimate is dominated by possible interference with a small nonresonant continuum amplitude.

NODE=M092W;LINKAGE=D

<sup>3</sup> From a fit to the dressed cross sections of AUBERT 09E by BaBar and SANTEL 16 by Belle above 10.68 GeV with a coherent sum of a continuum amplitude and three Breit-Wigner functions with constant widths.

NODE=M092W;LINKAGE=G

<sup>4</sup> From a fit to the total hadronic cross sections measured at 60 energy points within  $\sqrt{s} = 10.82\text{--}11.05$  GeV to a pair of interfering Breit-Wigner amplitudes and two floating continuum amplitudes with  $1/\sqrt{s}$  dependence, one coherent with the resonances and one incoherent, with six resonance parameters (a mass, width, and an amplitude for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , one relative phase, and one decoherence coefficient).

NODE=M092W;LINKAGE=A

<sup>5</sup> Not including uncertain and potentially large systematic errors due to assumed continuum amplitude  $1/\sqrt{s}$  dependence and related interference contributions.

NODE=M092W;LINKAGE=B

<sup>6</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 25 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with fourteen resonance parameters (a mass, width, and three amplitudes for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , a single universal relative phase, and three decoherence coefficients, one for each  $n$ ). Continuum contributions were measured (and therefore fixed) to be zero.

NODE=M092W;LINKAGE=C

<sup>7</sup> Superseded by MIZUK 19.

NODE=M092W;LINKAGE=E

<sup>8</sup> In a model where a flat non-resonant  $b\bar{b}$ -continuum is incoherently added to a second flat component interfering with two Breit-Wigner resonances. Systematic uncertainties not estimated.

NODE=M092W;LINKAGE=AU

<sup>9</sup> The parameters of the  $\Upsilon(11020)$  are fixed to those in AUBERT 09E.

NODE=M092W;LINKAGE=CH

<sup>10</sup> In a model where a flat nonresonant  $\Upsilon(1S, 2S, 3S)\pi^+\pi^-$  continuum interferes with a single Breit-Wigner resonance.

NODE=M092W;LINKAGE=CE

<sup>11</sup> In a model where a non-resonant  $b\bar{b}$ -continuum represented by a threshold function at  $\sqrt{s}=2m_B$  is incoherently added to a flat component interfering with two Breit-Wigner resonances. Not independent of other AUBERT 09E results. Systematic uncertainties not estimated.

NODE=M092W;LINKAGE=UB

<sup>12</sup> Assuming four Gaussians with radiative tails and a single step in  $R$ .

NODE=M092W;LINKAGE=BE

<sup>13</sup> In a coupled-channel model with three resonances and a smooth step in  $R$ .

NODE=M092W;LINKAGE=LO

**$\Upsilon(10860)$  DECAY MODES**

NODE=M092215;NODE=M092

| Mode                                                               | Fraction ( $\Gamma_i/\Gamma$ )            | Confidence level |          |
|--------------------------------------------------------------------|-------------------------------------------|------------------|----------|
| $\Gamma_1$ $B\bar{B}X$                                             | ( 76.2 $^{+2.7}_{-4.0}$ ) %               |                  | DESIG=9  |
| $\Gamma_2$ $B\bar{B}$                                              | ( 5.5 $\pm 1.0$ ) %                       |                  | DESIG=2  |
| $\Gamma_3$ $B\bar{B}^* + \text{c.c.}$                              | ( 13.7 $\pm 1.6$ ) %                      |                  | DESIG=3  |
| $\Gamma_4$ $B^*\bar{B}^*$                                          | ( 38.1 $\pm 3.4$ ) %                      |                  | DESIG=4  |
| $\Gamma_5$ $B\bar{B}^{(*)}\pi$                                     | < 19.7 %                                  | 90%              | DESIG=10 |
| $\Gamma_6$ $B\bar{B}\pi$                                           | ( 0.0 $\pm 1.2$ ) %                       |                  | DESIG=23 |
| $\Gamma_7$ $B^*\bar{B}\pi + B\bar{B}^*\pi$                         | ( 7.3 $\pm 2.3$ ) %                       |                  | DESIG=24 |
| $\Gamma_8$ $B^*\bar{B}^*\pi$                                       | ( 1.0 $\pm 1.4$ ) %                       |                  | DESIG=25 |
| $\Gamma_9$ $B\bar{B}\pi\pi$                                        | < 8.9 %                                   | 90%              | DESIG=11 |
| $\Gamma_{10}$ $B_s^{(*)}\bar{B}_s^{(*)}$                           | ( 20.1 $\pm 3.1$ ) %                      |                  | DESIG=16 |
| $\Gamma_{11}$ $B_s\bar{B}_s$                                       | ( 5 $\pm 5$ ) $\times 10^{-3}$            |                  | DESIG=5  |
| $\Gamma_{12}$ $B_s\bar{B}_s^* + \text{c.c.}$                       | ( 1.35 $\pm 0.32$ ) %                     |                  | DESIG=7  |
| $\Gamma_{13}$ $B_s^*\bar{B}_s^*$                                   | ( 17.6 $\pm 2.7$ ) %                      |                  | DESIG=8  |
| $\Gamma_{14}$ no open-bottom                                       | ( 3.8 $^{+5.0}_{-0.5}$ ) %                |                  | DESIG=28 |
| $\Gamma_{15}$ $e^+e^-$                                             | ( 8.3 $\pm 2.1$ ) $\times 10^{-6}$        |                  | DESIG=1  |
| $\Gamma_{16}$ $K^*(892)^0\bar{K}^0$                                | < 1.0 $\times 10^{-5}$                    | 90%              | DESIG=29 |
| $\Gamma_{17}$ $\Upsilon(1S)\pi^+\pi^-$                             | ( 5.3 $\pm 0.6$ ) $\times 10^{-3}$        |                  | DESIG=17 |
| $\Gamma_{18}$ $\Upsilon(2S)\pi^+\pi^-$                             | ( 7.8 $\pm 1.3$ ) $\times 10^{-3}$        |                  | DESIG=18 |
| $\Gamma_{19}$ $\Upsilon(3S)\pi^+\pi^-$                             | ( 4.8 $^{+1.9}_{-1.7}$ ) $\times 10^{-3}$ |                  | DESIG=19 |
| $\Gamma_{20}$ $\Upsilon(1S)K^+K^-$                                 | ( 6.1 $\pm 1.8$ ) $\times 10^{-4}$        |                  | DESIG=20 |
| $\Gamma_{21}$ $\eta\Upsilon_J(1D)$                                 | ( 4.8 $\pm 1.1$ ) $\times 10^{-3}$        |                  | DESIG=40 |
| $\Gamma_{22}$ $h_b(1P)\pi^+\pi^-$                                  | ( 3.5 $^{+1.0}_{-1.3}$ ) $\times 10^{-3}$ |                  | DESIG=26 |
| $\Gamma_{23}$ $h_b(2P)\pi^+\pi^-$                                  | ( 5.7 $^{+1.7}_{-2.1}$ ) $\times 10^{-3}$ |                  | DESIG=27 |
| $\Gamma_{24}$ $\chi_{bJ}(1P)\pi^+\pi^-\pi^0$                       | ( 2.5 $\pm 2.3$ ) $\times 10^{-3}$        |                  | DESIG=41 |
| $\Gamma_{25}$ $\chi_{b0}(1P)\pi^+\pi^-\pi^0$                       | < 6.3 $\times 10^{-3}$                    | 90%              | DESIG=30 |
| $\Gamma_{26}$ $\chi_{b0}(1P)\omega$                                | < 3.9 $\times 10^{-3}$                    | 90%              | DESIG=31 |
| $\Gamma_{27}$ $\chi_{b0}(1P)(\pi^+\pi^-\pi^0)_{\text{non-}\omega}$ | < 4.8 $\times 10^{-3}$                    | 90%              | DESIG=32 |
| $\Gamma_{28}$ $\chi_{b1}(1P)\pi^+\pi^-\pi^0$                       | ( 1.85 $\pm 0.33$ ) $\times 10^{-3}$      |                  | DESIG=33 |
| $\Gamma_{29}$ $\chi_{b1}(1P)\omega$                                | ( 1.57 $\pm 0.30$ ) $\times 10^{-3}$      |                  | DESIG=34 |
| $\Gamma_{30}$ $\chi_{b1}(1P)(\pi^+\pi^-\pi^0)_{\text{non-}\omega}$ | ( 5.2 $\pm 1.9$ ) $\times 10^{-4}$        |                  | DESIG=35 |
| $\Gamma_{31}$ $\chi_{b2}(1P)\pi^+\pi^-\pi^0$                       | ( 1.17 $\pm 0.30$ ) $\times 10^{-3}$      |                  | DESIG=36 |
| $\Gamma_{32}$ $\chi_{b2}(1P)\omega$                                | ( 6.0 $\pm 2.7$ ) $\times 10^{-4}$        |                  | DESIG=37 |
| $\Gamma_{33}$ $\chi_{b2}(1P)(\pi^+\pi^-\pi^0)_{\text{non-}\omega}$ | ( 6 $\pm 4$ ) $\times 10^{-4}$            |                  | DESIG=38 |
| $\Gamma_{34}$ $\gamma X_b \rightarrow \gamma \Upsilon(1S)\omega$   | < 3.8 $\times 10^{-5}$                    | 90%              | DESIG=39 |
| $\Gamma_{35}$ $\eta_b(1S)\omega$                                   | < 1.3 $\times 10^{-3}$                    | 90%              | DESIG=42 |
| $\Gamma_{36}$ $\eta_b(2S)\omega$                                   | < 5.6 $\times 10^{-3}$                    | 90%              | DESIG=43 |

**Inclusive Decays.**

NODE=M092;CLUMP=I

These decay modes are submodes of one or more of the decay modes above.

NODE=M092

|                                     |                             |          |
|-------------------------------------|-----------------------------|----------|
| $\Gamma_{37}$ $\phi$ anything       | ( 13.8 $^{+2.4}_{-1.7}$ ) % | DESIG=12 |
| $\Gamma_{38}$ $D^0$ anything + c.c. | ( 108 $\pm 8$ ) %           | DESIG=13 |
| $\Gamma_{39}$ $D_s$ anything + c.c. | ( 46 $\pm 6$ ) %            | DESIG=6  |
| $\Gamma_{40}$ $J/\psi$ anything     | ( 2.06 $\pm 0.21$ ) %       | DESIG=14 |
| $\Gamma_{41}$ $B^0$ anything + c.c. | ( 77 $\pm 8$ ) %            | DESIG=21 |
| $\Gamma_{42}$ $B^+$ anything + c.c. | ( 72 $\pm 6$ ) %            | DESIG=22 |

 **$\Upsilon(10860)$  PARTIAL WIDTHS**

NODE=M092220

 **$\Gamma(e^+e^-)$**  **$\Gamma_{15}$** 

| VALUE (keV)                                   | DOCUMENT ID                         | TECN | COMMENT                                  |
|-----------------------------------------------|-------------------------------------|------|------------------------------------------|
| <b>0.31 <math>\pm 0.07</math> OUR AVERAGE</b> | Error includes scale factor of 1.3. |      |                                          |
| 0.22 $\pm 0.05 \pm 0.07$                      | BESSION                             | 85   | CLEO $e^+e^- \rightarrow \text{hadrons}$ |
| 0.365 $\pm 0.070$                             | LOVELOCK                            | 85   | CUSB $e^+e^- \rightarrow \text{hadrons}$ |

NODE=M092W1  
NODE=M092W1

$$\Gamma(e^+e^-) \times \Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}} \quad \Gamma_{15}\Gamma_{17}/\Gamma$$

VALUE (eV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.09±0.34 <sup>1,2</sup> MIZUK 19 BELL  $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

<sup>2</sup> Reported as the range 0.75–1.43 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions.

NODE=M092R50  
NODE=M092R50

NODE=M092R50;LINKAGE=A

NODE=M092R50;LINKAGE=B

$$\Gamma(e^+e^-) \times \Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma_{\text{total}} \quad \Gamma_{15}\Gamma_{18}/\Gamma$$

VALUE (eV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.58±1.22 <sup>1,2</sup> MIZUK 19 BELL  $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

<sup>2</sup> Reported as the range 1.35–3.80 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions.

NODE=M092R51  
NODE=M092R51

NODE=M092R51;LINKAGE=A

NODE=M092R51;LINKAGE=B

$$\Gamma(e^+e^-) \times \Gamma(\Upsilon(3S)\pi^+\pi^-)/\Gamma_{\text{total}} \quad \Gamma_{15}\Gamma_{19}/\Gamma$$

VALUE (eV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.73±0.30 <sup>1,2</sup> MIZUK 19 BELL  $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

<sup>2</sup> Reported as the range 0.43–1.03 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions.

NODE=M092R52  
NODE=M092R52

NODE=M092R52;LINKAGE=A

NODE=M092R52;LINKAGE=B

## $\Upsilon(10860)$ BRANCHING RATIOS

“OUR EVALUATION” is obtained based on averages of rescaled data listed below. The averages and rescaling were performed by the Heavy Flavor Averaging Group (HFLAV) and are described at <https://hflav.web.cern.ch/>.

NODE=M092230

NODE=M092230

$$\Gamma(B\bar{B}X)/\Gamma_{\text{total}} \quad \Gamma_1/\Gamma$$

VALUE EVTS DOCUMENT ID TECN COMMENT

**0.762<sup>+0.027</sup><sub>-0.043</sub> OUR EVALUATION**

**0.71 ±0.06 OUR AVERAGE**

0.737±0.032±0.051 1063 <sup>1</sup> DRUTSKOY 10 BELL  $\Upsilon(5S) \rightarrow B^+X, B^0X$

0.589±0.100±0.092 <sup>2</sup> HUANG 07 CLEO  $\Upsilon(5S) \rightarrow \text{hadrons}$

<sup>1</sup> Not independent of DRUTSKOY 10 values for  $\Upsilon(5S) \rightarrow B^{\pm,0}$  anything.

<sup>2</sup> Using measurements or limits from AQUINES 06.

NODE=M092R13  
NODE=M092R13

→ UNCHECKED ←

NODE=M092R13;LINKAGE=DR  
NODE=M092R13;LINKAGE=HU

$$\Gamma(B\bar{B})/\Gamma_{\text{total}} \quad \Gamma_2/\Gamma$$

VALUE (units 10<sup>-2</sup>) CL% DOCUMENT ID TECN COMMENT

**5.5<sup>+1.0</sup><sub>-0.9</sub>±0.4** <sup>1</sup> DRUTSKOY 10 BELL  $\Upsilon(5S) \rightarrow B^+X, B^0X$

• • • We do not use the following data for averages, fits, limits, etc. • • •

<13.8 90 <sup>2</sup> HUANG 07 CLEO  $\Upsilon(5S) \rightarrow \text{hadrons}$

<sup>1</sup> Assuming isospin conservation.

<sup>2</sup> Using measurements or limits from AQUINES 06.

NODE=M092R16  
NODE=M092R16

NODE=M092R16;LINKAGE=DR  
NODE=M092R16;LINKAGE=HU

$$\Gamma(B\bar{B})/\Gamma(B\bar{B}X) \quad \Gamma_2/\Gamma_1$$

VALUE CL% DOCUMENT ID TECN COMMENT

**<0.22** 90 AQUINES 06 CLE3  $\Upsilon(5S) \rightarrow \text{hadrons}$

NODE=M092R05  
NODE=M092R05

$$\Gamma(B\bar{B}^* + \text{c.c.})/\Gamma_{\text{total}} \quad \Gamma_3/\Gamma$$

VALUE DOCUMENT ID TECN COMMENT

**0.137±0.016 OUR AVERAGE**

0.137±0.013±0.011 <sup>1</sup> DRUTSKOY 10 BELL  $\Upsilon(5S) \rightarrow B^+X, B^0X$

0.143±0.053±0.027 <sup>2</sup> HUANG 07 CLEO  $\Upsilon(5S) \rightarrow \text{hadrons}$

<sup>1</sup> Assuming isospin conservation.

<sup>2</sup> Using measurements or limits from AQUINES 06.

NODE=M092R15  
NODE=M092R15

NODE=M092R15;LINKAGE=DR  
NODE=M092R15;LINKAGE=HU



$$\Gamma(B\bar{B}^* + \text{c.c.})/\Gamma(B\bar{B}X)$$

| VALUE                 | EVTs | DOCUMENT ID | TECN | COMMENT                                        | $\Gamma_3/\Gamma_1$ |
|-----------------------|------|-------------|------|------------------------------------------------|---------------------|
| <b>0.24±0.09±0.03</b> | 10   | AQUINES     | 06   | CLE3 $\Upsilon(5S) \rightarrow \text{hadrons}$ |                     |

NODE=M092R06  
NODE=M092R06

$$\Gamma(B^*\bar{B}^*)/\Gamma_{\text{total}}$$

| VALUE                          | DOCUMENT ID | TECN | COMMENT | $\Gamma_4/\Gamma$ |
|--------------------------------|-------------|------|---------|-------------------|
| <b>0.381±0.034 OUR AVERAGE</b> |             |      |         |                   |

NODE=M092R14  
NODE=M092R14

$$0.375^{+0.021}_{-0.019} \pm 0.030$$

<sup>1</sup> DRUTSKOY 10 BELL  $\Upsilon(5S) \rightarrow B^+ X, B^0 X$

$$0.436 \pm 0.083 \pm 0.072$$

<sup>2</sup> HUANG 07 CLEO  $\Upsilon(5S) \rightarrow \text{hadrons}$

<sup>1</sup> Assuming isospin conservation.

<sup>2</sup> Using measurements or limits from AQUINES 06.

NODE=M092R14;LINKAGE=DR  
NODE=M092R14;LINKAGE=HU

$$\Gamma(B^*\bar{B}^*)/\Gamma(B\bar{B}X)$$

| VALUE                 | EVTs | DOCUMENT ID | TECN | COMMENT                                        | $\Gamma_4/\Gamma_1$ |
|-----------------------|------|-------------|------|------------------------------------------------|---------------------|
| <b>0.74±0.15±0.08</b> | 31   | AQUINES     | 06   | CLE3 $\Upsilon(5S) \rightarrow \text{hadrons}$ |                     |

NODE=M092R07  
NODE=M092R07

$$\Gamma(B\bar{B}^{(*)}\pi)/\Gamma_{\text{total}}$$

| VALUE            | CL% | DOCUMENT ID        | TECN | COMMENT                                        | $\Gamma_5/\Gamma$ |
|------------------|-----|--------------------|------|------------------------------------------------|-------------------|
| <b>&lt;0.197</b> | 90  | <sup>1</sup> HUANG | 07   | CLEO $\Upsilon(5S) \rightarrow \text{hadrons}$ |                   |

NODE=M092R17  
NODE=M092R17

<sup>1</sup> Using measurements or limits from AQUINES 06.

NODE=M092R17;LINKAGE=HU

$$\Gamma(B\bar{B}^{(*)}\pi)/\Gamma(B\bar{B}X)$$

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                                        | $\Gamma_5/\Gamma_1$ |
|-----------------|-----|-------------|------|------------------------------------------------|---------------------|
| <b>&lt;0.32</b> | 90  | AQUINES     | 06   | CLE3 $\Upsilon(5S) \rightarrow \text{hadrons}$ |                     |

NODE=M092R08  
NODE=M092R08

$$\Gamma(B\bar{B}\pi)/\Gamma_{\text{total}}$$

| VALUE (units 10 <sup>-2</sup> ) | EVTs | DOCUMENT ID           | TECN | COMMENT                                       | $\Gamma_6/\Gamma$ |
|---------------------------------|------|-----------------------|------|-----------------------------------------------|-------------------|
| <b>0.0±1.2±0.3</b>              | 0    | <sup>1</sup> DRUTSKOY | 10   | BELL $\Upsilon(5S) \rightarrow B^+, 0\pi^- X$ |                   |

NODE=M092R28  
NODE=M092R28

<sup>1</sup> Assuming isospin conservation.

NODE=M092R28;LINKAGE=DR

$$[\Gamma(B^*\bar{B}\pi) + \Gamma(B\bar{B}^*\pi)]/\Gamma_{\text{total}}$$

| VALUE (units 10 <sup>-2</sup> )                | EVTs | DOCUMENT ID           | TECN | COMMENT                                       | $\Gamma_7/\Gamma$ |
|------------------------------------------------|------|-----------------------|------|-----------------------------------------------|-------------------|
| <b>7.3<sup>+2.3</sup><sub>-2.1</sub> ± 0.8</b> | 38   | <sup>1</sup> DRUTSKOY | 10   | BELL $\Upsilon(5S) \rightarrow B^+, 0\pi^- X$ |                   |

NODE=M092R29  
NODE=M092R29

<sup>1</sup> Assuming isospin conservation.

NODE=M092R29;LINKAGE=DR

$$\Gamma(B^*\bar{B}^*\pi)/\Gamma_{\text{total}}$$

| VALUE (units 10 <sup>-2</sup> )                | EVTs | DOCUMENT ID           | TECN | COMMENT                                       | $\Gamma_8/\Gamma$ |
|------------------------------------------------|------|-----------------------|------|-----------------------------------------------|-------------------|
| <b>1.0<sup>+1.4</sup><sub>-1.3</sub> ± 0.4</b> | 5    | <sup>1</sup> DRUTSKOY | 10   | BELL $\Upsilon(5S) \rightarrow B^+, 0\pi^- X$ |                   |

NODE=M092R30  
NODE=M092R30

<sup>1</sup> Assuming isospin conservation.

NODE=M092R30;LINKAGE=DR

$$\Gamma(B\bar{B}\pi\pi)/\Gamma_{\text{total}}$$

| VALUE            | CL% | DOCUMENT ID        | TECN | COMMENT                                        | $\Gamma_9/\Gamma$ |
|------------------|-----|--------------------|------|------------------------------------------------|-------------------|
| <b>&lt;0.089</b> | 90  | <sup>1</sup> HUANG | 07   | CLEO $\Upsilon(5S) \rightarrow \text{hadrons}$ |                   |

NODE=M092R18  
NODE=M092R18

<sup>1</sup> Using measurements or limits from AQUINES 06.

NODE=M092R18;LINKAGE=HU

$$\Gamma(B\bar{B}\pi\pi)/\Gamma(B\bar{B}X)$$

| VALUE           | CL% | DOCUMENT ID | TECN | COMMENT                                        | $\Gamma_9/\Gamma_1$ |
|-----------------|-----|-------------|------|------------------------------------------------|---------------------|
| <b>&lt;0.14</b> | 90  | AQUINES     | 06   | CLE3 $\Upsilon(5S) \rightarrow \text{hadrons}$ |                     |

NODE=M092R09  
NODE=M092R09

$$\Gamma(B_s^{(*)}\bar{B}_s^{(*)})/\Gamma_{\text{total}}$$

| VALUE | DOCUMENT ID | TECN | COMMENT | $\Gamma_{10}/\Gamma = (\Gamma_{11} + \Gamma_{12} + \Gamma_{13})/\Gamma$ |
|-------|-------------|------|---------|-------------------------------------------------------------------------|
|-------|-------------|------|---------|-------------------------------------------------------------------------|

NODE=M092R01  
NODE=M092R01

$$0.201^{+0.030}_{-0.031} \text{ OUR EVALUATION}$$

→ UNCHECKED ←

$$0.189^{+0.027}_{-0.021} \text{ OUR AVERAGE}$$

$$0.172 \pm 0.030$$

<sup>1</sup> ESEN 13 BELL  $\Upsilon(5S) \rightarrow D^0 X, D_s X$

$$0.21^{+0.06}_{-0.03}$$

<sup>2</sup> HUANG 07 CLEO  $\Upsilon(5S) \rightarrow D_s X$

• • • We do not use the following data for averages, fits, limits, etc. • • •

$$0.180 \pm 0.013 \pm 0.032$$

<sup>3</sup> DRUTSKOY 07 BELL  $\Upsilon(5S) \rightarrow D^0 X, D_s X$

$$0.160 \pm 0.026 \pm 0.058$$

<sup>4</sup> ARTUSO 05B CLEO  $e^+e^- \rightarrow D_X X$

<sup>1</sup>Supersedes DRUTSKOY 07.

<sup>2</sup>Supersedes ARTUSO 05B. Combining inclusive  $\phi$ ,  $D_s$ , and  $B$  measurements. Using  $B(D_s^+ \rightarrow \phi \pi^+) = 4.4 \pm 0.6\%$  from PDG 06.

<sup>3</sup>Using  $B(D_s^+ \rightarrow \phi \pi^+) = (4.4 \pm 0.6)\%$  from PDG 06.

<sup>4</sup>Uses a model-dependent estimate  $B(B_s \rightarrow D_s X) = (92 \pm 11)\%$ .

NODE=M092R01;LINKAGE=ES  
NODE=M092R01;LINKAGE=HU

NODE=M092R01;LINKAGE=DR  
NODE=M092R01;LINKAGE=AR

$$\Gamma(B_s^{(*)} \bar{B}_s^{(*)}) / \Gamma(B \bar{B} X)$$

$$\Gamma_{10} / \Gamma_1$$

VALUE

DOCUMENT ID

$$0.264^{+0.052}_{-0.045} \text{ OUR EVALUATION}$$

NODE=M092R34  
NODE=M092R34

→ UNCHECKED ←

$$\Gamma(B_s^* \bar{B}_s^*) / \Gamma(B_s^{(*)} \bar{B}_s^{(*)})$$

$$\Gamma_{13} / \Gamma_{10} = \Gamma_{13} / (\Gamma_{11} + \Gamma_{12} + \Gamma_{13})$$

VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**87.8 ± 1.5 OUR AVERAGE**

87.0 ± 1.7      1,2 ESEN      13 BELL       $B_s^0 \rightarrow D_s^- \pi^+$

90.5 ± 3.2 ± 0.1      227 2,3 LI      12 BELL       $B_s^0 \rightarrow J/\psi \eta^{(\prime)}$

• • • We do not use the following data for averages, fits, limits, etc. • • •

90.1<sup>+3.8</sup><sub>-4.0</sub> ± 0.2      4 LOUVOT      09 BELL      10.86  $e^+ e^- \rightarrow B_s^{(*)} \bar{B}_s^{(*)}$

93<sup>+7</sup><sub>-9</sub> ± 1      4 DRUTSKOY      07A BELL      Superseded by LOUVOT 09

<sup>1</sup>Supersedes LOUVOT 09.

<sup>2</sup>With  $N(B_s^{(*)} \bar{B}_s^{(*)}) = (7.11 \pm 1.30) \times 10^6$ .

<sup>3</sup>The ratios  $N(B_s^* \bar{B}_s^*) / N(B_s^{(*)} \bar{B}_s^{(*)})$  and  $N(B_s^* \bar{B}_s^0) / N(B_s^{(*)} \bar{B}_s^{(*)})$  are measured with a correlation coefficient of  $-0.72$ .

<sup>4</sup>From a measurement of  $\sigma(e^+ e^- \rightarrow B_s^* \bar{B}_s^*) / \sigma(e^+ e^- \rightarrow B_s^{(*)} \bar{B}_s^{(*)})$  at  $\sqrt{s} = 10.86$  GeV.

NODE=M092R19  
NODE=M092R19

NODE=M092R19;LINKAGE=ES

NODE=M092R19;LINKAGE=IL

NODE=M092R19;LINKAGE=LI

NODE=M092R19;LINKAGE=DR

$$\Gamma(B_s \bar{B}_s) / \Gamma(B_s^{(*)} \bar{B}_s^{(*)})$$

$$\Gamma_{11} / \Gamma_{10} = \Gamma_{11} / (\Gamma_{11} + \Gamma_{12} + \Gamma_{13})$$

VALUE (units  $10^{-2}$ )

DOCUMENT ID

TECN

COMMENT

**2.6<sup>+2.6</sup><sub>-2.5</sub>**      LOUVOT      09 BELL      10.86  $e^+ e^- \rightarrow B_s^{(*)} \bar{B}_s^{(*)}$

NODE=M092R24  
NODE=M092R24

$$\Gamma(B_s \bar{B}_s) / \Gamma(B_s^* \bar{B}_s^*)$$

$$\Gamma_{11} / \Gamma_{13}$$

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<0.16**      90      BONVICINI      06 CLE3       $e^+ e^-$

NODE=M092R03  
NODE=M092R03

$$\Gamma(B_s \bar{B}_s^* + \text{c.c.}) / \Gamma(B_s^{(*)} \bar{B}_s^{(*)})$$

$$\Gamma_{12} / \Gamma_{10} = \Gamma_{12} / (\Gamma_{11} + \Gamma_{12} + \Gamma_{13})$$

VALUE (units  $10^{-2}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

**6.7 ± 1.2 OUR AVERAGE**

7.3 ± 1.4      1,2 ESEN      13 BELL       $B_s^0 \rightarrow D_s^- \pi^+$

4.9 ± 2.5 ± 0.0      227 2,3 LI      12 BELL       $B_s^0 \rightarrow J/\psi \eta^{(\prime)}$

• • • We do not use the following data for averages, fits, limits, etc. • • •

7.3<sup>+3.3</sup><sub>-3.0</sub> ± 0.1      LOUVOT      09 BELL      10.86  $e^+ e^- \rightarrow B_s^{(*)} \bar{B}_s^{(*)}$

<sup>1</sup>Supersedes LOUVOT 09.

<sup>2</sup>With  $N(B_s^{(*)} \bar{B}_s^{(*)}) = (7.11 \pm 1.30) \times 10^6$ .

<sup>3</sup>The ratios  $N(B_s^* \bar{B}_s^*) / N(B_s^{(*)} \bar{B}_s^{(*)})$  and  $N(B_s^* \bar{B}_s^0) / N(B_s^{(*)} \bar{B}_s^{(*)})$  are measured with a correlation coefficient of  $-0.72$ .

NODE=M092R25  
NODE=M092R25

NODE=M092R25;LINKAGE=ES

NODE=M092R25;LINKAGE=IL

NODE=M092R25;LINKAGE=LI

$$\Gamma(B_s \bar{B}_s^* + \text{c.c.}) / \Gamma(B_s^* \bar{B}_s^*)$$

$$\Gamma_{12} / \Gamma_{13}$$

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<0.16**      90      BONVICINI      06 CLE3       $e^+ e^-$

NODE=M092R04  
NODE=M092R04

$$\Gamma(\text{no open-bottom}) / \Gamma_{\text{total}}$$

$$\Gamma_{14} / \Gamma$$

VALUE

DOCUMENT ID

$$0.038^{+0.051}_{-0.005} \text{ OUR EVALUATION}$$

NODE=M092R33  
NODE=M092R33

→ UNCHECKED ←

$$\Gamma(K^*(892)^0 \bar{K}^0) / \Gamma_{\text{total}}$$

$$\Gamma_{16} / \Gamma$$

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

**<1.0 × 10<sup>-5</sup>**      90      SHEN      13A BELL       $e^+ e^- \rightarrow K^*(892)^0 \bar{K}^0$

NODE=M092R35  
NODE=M092R35

$\Gamma(\eta \Upsilon_J(1D))/\Gamma_{\text{total}}$  $\Gamma_{21}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

 **$4.8 \pm 0.92 \pm 0.67$** <sup>1</sup> TAMPONI 18 BELL  $e^+e^- \rightarrow \Upsilon(5S) \rightarrow \eta X$ <sup>1</sup> Mainly  $J = 2$ , assumes no continuum contribution under  $\Upsilon(5S)$ .NODE=M092R48  
NODE=M092R48

NODE=M092R48;LINKAGE=A

 $\Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{17}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 **$5.3 \pm 0.3 \pm 0.5$** 

325

<sup>1</sup> CHEN 08 BELL  $10.87 e^+e^- \rightarrow \Upsilon(1S)\pi^+\pi^-$ <sup>1</sup> Assuming that the observed events are solely due to the  $\Upsilon(5S)$  resonance.NODE=M092R20  
NODE=M092R20

NODE=M092R20;LINKAGE=CH

 $\Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{18}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 **$7.8 \pm 0.6 \pm 1.1$** 

186

<sup>1</sup> CHEN 08 BELL  $10.87 e^+e^- \rightarrow \Upsilon(2S)\pi^+\pi^-$ <sup>1</sup> Assuming that the observed events are solely due to the  $\Upsilon(5S)$  resonance.NODE=M092R21  
NODE=M092R21

NODE=M092R21;LINKAGE=CH

 $\Gamma(\Upsilon(3S)\pi^+\pi^-)/\Gamma_{\text{total}}$  $\Gamma_{19}/\Gamma$ VALUE (units  $10^{-3}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 **$4.8 \pm 1.8 \pm 0.7$**   
 **$1.5 \pm 0.7$** 

10

<sup>1</sup> CHEN 08 BELL  $10.87 e^+e^- \rightarrow \Upsilon(3S)\pi^+\pi^-$ <sup>1</sup> Assuming that the observed events are solely due to the  $\Upsilon(5S)$  resonance.NODE=M092R22  
NODE=M092R22

NODE=M092R22;LINKAGE=CH

 $\Gamma(\Upsilon(1S)K^+K^-)/\Gamma_{\text{total}}$  $\Gamma_{20}/\Gamma$ VALUE (units  $10^{-4}$ )

EVTS

DOCUMENT ID

TECN

COMMENT

 **$6.1 \pm 1.6 \pm 1.0$**   
 **$1.4 \pm 1.0$** 

20

<sup>1</sup> CHEN 08 BELL  $10.87 e^+e^- \rightarrow \Upsilon(1S)K^+K^-$ <sup>1</sup> Assuming that the observed events are solely due to the  $\Upsilon(5S)$  resonance.NODE=M092R23  
NODE=M092R23

NODE=M092R23;LINKAGE=CH

 $\Gamma(h_b(1P)\pi^+\pi^-)/\Gamma(\Upsilon(2S)\pi^+\pi^-)$  $\Gamma_{22}/\Gamma_{18}$ 

VALUE

DOCUMENT ID

TECN

COMMENT

 **$0.45 \pm 0.08 \pm 0.07$**   
 **$0.12 \pm 0.07$** 

ADACHI

12

BELL  $10.86 e^+e^- \rightarrow \text{hadrons}$ NODE=M092R31  
NODE=M092R31 $\Gamma(h_b(2P)\pi^+\pi^-)/\Gamma(\Upsilon(2S)\pi^+\pi^-)$  $\Gamma_{23}/\Gamma_{18}$ 

VALUE

DOCUMENT ID

TECN

COMMENT

 **$0.77 \pm 0.08 \pm 0.22$**   
 **$0.17 \pm 0.22$** 

ADACHI

12

BELL  $10.86 e^+e^- \rightarrow \text{hadrons}$ NODE=M092R32  
NODE=M092R32 $\Gamma(h_b(1P)\pi^+\pi^-)/\Gamma(h_b(2P)\pi^+\pi^-)$  $\Gamma_{22}/\Gamma_{23}$ 

VALUE

DOCUMENT ID

TECN

COMMENT

 **$0.616 \pm 0.052 \pm 0.017$** 

MIZUK

16

BELL  $e^+e^- \rightarrow h_b(1P, 2P)\pi^+\pi^-$ NODE=M092R00  
NODE=M092R00 $\Gamma(\chi_{bJ}(1P)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{24}/\Gamma$ VALUE (units  $10^{-3}$ )

DOCUMENT ID

TECN

COMMENT

 **$2.5 \pm 0.6 \pm 2.2$** 

YIN

18

BELL  $e^+e^- \rightarrow \text{hadrons}$ NODE=M092R49  
NODE=M092R49 $\Gamma(\chi_{b0}(1P)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{25}/\Gamma$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

 **$< 6.3 \times 10^{-3}$** 

90

<sup>1</sup> HE 14 BELL  $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ <sup>1</sup> Assuming that all the  $b\bar{b}$  events are from  $\Upsilon(5S)$  resonance decays and using  $\sigma(e^+e^- \rightarrow b\bar{b}) = 0.340 \pm 0.016$  nb from ESEN 13. Correlated with other results from HE 14.NODE=M092R36  
NODE=M092R36

NODE=M092R36;LINKAGE=A

 $\Gamma(\chi_{b0}(1P)\omega)/\Gamma_{\text{total}}$  $\Gamma_{26}/\Gamma$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

 **$< 3.9 \times 10^{-3}$** 

90

<sup>1</sup> HE 14 BELL  $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ <sup>1</sup> Assuming that all the  $b\bar{b}$  events are from  $\Upsilon(5S)$  resonance decays and using  $\sigma(e^+e^- \rightarrow b\bar{b}) = 0.340 \pm 0.016$  nb from ESEN 13. Correlated with other results from HE 14.NODE=M092R37  
NODE=M092R37

NODE=M092R37;LINKAGE=A

 $\Gamma(\chi_{b0}(1P)(\pi^+\pi^-\pi^0)_{\text{non-}\omega})/\Gamma_{\text{total}}$  $\Gamma_{27}/\Gamma$ 

VALUE

CL%

DOCUMENT ID

TECN

COMMENT

 **$< 4.8 \times 10^{-3}$** 

90

<sup>1</sup> HE 14 BELL  $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ <sup>1</sup> Assuming that all the  $b\bar{b}$  events are from  $\Upsilon(5S)$  resonance decays and using  $\sigma(e^+e^- \rightarrow b\bar{b}) = 0.340 \pm 0.016$  nb from ESEN 13. Correlated with other results from HE 14.NODE=M092R38  
NODE=M092R38

NODE=M092R38;LINKAGE=A

$\Gamma(\chi_{b1}(1P)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{28}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID     | TECN | COMMENT                                                           |
|--------------------------------------------|------|-----------------|------|-------------------------------------------------------------------|
| <b><math>1.85 \pm 0.23 \pm 0.23</math></b> | 80   | <sup>1</sup> HE | 14   | BELL $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ |

NODE=M092R39  
 NODE=M092R39

<sup>1</sup> Assuming that all the  $b\bar{b}$  events are from  $\Upsilon(5S)$  resonance decays and using  $\sigma(e^+e^- \rightarrow b\bar{b}) = 0.340 \pm 0.016$  nb from ESEN 13. Correlated with other results from HE 14.

NODE=M092R39;LINKAGE=A

 $\Gamma(\chi_{b1}(1P)\omega)/\Gamma_{\text{total}}$  $\Gamma_{29}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID     | TECN | COMMENT                                                           |
|--------------------------------------------|------|-----------------|------|-------------------------------------------------------------------|
| <b><math>1.57 \pm 0.22 \pm 0.21</math></b> | 60   | <sup>1</sup> HE | 14   | BELL $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ |

NODE=M092R40  
 NODE=M092R40

<sup>1</sup> Assuming that all the  $b\bar{b}$  events are from  $\Upsilon(5S)$  resonance decays and using  $\sigma(e^+e^- \rightarrow b\bar{b}) = 0.340 \pm 0.016$  nb from ESEN 13. Correlated with other results from HE 14.

NODE=M092R40;LINKAGE=A

 $\Gamma(\chi_{b1}(1P)(\pi^+\pi^-\pi^0)_{\text{non-}\omega})/\Gamma_{\text{total}}$  $\Gamma_{30}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID     | TECN | COMMENT                                                           |
|--------------------------------------------|------|-----------------|------|-------------------------------------------------------------------|
| <b><math>0.52 \pm 0.15 \pm 0.11</math></b> | 24   | <sup>1</sup> HE | 14   | BELL $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ |

NODE=M092R41  
 NODE=M092R41

<sup>1</sup> Assuming that all the  $b\bar{b}$  events are from  $\Upsilon(5S)$  resonance decays and using  $\sigma(e^+e^- \rightarrow b\bar{b}) = 0.340 \pm 0.016$  nb from ESEN 13. Correlated with other results from HE 14.

NODE=M092R41;LINKAGE=A

 $\Gamma(\chi_{b2}(1P)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$  $\Gamma_{31}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID     | TECN | COMMENT                                                           |
|--------------------------------------------|------|-----------------|------|-------------------------------------------------------------------|
| <b><math>1.17 \pm 0.27 \pm 0.14</math></b> | 29   | <sup>1</sup> HE | 14   | BELL $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ |

NODE=M092R42  
 NODE=M092R42

<sup>1</sup> Assuming that all the  $b\bar{b}$  events are from  $\Upsilon(5S)$  resonance decays and using  $\sigma(e^+e^- \rightarrow b\bar{b}) = 0.340 \pm 0.016$  nb from ESEN 13. Correlated with other results from HE 14.

NODE=M092R42;LINKAGE=A

 $\Gamma(\chi_{b2}(1P)\omega)/\Gamma_{\text{total}}$  $\Gamma_{32}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID     | TECN | COMMENT                                                           |
|--------------------------------------------|------|-----------------|------|-------------------------------------------------------------------|
| <b><math>0.60 \pm 0.23 \pm 0.15</math></b> | 13   | <sup>1</sup> HE | 14   | BELL $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ |

NODE=M092R43  
 NODE=M092R43

<sup>1</sup> Assuming that all the  $b\bar{b}$  events are from  $\Upsilon(5S)$  resonance decays and using  $\sigma(e^+e^- \rightarrow b\bar{b}) = 0.340 \pm 0.016$  nb from ESEN 13. Correlated with other results from HE 14.

NODE=M092R43;LINKAGE=A

 $\Gamma(\chi_{b2}(1P)\omega)/\Gamma(\chi_{b1}(1P)\omega)$  $\Gamma_{32}/\Gamma_{29}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M092R44  
 NODE=M092R44

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |                 |    |                                                                   |
|--------------------------|-----------------|----|-------------------------------------------------------------------|
| $0.38 \pm 0.16 \pm 0.09$ | <sup>1</sup> HE | 14 | BELL $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ |
|--------------------------|-----------------|----|-------------------------------------------------------------------|

<sup>1</sup> Accounting for correlated systematics.

NODE=M092R44;LINKAGE=A

 $\Gamma(\chi_{b2}(1P)(\pi^+\pi^-\pi^0)_{\text{non-}\omega})/\Gamma_{\text{total}}$  $\Gamma_{33}/\Gamma$ 

| VALUE (units $10^{-3}$ )                   | EVTS | DOCUMENT ID     | TECN | COMMENT                                                           |
|--------------------------------------------|------|-----------------|------|-------------------------------------------------------------------|
| <b><math>0.61 \pm 0.22 \pm 0.28</math></b> | 16   | <sup>1</sup> HE | 14   | BELL $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ |

NODE=M092R45  
 NODE=M092R45

<sup>1</sup> Assuming that all the  $b\bar{b}$  events are from  $\Upsilon(5S)$  resonance decays and using  $\sigma(e^+e^- \rightarrow b\bar{b}) = 0.340 \pm 0.016$  nb from ESEN 13. Correlated with other results from HE 14.

NODE=M092R45;LINKAGE=A

 $\Gamma(\chi_{b2}(1P)(\pi^+\pi^-\pi^0)_{\text{non-}\omega})/\Gamma(\chi_{b1}(1P)(\pi^+\pi^-\pi^0)_{\text{non-}\omega})$  $\Gamma_{33}/\Gamma_{30}$ 

| VALUE | DOCUMENT ID | TECN | COMMENT |
|-------|-------------|------|---------|
|-------|-------------|------|---------|

NODE=M092R46  
 NODE=M092R46

• • • We do not use the following data for averages, fits, limits, etc. • • •

|                          |                 |    |                                                                   |
|--------------------------|-----------------|----|-------------------------------------------------------------------|
| $1.20 \pm 0.55 \pm 0.65$ | <sup>1</sup> HE | 14 | BELL $\Upsilon(5S) \rightarrow \pi^+\pi^-\pi^0\gamma\Upsilon(1S)$ |
|--------------------------|-----------------|----|-------------------------------------------------------------------|

<sup>1</sup> Accounting for correlated systematics.

NODE=M092R46;LINKAGE=A

 $\Gamma(\eta_b(1S)\omega)/\Gamma_{\text{total}}$  $\Gamma_{35}/\Gamma$ 

| VALUE                                      | CL% | DOCUMENT ID        | TECN | COMMENT                            |
|--------------------------------------------|-----|--------------------|------|------------------------------------|
| <b><math>&lt;1.3 \times 10^{-3}</math></b> | 90  | <sup>1</sup> OSKIN | 20   | BELL $e^+e^- \rightarrow \omega X$ |

NODE=M092R53  
 NODE=M092R53

<sup>1</sup> Using  $\sigma_{b\bar{b}} = 0.340 \pm 0.016$  nb from TAMPONI 15.

NODE=M092R53;LINKAGE=A

 $\Gamma(\eta_b(2S)\omega)/\Gamma_{\text{total}}$  $\Gamma_{36}/\Gamma$ 

| VALUE                                      | CL% | DOCUMENT ID        | TECN | COMMENT                            |
|--------------------------------------------|-----|--------------------|------|------------------------------------|
| <b><math>&lt;5.6 \times 10^{-3}</math></b> | 90  | <sup>1</sup> OSKIN | 20   | BELL $e^+e^- \rightarrow \omega X$ |

NODE=M092R54  
 NODE=M092R54

<sup>1</sup> Using  $\sigma_{b\bar{b}} = 0.340 \pm 0.016$  nb from TAMPONI 15.

NODE=M092R54;LINKAGE=A

$\Gamma(\gamma X_b \rightarrow \gamma \Upsilon(1S)\omega)/\Gamma_{\text{total}}$ 
 $\Gamma_{34}/\Gamma$ 

| VALUE                 | CL% | DOCUMENT ID     | TECN | COMMENT                                                               |
|-----------------------|-----|-----------------|------|-----------------------------------------------------------------------|
| $<3.8 \times 10^{-5}$ | 90  | <sup>1</sup> HE | 14   | BELL $\Upsilon(5S) \rightarrow \pi^+ \pi^- \pi^0 \gamma \Upsilon(1S)$ |

<sup>1</sup> Assuming that all the  $b\bar{b}$  events are from  $\Upsilon(5S)$  resonance decays and using  $\sigma(e^+e^- \rightarrow b\bar{b}) = 0.340 \pm 0.016$  nb from ESEN 13. Correlated with other results from HE 14. For a state  $X_b$  with mass between 10.55 GeV/c<sup>2</sup> and 10.65 GeV/c<sup>2</sup>, the obtained 90% upper limit as a function of  $m_{X_b}$  varies from  $2.6 \times 10^{-5}$  to  $3.8 \times 10^{-5}$ .

NODE=M092R47  
NODE=M092R47

NODE=M092R47;LINKAGE=A

 $\Gamma(\phi \text{ anything})/\Gamma_{\text{total}}$ 
 $\Gamma_{37}/\Gamma$ 

| VALUE                               | DOCUMENT ID | TECN | COMMENT                                |
|-------------------------------------|-------------|------|----------------------------------------|
| $0.138 \pm 0.007^{+0.023}_{-0.015}$ | HUANG       | 07   | CLEO $\Upsilon(5S) \rightarrow \phi X$ |

NODE=M092R12  
NODE=M092R12

 $\Gamma(D^0 \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{38}/\Gamma$ 

| VALUE                       | DOCUMENT ID | TECN | COMMENT                               |
|-----------------------------|-------------|------|---------------------------------------|
| $1.076 \pm 0.040 \pm 0.068$ | DRUTSKOY    | 07   | BELL $\Upsilon(5S) \rightarrow D^0 X$ |

NODE=M092R10  
NODE=M092R10

 $\Gamma(D_s \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{39}/\Gamma$ 

| VALUE                          | DOCUMENT ID           | TECN | COMMENT                               |
|--------------------------------|-----------------------|------|---------------------------------------|
| <b>0.46 ± 0.06 OUR AVERAGE</b> |                       |      |                                       |
| $0.472 \pm 0.024 \pm 0.072$    | <sup>1</sup> DRUTSKOY | 07   | BELL $\Upsilon(5S) \rightarrow D_s X$ |
| $0.44 \pm 0.09 \pm 0.04$       | <sup>2</sup> ARTUSO   | 05B  | CLE3 $e^+e^- \rightarrow D_s X$       |

NODE=M092R02  
NODE=M092R02

<sup>1</sup> Using  $B(D_s^+ \rightarrow \phi \pi^+) = (4.4 \pm 0.6)\%$  from PDG 06.

<sup>2</sup> ARTUSO 05B reports  $[\Gamma(\Upsilon(10860) \rightarrow D_s \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}] \times [B(D_s^+ \rightarrow \phi \pi^+)] = 0.0198 \pm 0.0019 \pm 0.0038$  which we divide by our best value  $B(D_s^+ \rightarrow \phi \pi^+) = (4.5 \pm 0.4) \times 10^{-2}$ . Our first error is their experiment's error and our second error is the systematic error from using our best value.

NODE=M092R02;LINKAGE=DR

NODE=M092R02;LINKAGE=AR

 $\Gamma(J/\psi \text{ anything})/\Gamma_{\text{total}}$ 
 $\Gamma_{40}/\Gamma$ 

| VALUE (units $10^{-2}$ )    | DOCUMENT ID | TECN | COMMENT                                  |
|-----------------------------|-------------|------|------------------------------------------|
| $2.060 \pm 0.160 \pm 0.134$ | DRUTSKOY    | 07   | BELL $\Upsilon(5S) \rightarrow J/\psi X$ |

NODE=M092R11  
NODE=M092R11

 $\Gamma(B^0 \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{41}/\Gamma$ 

| VALUE                               | EVTs | DOCUMENT ID | TECN | COMMENT                               |
|-------------------------------------|------|-------------|------|---------------------------------------|
| $0.770^{+0.058}_{-0.056} \pm 0.061$ | 352  | DRUTSKOY    | 10   | BELL $\Upsilon(5S) \rightarrow B^0 X$ |

NODE=M092R26  
NODE=M092R26

 $\Gamma(B^+ \text{ anything} + \text{c.c.})/\Gamma_{\text{total}}$ 
 $\Gamma_{42}/\Gamma$ 

| VALUE                               | EVTs | DOCUMENT ID | TECN | COMMENT                               |
|-------------------------------------|------|-------------|------|---------------------------------------|
| $0.721^{+0.039}_{-0.038} \pm 0.050$ | 711  | DRUTSKOY    | 10   | BELL $\Upsilon(5S) \rightarrow B^+ X$ |

NODE=M092R27  
NODE=M092R27

## $\Upsilon(10860)$ REFERENCES

NODE=M092

|           |     |                |                               |                 |
|-----------|-----|----------------|-------------------------------|-----------------|
| DONG      | 20A | CP C44 083001  | X.-K. Dong <i>et al.</i>      |                 |
| OSKIN     | 20  | PR D102 092011 | P. Oskin <i>et al.</i>        | (BELLE Collab.) |
| MIZUK     | 19  | JHEP 1910 220  | R. Mizuk <i>et al.</i>        | (BELLE Collab.) |
| TAMPONI   | 18  | EPJ C78 633    | U. Tamponi <i>et al.</i>      | (BELLE Collab.) |
| YIN       | 18  | PR D98 091102  | J.H. Yin <i>et al.</i>        | (BELLE Collab.) |
| MIZUK     | 16  | PRL 117 142001 | R. Mizuk <i>et al.</i>        | (BELLE Collab.) |
| SANTEL    | 16  | PR D93 011101  | D. Santel <i>et al.</i>       | (BELLE Collab.) |
| TAMPONI   | 15  | PRL 115 142001 | U. Tamponi <i>et al.</i>      | (BELLE Collab.) |
| HE        | 14  | PRL 113 142001 | X.H. He <i>et al.</i>         | (BELLE Collab.) |
| ESEN      | 13  | PR D87 031101  | S. Esen <i>et al.</i>         | (BELLE Collab.) |
| SHEN      | 13A | PR D88 052019  | C.P. Shen <i>et al.</i>       | (BELLE Collab.) |
| ADACHI    | 12  | PRL 108 032001 | I. Adachi <i>et al.</i>       | (BELLE Collab.) |
| LI        | 12  | PRL 108 181808 | J. Li <i>et al.</i>           | (BELLE Collab.) |
| CHEN      | 10  | PR D82 091106  | K.-F. Chen <i>et al.</i>      | (BELLE Collab.) |
| DRUTSKOY  | 10  | PR D81 112003  | A. Drutskoy <i>et al.</i>     | (BELLE Collab.) |
| AUBERT    | 09E | PRL 102 012001 | B. Aubert <i>et al.</i>       | (BABAR Collab.) |
| LOUVOT    | 09  | PRL 102 021801 | R. Louvot <i>et al.</i>       | (BELLE Collab.) |
| CHEN      | 08  | PRL 100 112001 | K.-F. Chen <i>et al.</i>      | (BELLE Collab.) |
| DRUTSKOY  | 07  | PRL 98 052001  | A. Drutskoy <i>et al.</i>     | (BELLE Collab.) |
| DRUTSKOY  | 07A | PR D76 012002  | A. Drutskoy <i>et al.</i>     | (BELLE Collab.) |
| HUANG     | 07  | PR D75 012002  | G.S. Huang <i>et al.</i>      | (CLEO Collab.)  |
| AQUINES   | 06  | PRL 96 152001  | O. Aquines <i>et al.</i>      | (CLEO Collab.)  |
| BONVICINI | 06  | PRL 96 022002  | G. Bonvicini <i>et al.</i>    | (CLEO Collab.)  |
| PDG       | 06  | JP G33 1       | W.-M. Yao <i>et al.</i>       | (PDG Collab.)   |
| ARTUSO    | 05B | PRL 95 261801  | M. Artuso <i>et al.</i>       | (CLEO Collab.)  |
| BESSION   | 85  | PRL 54 381     | D. Besson <i>et al.</i>       | (CLEO Collab.)  |
| LOVELOCK  | 85  | PRL 54 377     | D.M.J. Lovelock <i>et al.</i> | (CUSP Collab.)  |

REFID=60595  
REFID=60735  
REFID=60090  
REFID=59195  
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REFID=51004  
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REFID=22368  
REFID=22369

$\Upsilon(11020)$ 

$$J^{PC} = 0^{-}(1^{-}-)$$

NODE=M093

 **$\Upsilon(11020)$  MASS**

NODE=M093M

NODE=M093M

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN     | COMMENT                                             |
|-------------------------------------------------------------------------------|-----------------------|----------|-----------------------------------------------------|
| <b>11000 <math>\pm</math> 4 OUR AVERAGE</b>                                   |                       |          |                                                     |
| 11000.0 $^{+4.0+1.0}_{-4.5-1.3}$                                              | <sup>1</sup> MIZUK    | 19 BELL  | $e^+e^- \rightarrow \Upsilon(1S, 2S, 3S)\pi^+\pi^-$ |
| 10999.0 $^{+7.3+16.9}_{-7.8-1.0}$                                             | <sup>2</sup> MIZUK    | 16 BELL  | $e^+e^- \rightarrow h_b(1P, 2P)\pi^+\pi^-$          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |          |                                                     |
| 11001 $\pm$ 1                                                                 | <sup>3</sup> DONG     | 20A      | $e^+e^- \rightarrow b\bar{b}$                       |
| 11003.0 $\pm 1.1^{+0.9}_{-1.0}$                                               | <sup>4,5</sup> SANTEL | 16 BELL  | $e^+e^- \rightarrow$ hadrons                        |
| 10987.5 $^{+6.4+9.1}_{-2.5-2.3}$                                              | <sup>6,7</sup> SANTEL | 16 BELL  | $e^+e^- \rightarrow \Upsilon(1S, 2S, 3S)\pi^+\pi^-$ |
| 10996 $\pm$ 2                                                                 | <sup>8</sup> AUBERT   | 09E BABR | $e^+e^- \rightarrow$ hadrons                        |
| 11019 $\pm$ 5 $\pm$ 7                                                         | BESSION               | 85 CLEO  | $e^+e^- \rightarrow$ hadrons                        |
| 11020 $\pm$ 30                                                                | LOVELOCK              | 85 CUSB  | $e^+e^- \rightarrow$ hadrons                        |

OCCUR=2

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

NODE=M093M;LINKAGE=E

<sup>2</sup> From a simultaneous fit to the  $h_b(nP)\pi^+\pi^-$ ,  $n = 1, 2$  cross sections at 22 energy points within  $\sqrt{s} = 10.77\text{--}11.02$  GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with eight resonance parameters (a mass and width for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , a single relative phase, a single relative amplitude, and two overall normalization factors, one for each  $n$ ). The systematic error estimate is dominated by possible interference with a small nonresonant continuum amplitude.

NODE=M093M;LINKAGE=D

<sup>3</sup> From a fit to the dressed cross sections of AUBERT 09E by BaBar and SANTEL 16 by Belle above 10.68 GeV with a coherent sum of a continuum amplitude and three Breit-Wigner functions with constant widths.

NODE=M093M;LINKAGE=G

<sup>4</sup> From a fit to the total hadronic cross sections measured at 60 energy points within  $\sqrt{s} = 10.82\text{--}11.05$  GeV to a pair of interfering Breit-Wigner amplitudes and two floating continuum amplitudes with  $1/\sqrt{s}$  dependence, one coherent with the resonances and one incoherent, with six resonance parameters (a mass, width, and an amplitude for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , one relative phase, and one decoherence coefficient).

NODE=M093M;LINKAGE=A

<sup>5</sup> Not including uncertain and potentially large systematic errors due to assumed continuum amplitude  $1/\sqrt{s}$  dependence and related interference contributions.

NODE=M093M;LINKAGE=B

<sup>6</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 25 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with fourteen resonance parameters (a mass, width, and three amplitudes for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , a single universal relative phase, and three decoherence coefficients, one for each  $n$ ). Continuum contributions were measured (and therefore fixed) to be zero.

NODE=M093M;LINKAGE=C

<sup>7</sup> Superseded by MIZUK 19.

NODE=M093M;LINKAGE=F

<sup>8</sup> In a model where a flat non-resonant  $b\bar{b}$ -continuum is incoherently added to a second flat component interfering with two Breit-Wigner resonances. Systematic uncertainties not estimated.

NODE=M093M;LINKAGE=AU

 **$\Upsilon(11020)$  WIDTH**

NODE=M093W

NODE=M093W

| VALUE (MeV)                                                                   | DOCUMENT ID           | TECN     | COMMENT                                             |
|-------------------------------------------------------------------------------|-----------------------|----------|-----------------------------------------------------|
| <b>24 <math>^{+8}_{-6}</math> OUR AVERAGE</b>                                 |                       |          |                                                     |
| 23.8 $^{+8.0+0.7}_{-6.8-1.8}$                                                 | <sup>1</sup> MIZUK    | 19 BELL  | $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$         |
| 27 $^{+27+5}_{-11-12}$                                                        | <sup>2</sup> MIZUK    | 16 BELL  | $e^+e^- \rightarrow h_b(1P, 2P)\pi^+\pi^-$          |
| • • • We do not use the following data for averages, fits, limits, etc. • • • |                       |          |                                                     |
| 35.1 $\pm 1.2$                                                                | <sup>3</sup> DONG     | 20A      | $e^+e^- \rightarrow b\bar{b}$                       |
| 39.3 $^{+1.7+1.3}_{-1.6-2.4}$                                                 | <sup>4,5</sup> SANTEL | 16 BELL  | $e^+e^- \rightarrow$ hadrons                        |
| 61 $^{+9+2}_{-19-20}$                                                         | <sup>6,7</sup> SANTEL | 16 BELL  | $e^+e^- \rightarrow \Upsilon(1S, 2S, 3S)\pi^+\pi^-$ |
| 37 $\pm 3$                                                                    | <sup>8</sup> AUBERT   | 09E BABR | $e^+e^- \rightarrow$ hadrons                        |
| 61 $\pm 13 \pm 22$                                                            | BESSION               | 85 CLEO  | $e^+e^- \rightarrow$ hadrons                        |
| 90 $\pm 20$                                                                   | LOVELOCK              | 85 CUSB  | $e^+e^- \rightarrow$ hadrons                        |

OCCUR=2

- <sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .
- <sup>2</sup> From a simultaneous fit to the  $h_b(nP)\pi^+\pi^-$ ,  $n = 1, 2$  cross sections at 22 energy points within  $\sqrt{s} = 10.77\text{--}11.02$  GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with eight resonance parameters (a mass and width for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , a single relative phase, a single relative amplitude, and two overall normalization factors, one for each  $n$ ). The systematic error estimate is dominated by possible interference with a small nonresonant continuum amplitude.
- <sup>3</sup> From a fit to the dressed cross sections of AUBERT 09E by BaBar and SANTEL 16 by Belle above 10.68 GeV with a coherent sum of a continuum amplitude and three Breit-Wigner functions with constant widths.
- <sup>4</sup> From a fit to the total hadronic cross sections measured at 60 energy points within  $\sqrt{s} = 10.82\text{--}11.05$  GeV to a pair of interfering Breit-Wigner amplitudes and two floating continuum amplitudes with  $1/\sqrt{s}$  dependence, one coherent with the resonances and one incoherent, with six resonance parameters (a mass, width, and an amplitude for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , one relative phase, and one decoherence coefficient).
- <sup>5</sup> Not including uncertain and potentially large systematic errors due to assumed continuum amplitude  $1/\sqrt{s}$  dependence and related interference contributions.
- <sup>6</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n=1, 2, 3$ , cross sections at 25 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV to a pair of interfering Breit-Wigner amplitudes modified by phase space factors, with fourteen resonance parameters (a mass, width, and three amplitudes for each of  $\Upsilon(10860)$  and  $\Upsilon(11020)$ , a single universal relative phase, and three decoherence coefficients, one for each  $n$ ). Continuum contributions were measured (and therefore fixed) to be zero.
- <sup>7</sup> Superseded by MIZUK 19.
- <sup>8</sup> In a model where a flat non-resonant  $b\bar{b}$ -continuum is incoherently added to a second flat component interfering with two Breit-Wigner resonances. Systematic uncertainties not estimated.

NODE=M093W;LINKAGE=E

NODE=M093W;LINKAGE=D

NODE=M093W;LINKAGE=G

NODE=M093W;LINKAGE=A

NODE=M093W;LINKAGE=B

NODE=M093W;LINKAGE=C

NODE=M093W;LINKAGE=F

NODE=M093W;LINKAGE=AU

 **$\Upsilon(11020)$  DECAY MODES**

NODE=M093215;NODE=M093

| Mode                                      | Fraction ( $\Gamma_i/\Gamma$ )       |
|-------------------------------------------|--------------------------------------|
| $\Gamma_1$ $e^+e^-$                       | $(5.4^{+1.9}_{-2.1}) \times 10^{-6}$ |
| $\Gamma_2$ $\Upsilon(1S)\pi^+\pi^-$       |                                      |
| $\Gamma_3$ $\Upsilon(2S)\pi^+\pi^-$       |                                      |
| $\Gamma_4$ $\Upsilon(3S)\pi^+\pi^-$       |                                      |
| $\Gamma_5$ $\chi_{bJ}(1P)\pi^+\pi^-\pi^0$ | $(9^{+9}_{-8}) \times 10^{-3}$       |
| $\Gamma_6$ $\chi_{b1}(1P)\pi^+\pi^-\pi^0$ | seen                                 |
| $\Gamma_7$ $\chi_{b2}(1P)\pi^+\pi^-\pi^0$ | seen                                 |

DESIG=1

DESIG=5

DESIG=6

DESIG=7

DESIG=2

DESIG=3

DESIG=4

 **$\Upsilon(11020)$  PARTIAL WIDTHS**

NODE=M093220

| $\Gamma(e^+e^-)$               |             |      |         |                                     | $\Gamma_1$ |
|--------------------------------|-------------|------|---------|-------------------------------------|------------|
| VALUE (keV)                    | DOCUMENT ID | TECN | COMMENT |                                     |            |
| <b>0.130±0.030 OUR AVERAGE</b> |             |      |         |                                     |            |
| 0.095±0.03 ±0.035              | BESSON      | 85   | CLEO    | $e^+e^- \rightarrow \text{hadrons}$ |            |
| 0.156±0.040                    | LOVELOCK    | 85   | CUSB    | $e^+e^- \rightarrow \text{hadrons}$ |            |

NODE=M093W1

NODE=M093W1

| $\Gamma(e^+e^-) \times \Gamma(\Upsilon(1S)\pi^+\pi^-)/\Gamma_{\text{total}}$ |             |      |         |  | $\Gamma_1\Gamma_2/\Gamma$ |
|------------------------------------------------------------------------------|-------------|------|---------|--|---------------------------|
| VALUE (eV)                                                                   | DOCUMENT ID | TECN | COMMENT |  |                           |

NODE=M093R04

NODE=M093R04

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |           |    |      |                                             |
|-----------|-----------|----|------|---------------------------------------------|
| 0.46±0.08 | 1,2 MIZUK | 19 | BELL | $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$ |
|-----------|-----------|----|------|---------------------------------------------|

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

NODE=M093R04;LINKAGE=A

<sup>2</sup> Reported as the range 0.38–0.54 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions.

NODE=M093R04;LINKAGE=B

| $\Gamma(e^+e^-) \times \Gamma(\Upsilon(2S)\pi^+\pi^-)/\Gamma_{\text{total}}$ |             |      |         |  | $\Gamma_1\Gamma_3/\Gamma$ |
|------------------------------------------------------------------------------|-------------|------|---------|--|---------------------------|
| VALUE (eV)                                                                   | DOCUMENT ID | TECN | COMMENT |  |                           |

NODE=M093R05

NODE=M093R05

• • • We do not use the following data for averages, fits, limits, etc. • • •

|           |           |    |      |                                             |
|-----------|-----------|----|------|---------------------------------------------|
| 0.65±0.52 | 1,2 MIZUK | 19 | BELL | $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$ |
|-----------|-----------|----|------|---------------------------------------------|

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

NODE=M093R05;LINKAGE=A

<sup>2</sup> Reported as the range 0.13–1.16 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions.

NODE=M093R05;LINKAGE=B

$$\Gamma(e^+e^-) \times \Gamma(\Upsilon(3S)\pi^+\pi^-)/\Gamma_{\text{total}}$$

$$\Gamma_1\Gamma_4/\Gamma$$

VALUE (eV) DOCUMENT ID TECN COMMENT

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.33±0.16<sup>1,2</sup> MIZUK 19 BELL  $e^+e^- \rightarrow \Upsilon(nS)\pi^+\pi^-$

<sup>1</sup> From a simultaneous fit to the  $\Upsilon(nS)\pi^+\pi^-$ ,  $n = 1, 2, 3$ , cross sections at 28 energy points within  $\sqrt{s} = 10.6\text{--}11.05$  GeV, including the initial-state radiation at  $\Upsilon(10860)$ .

<sup>2</sup> Reported as the range 0.17–0.49 eV obtained from multiple solutions of an amplitude fit within a model composed as a sum of Breit-Wigner functions.

NODE=M093R06  
NODE=M093R06

NODE=M093R06;LINKAGE=A

NODE=M093R06;LINKAGE=B

$$\Gamma(\chi_{bJ}(1P)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$$

$$\Gamma_5/\Gamma$$

VALUE (units 10<sup>-3</sup>) DOCUMENT ID TECN COMMENT

8.7±4.3<sup>+7.6</sup><sub>-6.6</sub> YIN 18 BELL  $e^+e^- \rightarrow \text{hadrons}$

NODE=M093R00  
NODE=M093R00

$$\Gamma(\chi_{b1}(1P)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$$

$$\Gamma_6/\Gamma$$

VALUE DOCUMENT ID TECN COMMENT

seen YIN 18 BELL  $e^+e^- \rightarrow \text{hadrons}$

NODE=M093R01  
NODE=M093R01

$$\Gamma(\chi_{b2}(1P)\pi^+\pi^-\pi^0)/\Gamma_{\text{total}}$$

$$\Gamma_7/\Gamma$$

VALUE DOCUMENT ID TECN COMMENT

seen YIN 18 BELL  $e^+e^- \rightarrow \text{hadrons}$

NODE=M093R02  
NODE=M093R02

$$\Gamma(\chi_{b2}(1P)\pi^+\pi^-\pi^0)/\Gamma(\chi_{b1}(1P)\pi^+\pi^-\pi^0)$$

$$\Gamma_7/\Gamma_6$$

VALUE DOCUMENT ID TECN COMMENT

0.4±0.2 YIN 18 BELL  $e^+e^- \rightarrow \text{hadrons}$

NODE=M093R03  
NODE=M093R03

## $\Upsilon(11020)$ REFERENCES

NODE=M093

|          |     |                |                               |                 |
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| LOVELOCK | 85  | PRL 54 377     | D.M.J. Lovelock <i>et al.</i> | (CUSB Collab.)  |

REFID=60595  
REFID=60090  
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